MAGAZINE 2019

Formula Student Germany

AN INTERNATIONAL DESIGN COMPETITION OF SKILLS, SPEED AND SPIRIT

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A special thanks goes to the numerous volunteers who contributed significantly in the realisation of the fourteenth Formula Student Germany.

Editorial

Dipl.–Ing. Alia Hall

Formula Student Germany (FSG) has thrived since the beginning, almost 15 years, because it has been built by 'Giants' and it grows future 'Giants'. By 'Giants' I mean that kind of person who comes with such a passion and motivation that they will do whatever it takes to turn ideas into reality and won't stop until the work is done.

The drive continues to grow as the FSG team of 'Giants' continue to develop the event to align with what is forecast to happen within the automotive industry. In this year's magazine, we talk about the future of FSG.

It doesn't stop there though, the team members who complete their seasons within Formula Student, then graduate and go on to do greater things and strive to become the 'Giants' of the real world.

With good teamwork a good idea can become a great idea. FSG is the perfect example of how working together and supporting each other can achieve new realities.

In the 2019 FSG magazine, through the perspectives from FSG Alumni, Officials and Sponsors, we look into the past from how far we have come and then into the future as to where we want to get to.

Enjoy the read!

Die Formula Student Germany (FSG) hat sich von Anfang an, inzwischen seit fast 15 Jahren, so erfolgreich entwickelt, weil sie von tollen Menschen aufgebaut wurde und tolle Menschen großzieht. Damit meine ich jene Art von Persönlichkeiten, die eine solche Leidenschaft und Motivation mitbringen, dass sie alles tun würden, um ihre Ideen in die Realität umzusetzen und nicht aufhören, bis ihr Ziel erreicht ist.

Und die Formula Student Germany entwickelt gerade wieder eine neue Dynamik. Denn es geht auch immer darum, dass wir den Wettbewerb an den künftigen Herausforderungen der Automobilindustrie ausrichten. In diesem Heft ist daher die Zukunft der FSG ein Thema.

Doch damit nicht genug: Die Teammitglieder, die ihre Formula Student-Saisons beenden, verfolgen mit diesen Erfahrungen und ihrem Abschluss in der Tasche auch in der Wirtschaft hohe Ziele und werden dann ganz tolle Menschen in der „realen Welt".

Dass mit guter Teamarbeit aus einer guten Idee eine großartige werden kann, beweist die FSG. Der Wettbewerb ist das perfekte Beispiel dafür, wie Zusammenarbeit und gegenseitige Unterstützung tolle neue Projekte enstehen lassen.

Im FSG-Magazin 2019 schauen wir aus der Perspektive von FSG-Alumni, Officials und Sponsoren in die Vergangenheit, woher wir kommen, und blicken in die Zukunft, wo es hingehen soll.

Viel Spaß beim Lesen!

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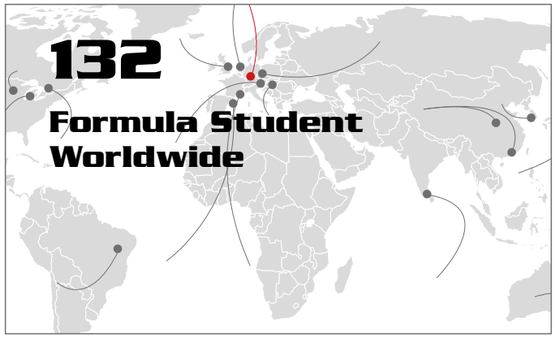


Introduction
Einführung

The Challenge

Formula Student Germany (FSG) is an international design com petition for university students, based on the Formula SAE rules and guidelines. Teams from around the world have the task of designing a single-seated, formula car with either a combustion or electric drive train and to then manufacture a functional prototype. They can then also decide if it will have autonomous features, enabling them to compete in the Formula Student Driverless competition. Along with these technical aspects, the teams must develop a viable business plan and a marketing concept for batch production of the vehicle. Therefore, the racecar must not only have manageable handling and possess good acceleration and braking ability, but must also be inexpensive to buy and run. Thus, other important aspects of the vehicle that must be developed include aesthetics, ergonomics, and use of off the shelf components. The vehicle designs are judged by experts from the automobile, motorsport and supply industries. The teams are then able to score points in various static and dynamic events, which will ultimately decide the overall ranking. The team with the best overall scores from the combination of design, financial planning, marketing strategy and performance on the track will win Formula Student Germany.

Practical Experience

FSG enriches the teaching content of a course of study with challenging and practical experience in the fields of manufacturing and production, whilst not neglecting the practice-oriented requirements relating to profitability and market relevance.

The aspects assessed by the competition correspond directly to the demands of the different branches of the industry for new product development, which is why they are not merely restricted to vehicle design. By working as part of an interdisciplinary team of students from different fields of study and expertise, the competitors learn firsthand how to combine the economic and technical goals of product development and at the same time, how to defend the solutions they themselves have developed and assert these against competing developments.

Herausforderung

Die Formula Student Germany (FSG) ist ein internationaler Konstruktionswettbewerb für Studenten, der sich an den Formula Student-Wettbewerb der amerikanischen Society of Automotive Engineers (SAE) anlehnt. Die Aufgabe für die Teams aus der ganzen Welt besteht darin, ein einsitziges Formel-Fahrzeug mit einem Elektrik- oder Verbrennungsmotor zu konstruieren und einen fahrfertigen Prototypen herzustellen. Zudem können sich die Teams für die Implementierung von autonomen Funktionen in ihrem Fahrzeug entscheiden, was ihnen eine Teilnahme im neuen Formula Student Driverless-Wettbewerb ermöglicht. Parallel zu der technischen Entwicklung müssen die Teams einen tragfähigen Businessplan und ein Vermarktungskonzept für eine Kleinserienfertigung des Fahrzeugs entwickeln. Daher muss der Rennwagen nicht nur ein beherrschbares Handling, sowie gute Beschleunigungs- und Bremswerte haben, sondern auch günstig in der Anschaffung und im Unterhalt sein. Wichtige Nebenaspekte des entwickelten Fahrzeuges sind Ästhetik, Ergonomie und die Verwendung von Serienbauteilen. Bewertet werden die Fahrzeugkonzepte von Experten aus der Automobil-, Motorsport- und Zulieferindustrie. In verschiedenen statischen und dynamischen Disziplinen können die Teams wichtige Punkte sammeln, die letztlich über die Gesamtplatzierung entscheiden. Den Sieg der Formula Student Germany erringt das Team mit dem besten Gesamtpaket aus Konstruktion, Finanzplanung, Verkaufsargumentation und Rennperformance.

Praxisnahe Erfahrung

Die FSG bereichert die Lehrinhalte des Studiums um herausfordernde und praktische Erfahrungen in den Bereichen Konstruktion und Fertigung, ohne dabei die praxisrelevanten Voraussetzungen in Bezug auf Wirtschaftlichkeit und Marktrelevanz zu vernachlässigen.

Die im Wettbewerb abgefragten Aspekte entsprechen den Anforderungen verschiedener Industriebereiche hinsichtlich Produktneuentwicklungen und sind daher nicht nur für den Fahrzeugbau anwendbar. Durch die Arbeit in einem interdisziplinären Team aus Studenten verschiedener Studien- und Fachrichtungen lernen die Teilnehmer, die wirtschaftlichen und technischen Ziele einer Produktentwicklung in Einklang zu bringen und dabei ihre selbst entwickelten Lösungen zu verteidigen und gegenüber konkurrierenden Entwicklungen durchzusetzen.

An International Design Competition

Ein internationaler Konstruktionswettbewerb

Formula Student Combustion / Formula Student Electric

Formula Student Germany is an engineering design competition for students. Students work together in teams to design and manufacture a prototype racecar, based on a hypothetical manufacturing contract. In order for the competing teams to be compared, their designs, plans and cars are judged by experts. Each team has the chance to win in total a maximum of 1,000 points over the course of static events, dynamic events and through proving the efficiency of their car. The team with the best overall combination of design, track performance, financial planning and marketing strategy will be a winner of FSG. In theory it is possible to win the overall competition without being the best in (or even being eliminated from) one or more events. Similarly, teams can win the top prize in one or more of the categories and still have no chance at an overall victory.

Die Formula Student Germany ist ein Konstruktionswettbewerb für Studenten, bei dem unter der Annahme eines fiktiven Konstruktionsauftrags der Prototyp eines Rennwagens entstehen soll. Um einen Vergleich der startenden Teams zu ermöglichen, werden die Konzepte, Planungen und Fahrzeuge von Experten bewertet. Insgesamt kann jedes Team in drei statischen und fünf dynamischen Disziplinen maximal 1000 Punkte erhalten. Den Gesamtsieg erringt das Team mit dem besten Gesamtpaket aus Konstruktion, Rennperformance, Finanzplanung und Verkaufsargumentation. Prinzipiell kann also auch ein Team den Gesamtwettbewerb gewinnen, das in einer oder mehreren Disziplinen nicht zu den Besten zählt oder sogar ausscheidet. Auf der anderen Seite können durch dieses Bewertungssystem auch Teams einen Titel in einer oder mehreren Disziplinen erringen, obwohl sie keine Chance auf den Gesamtsieg haben.

Static Events

The Formula Student Germany competition is designed to introduce the participating students to the interdisciplinary approach of today's automotive industry. This not only includes technical understanding, but also economic and communication abilities such as presentation techniques or financial planning skills. This is why the three static events demand collaboration across the team in the areas of design and layout, construction, marketing and pricing of a product. They also require specialised expertise from different technical and financial courses of study. The teams can win up to 325 points of the possible 1000 in the three static events, and each individual event is weighted differently. A panel of experienced experts from the automobile, motorsport, and supply industries judge the performance of each team.

Engineering Design – 150 points
At the start of the engineering design competition, the students must hand in an eight-page technical description of their car. It must show both their design and how the design will be applied to their chosen construction. On the basis of this document, the members of the jury will evaluate the layout, technical design, construction and implementation of the production of the actual vehicle. Then, there will be a discussion where the teams are questioned by the judges. These discussions focus on clarifying technical details, exploring the thinking behind the chosen design, as well as the corresponding technical understanding of the students. The evaluation will not only assess the quality of the technical solution in question but also the reasons behind it.

Cost and Manufacturing – 100 points
Cost is a decisive factor in the design of any product. In the cost analysis event, the teams must grapple with the calculative size of the vehicle, its components, and the necessary manufacturing steps and record all of this in a written cost report. The students must then answer questions from the judges relating to the cost report on their prototype. In addition to considering the thoroughness of the written report, the students' understanding of the manufacturing process and the total cost calculation will be assessed.

Business Plan Presentation – 75 points
Each team presents their business plan for the constructed prototype to a fictitious manufacturing company represented by judges. During a ten-minute presentation, the team must demonstrate why their design best fulfils the demands of their target group of amateur weekend racers and show how their design can be successfully marketed. The presentation will be followed by a five-minute discussion and question round with the judges. In this event the content, structure, and editing of the presentation, as well as the team's performance in delivering it, will be evaluated alongside their answers to the panel's questions.

Total: 325 points

Deep diving into the details of the car for the design event
Deep Dive in die Details des Autos für das Design-Event

Statische Disziplinen

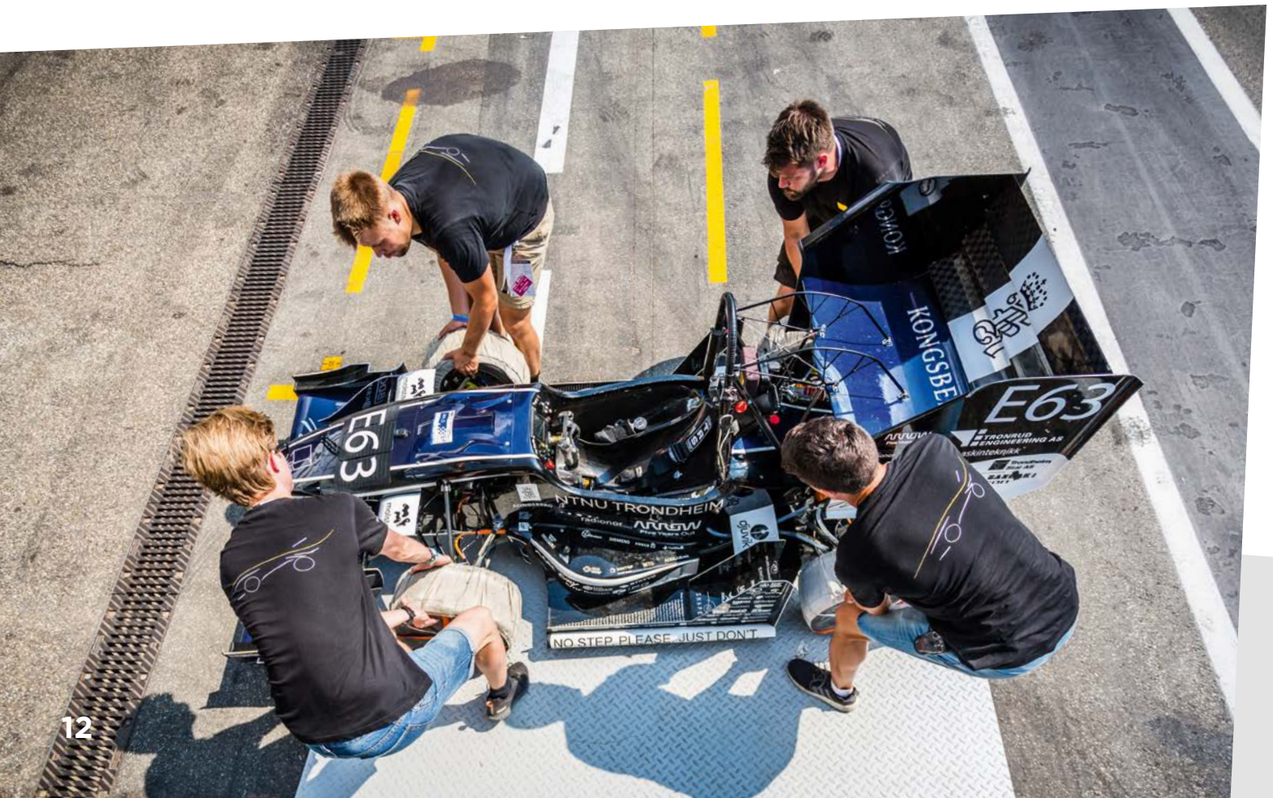
Der Formula-Student-Wettbewerb soll die teilnehmenden Studenten an die interdisziplinäre Arbeitsweise in der Industrie heranführen. Dazu zählen nicht nur technisches Verständnis, sondern auch wirtschaftliche und kommunikative Fähigkeiten, wie z. B. Präsentationstechniken oder Kompetenzen in der Finanzplanung. Daher wird in drei statischen Disziplinen sowohl die teamübergreifende Zusammenarbeit bei Konzept, Auslegung, Konstruktion, Vermarktung und Preisgestaltung eines Produktes als auch spezielles Fachwissen aus verschiedenen technischen und wirtschaftlichen Studiengängen gefördert und gefragt. In den drei statischen Disziplinen können die Teams maximal 325 Punkte erreichen, wobei die Einzeldisziplinen unterschiedliche Gewichtungen haben. Bewertet werden die Leistungen der Teams durch eine Jury aus erfahrenen Experten der Automobil- und Zulieferindustrie sowie dem Motorsport.

Engineering Design – 150 Punkte
Zu Beginn des Engineering Design-Wettbewerbs reichen die Studenten eine achtseitige technische Beschreibung zu ihrem Fahrzeug ein, um das Konzept sowie Besonderheiten der Konstruktion darzustellen. Die Juroren begutachten auf Basis der Unterlagen das technische Konzept, die Auslegung, Konstruktionen sowie Umsetzung in der Fertigung am realen Fahrzeug. Die Teams müssen ihnen dabei zu allen Fragen in einer Diskussion Rede und Antwort stehen. In den Gesprächen geht es um die Abfrage der technischen Details, die Hintergründe für die Wahl eines Konzepts und das dazugehörige technische Verständnis. In die Bewertung fließen also nicht nur die Qualität der vorliegenden technischen Lösungen ein, sondern auch die Gründe für die gewählten Lösungen.

Cost and Manufacturing – 100 Punkte
Die Kosten sind für Gestaltung eines Produktes ein entscheidender Faktor. Bei der Disziplin Cost Analysis müssen sich die Teams mit den kalkulatorischen Größen des Fahrzeugs, seiner Bauteile und der notwendigen Fertigungsschritte auseinandersetzen und diese schriftlich in einem Cost Report festhalten. Zu den eingereichten Unterlagen müssen sich die Studenten mit ihrem Prototypen einer Diskussion mit den Juroren stellen. Bewertet werden neben der Aufbereitung und Vollständigkeit des schriftlichen Reports auch das Verständnis der Fertigungsprozesse sowie der Gesamtpreis.

Business Plan Presentation – 75 Punkte
Mit ihrem Business Plan präsentieren die Teams einem potentiellen Investor oder Partner, vertreten durch die Juroren, ihren Geschäftsplan für den gebauten Prototyp. Die Teams stellen in einem zehnminütigen Vortrag dar, weshalb ihr Konzept am besten für die Zielgruppe geeignet ist und eine gewinnbringende Investition darstellt. Der Präsentation folgt eine fünfminütige Diskussions- und Fragerunde mit den Juroren. Bei dieser Disziplin werden Inhalt, Aufbau und Aufbereitung des Vortrags sowie der Auftritt der Teams ebenso bewertet wie die Antworten auf die Fragen der Juroren.

Gesamtpunktzahl: 325 Punkte



Success through teamwork
Erfolg durch Teamarbeit

The confidence to present your ideas
Das Vertrauen, Deine Ideen zu präsentieren

The knowledge to impress the judge
Das Wissen, den Judge zu beeindrucken

Dynamic Events

The cars that the students design will not only be assessed when stationary. Their performance on the racetrack will also be put to the test. Each dynamic event tests different features of the vehicles. In addition to the maximum longitudinal and lateral acceleration, race performance, efficiency and endurance of the formula cars will be examined and evaluated. For the Acceleration, Skid Pad and Autocross events, each car starts with two drivers, each of whom is allowed two attempts. The best attempt is the one on which the car will be scored. A maximum of 675 points can be scored over the course of the four dynamic events and the efficiency event.

Acceleration – 75 points
The vehicle‘s acceleration from a standing start is measured over a 75 metre straight. In addition to traction, the correct engine design is especially important, either in terms of greater power or for the highest possible torque. The fastest cars cross the line in less than four seconds and can reach speeds of over 100 km/h by the end of the stretch.

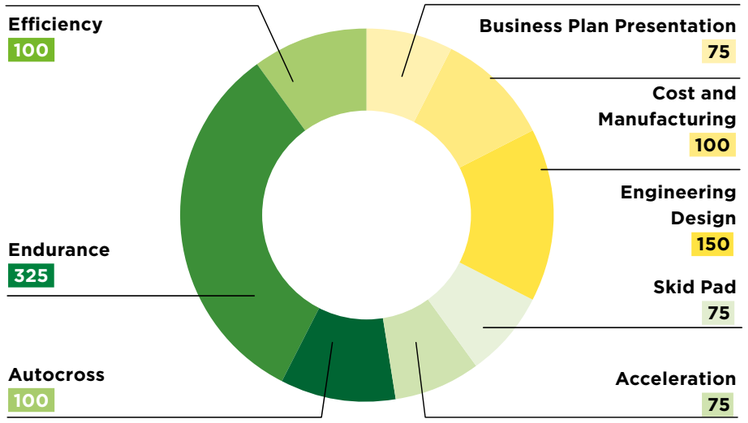
Skid Pad – 75 points
During the Skid Pad event, the cars must drive a figure of 8 circuit lined with track cones, performing two laps of each circle. In each case, the second lap will be measured. The lap time gives a comparative value for the maximum possible lateral acceleration of the car. Most of the cars use aerodynamics to raise the contact pressure and thus, increase lateral acceleration. As with all the dynamic events, knocking over any of the cones results in a time penalty.

Autocross – 100 points
In the autocross event, the cars traverse a kilometre-long track with straights, curves, and chicanes. A fast lap time is a sign of high driving dynamics, precise handling and good acceleration and braking ability. Once again, time penalties occur for those who knock over any cones. The autocross rankings decide the starting positions for the endurance competition that follows.

Endurance – 325 points
The endurance race represents almost a third of all available points and is consequently the most important event of the Formula Student Germany competition.The cars must demonstrate their capacity for endurance over a gruelling track distance of 22 km and all of the prototypes’ features are crucial for this event, from acceleration and handling to driving dynamics. The skill of the driver is also tested here, as they may only familiarise themselves with the track before the race by walking the length of the course (Course Walk). Each team gets just a single try and the drivers must be swapped at the halfway point. There can be up to four cars on the circuit at any given time and so overtaking manoeuvres must be performed frequently. Overtaking is signalled by a blue flag and is only permitted at specially marked sections of the track. A team will receive no points at the end if they are more than a third slower than the fastest team overall.

Efficiency – 100 points
During the endurance race, fuel consumption (FSC cars) or energy consumption (FSE cars) is precisely recorded. However, the absolute fuel and energy consumption is not what is used to calculate the efficiency score, but rather the consumption relative to speed. This is to prevent teams from driving particularly slowly in the endurance competition in order to score as highly as possible in the efficiency category.

Total: 675 points



▸ The points for FSC and FSE have the same distribution as the teams compete in 5 dynamic events and 3 static events.

▸ Die Punkteverteilung für FSC und FSE ist identisch, da die Teams in 5 dynamischen und 3 statischen Events konkurrieren.

▸ Dynamische Diszplinen

Die von den Studenten konstruierten Fahrzeuge werden natürlich nicht nur im Stand bewertet. Sie müssen ihre Performance auch auf der Rennstrecke unter Beweis stellen. In jeder dynamischen Disziplin werden andere Eigenschaften des Fahrzeugs getestet. Neben der maximalen Längs- und Querbeschleunigung werden auch die Rennperformance, Effizienz und Haltbarkeit der Formel-Rennwägen ermittelt und bewertet. Bei den Disziplinen Acceleration, Skid Pad und Autocross starten je Fahrzeug zwei Fahrer, die jeweils zwei Versuche haben. Gewertet wird das beste mit dem Fahrzeug erzielte Ergebnis. In den fünf dynamischen Disziplinen können maximal 675 Punkte erzielt werden.

Acceleration – 75 Punkte
Auf einer 75 Meter langen Geraden wird die Beschleunigung der Fahrzeuge aus dem Stand gemessen. Hier kommt es neben der Traktion vor allem auf eine richtige Auslegung des Getriebes und eine möglichst hohe Leistung, bzw. ein hohes Drehmoment an. Die schnellsten Fahrzeuge absolvieren diese Prüfung in einer Zeit unter vier Sekunden und erreichen am Ende der Messstrecke Geschwindigkeiten von mehr als 100 km/h.

Skid Pad – 75 Punkte
Beim Skid Pad durchfahren die Rennwagen einen mit Pylonen begrenzten Parcours in Form einer Acht. Jeder Kreisring wird zweimal umrundet. Gemessen wird jeweils die zweite Runde. Die Rundenzeit gibt einen Vergleichswert für die maximal erzielbare Querbeschleunigung der Fahrzeuge. Bei den meisten Fahrzeugen werden durch den Einsatz aerodynamischer Hilfsmittel der Anpressdruck und damit die Querbeschleunigung erhöht. Das Umstoßen von Pylonen wird mit einer Zeitstrafe belegt.

Autocross – 100 Punkte
Bei der Disziplin Autocross fahren die Rennwagen über einen etwa ein Kilometer langen Kurs mit Geraden, Kurven und Schikanen. Eine schnelle Rundenzeit ist ein Indikator für eine hohe Fahrdynamik, ein präzises Handling sowie gute Beschleunigungs- und Bremseigenschaften. Auch hier werden umgestoßene Pylonen mit einer Zeitstrafe geahndet. Die Platzierung im Autocross entscheidet auch über die Startreihenfolge im nachfolgenden Endurance-Wettbewerb.

▸ It's about speed vs. strategy

▸ Es geht um Geschwindigkeit vs. Strategie

▸ The feeling of pure bliss when you cross the finish line

▸ Das Gefühl purer Glückseligkeit beim Überqueren der Ziellinie

Endurance – 325 Punkte
Das Endurance-Rennen stellt mit fast einem Drittel aller erreichbaren Punkte die Hauptdisziplin des Formula Student-Wettbewerbs dar. Über eine Renndistanz von 22 Kilometern müssen sich die konstruierten Rennfahrzeuge unter Dauerbelastung beweisen. Bei dieser Disziplin sind alle Eigenschaften der Prototypen wichtig, von der Beschleunigung bis zum Handling und der Fahrdynamik. Zusätzlich ist auch das Geschick der Fahrer gefragt, da die Strecke vor dem Rennen nur zu Fuß abgeschritten werden darf (Course Walk). Jedes Team hat einen einzigen Versuch, wobei nach der Hälfte der Distanz ein Fahrerwechsel erfolgen muss. Es sind bis zu sieben Fahrzeuge gleichzeitig auf der Strecke, wodurch es oft auch zu Überholvorgängen kommt. Diese werden von der Rennleitung veranlasst und finden in eigens dafür eingerichteten Überholzonen statt, an denen die Strecke breiter ist. Das langsamere Fahrzeug bekommt dafür von den Streckenposten durch blaue Flaggen signalisiert, dass es einen schnelleren Teilnehmer überholen lassen muss. Die Teams erhalten nur dann Punkte, wenn sie höchstens ein Drittel langsamer waren als das schnellste Team. Auch hier werden Pylonenfehler durch Zeitstrafen geahndet.

Efficiency – 100 Punkte
Während des Endurance-Rennens wird der Kraftstoffverbrauch (FSC-Fahrzeuge), bzw. der Energieverbrauch (FSE-Fahrzeuge) gemessen. Bei der Berechnung der Effizienz und der Punkte wird allerdings nicht der absolute Kraftstoff-/ Energieverbrauch gemessen, sondern der Verbrauch in Relation zur Geschwindigkeit. Dadurch wird verhindert, dass Teams während des Endurance-Wettbewerbs besonders langsam fahren, um eine möglichst hohe Punktzahl in der Efficiency-Disziplin zu erreichen.

Gesamtpunktzahl: 675 Punkte

Preparing for FSD dynamics

Vorbereitungen für FSD dynamics

Formula Student Driverless (FSD)

As with the other two FSG competitions, the student racing teams at FSD compete with independently designed vehicles in dynamic and static disciplines. In contrast to FSC and FSE, the vehicles must cope with all dynamic disciplines completely autonomously with no driver sitting in the vehicle. In principle, however, "normal" driving with an FSD car is possible. The teams can freely select the type of drivetrain (electric or combustion), but must comply with the safety regulations of the respective vehicle category.

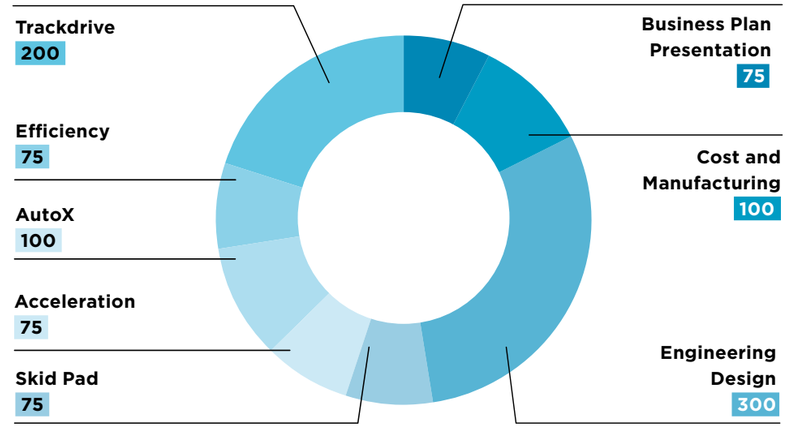
In the case of autonomous vehicles, the development focus shifts away from pure driving dynamics to an optimal adaptation of the autonomous vehicle system to the respective driving situation. FSG takes this into account when judging the FSD teams. This requires different static and dynamic disciplines, as well as a redistribution of the maximum achievable points. By maintaining as many disciplines as possible and maintaining the same maximum overall score, the comparability between all FSG competitions should at least be partially preserved.

Wie bei den anderen beiden FSG-Wettbewerben konkurrieren die Teams bei FSD mit eigens entwickelten Fahrzeugen in den dynamischen und statischen Disziplinen. Im Gegensatz zu FSC und FSE müssen die Fahrzeuge alle dynamischen Disziplinen komplett autonom bewältigen – ohne Fahrer im Fahrzeug. Prinzipiell ist jedoch „normales" Fahren mit einem FSD-Auto durchaus möglich. Bei der Wahl der Art des Antriebsstrangs (elektrisch oder Verbrenner) sind die Teams völlig frei. Die Sicherheitsvorschriften der jeweiligen Fahrzeugklasse müssen jedoch eingehalten werden.

Bei autonomen Fahrzeugen verschiebt sich der Entwicklungsschwerpunkt von reiner Fahrdynamik hin zu einer optimalen Auslegung der autonomen Fahrzeugsysteme auf die jeweilige Fahrsituation. Dies berücksichtigt FSG bei der Beurteilung der FSD-Teams, was Unterschiede bei den statischen und dynamischen Disziplinen sowie eine Umverteilung der erreichbaren Punkte pro Disziplin erfordert. Durch die Beibehaltung möglichst aller Disziplinen im Vergleich zu FSC und FSE sowie der selben maximal erreichbaren Gesamtpunktzahl bleibt die Vergleichbarkeit aller FSG-Wettbewerbe zumindest teilweise erhalten.

The points for the FSD competition are more heavily weighted to the static disciplines.

Bei der Punkteverteilung für FSD liegt mehr Gewicht auf den statischen Disziplinen.



Static Disciplines

The Static Disciplines will give the teams the opportunity to gain almost 50 % of the points. These are critical for the teams in order to gain a competitive overall position.

Business Plan Presentation – 75 points and Cost Analysis – 100 points are identical to FSC and FCE.

Engineering Design – 300 points
The FSD Engineering Design event is considered more valuable for the teams as far as points. Not only will the design of the vehicle be judged, like it is in FSC and FSE, but the teams will also be judged on vehicle data from the dynamic disciplines.

Total: 475 points

Statische Disziplinen

In den statischen Disziplinen können die Teams knapp 50 % der Punkte sammeln. Diese Disziplinen sind also entscheidend, um eine gute Gesamtposition zu erreichen.

Business Plan Presentation – 75 Punkte und Cost Analysis – 100 Punkte sind identisch zu FSC und FCE.

Engineering Design – 300 Punkte
Das FSD Engineering Design erhält in Bezug auf die erreichbaren Punkte ein größeres Gewicht und gewinnt damit an Bedeutung für die FSD Teams. Im Gegensatz zu FSC und FSE wird bei der Bewertung des Ingenieurswissens ein deutlicher Fokus auf die autonomen Systeme gelegt.

Gesamtpunktzahl: 475 Punkte

Dynamic Disciplines

The Dynamic Disciplines make up the remaining points. In Formula Student Driverless, the Trackdrive replaces the Endurance event.

Acceleration – 75 points and Skid Pad – 75 points will also be held for FSD as described above, but as a driverless event.

Autocross - 100 points
As with FSC and FSE, the cars handling is demonstrated. The extra challenge for the autonomous cars is that they must drive around an unknown track.

Efficiency – 75 points
As in the case of the FSC and FSE, consumption-related points for the efficiency are also added.

Trackdrive – 200 points
The Autonomous Vehicles will race in a Track Race over 10 laps on a 300 to 500 metre long coned course.

Total: 525 points

Dynamische Disziplinen

In den dynamischen Disziplinen können die Teams die restlichen Punkte einfahren. Bei der Formula Student Driverless ersetzt der so genannte „Track Drive" das Endurance-Rennen.

Acceleration – 75 points und Skid Pad – 75 Punkte werden wie oben beschrieben ebenfalls für FSD beibehalten, jedoch ohne Fahrer.

Autocross - 100 Punkte
Wie bei FSC und FSE wir hier eine Runde auf einem Handlingparcours gefahren. Die unbekannte Strecke stellt für die autonomen Fahrzeuge eine besondere Herausforderung dar.

Efficiency – 75 Punkte
Wie bei FSC und FSE werden verbrauchsbezogene Punkte für die Effizienz vergeben.

Trackdrive – 200 Punkte
Die autonomen Fahrzeuge werden in einem Track Race über 10 Runden auf einem 300 bis 500 Meter langen Kurs fahren.

Gesamtpunktzahl: 525 Punkte

Safety Regulations

Sicherheit und Regeln

A series of safety measures and regulations must be observed for every prototype car competing. This is to ensure safety and a levelled playing field between the teams. It is important as all teams are at different levels, whether it is be different qualifications in terms of experience, personal ability or financial resources. Every car must pass Scrutineering in order to be allowed to participate in the dynamic categories. Teams are awarded various stickers for each safety check they pass. They must be placed on the front of their cars to show it has passed a particular test. For the FSC and FSE series, there are also system-specific differences in terms of operation safety that have to be followed during scrutineering.

Da alle Fahrzeuge Prototypen sind, müssen die Teams eine Reihe von Sicherheitsmaßnahmen und Regeln einhalten. Auf diese Weise wird zudem eine Chancengleichheit zwischen den Teams gewährt, die mit unterschiedlichen Voraussetzungen in Bezug auf Erfahrung, personelle Kapazitäten und finanzielle Ressourcen an den Start gehen. Das erfolgreiche Absolvieren des sogenannten Scrutineerings ist die Grundvoraussetzung für die Zulassung eines Fahrzeugs zu den dynamischen Disziplinen. Für jeden erfolgreich absolvierten Check erhalten die Teams einen Aufkleber, der auf der Fahrzeugnase angebracht werden muss. Bei FSC und FSE gibt es Unterschiede bei der Betriebssicherheit, die beim Scrutineering berücksichtigt werden müssen.

Checking the space frame

Überprüfung des Gitterrohrrahmens

Checking for leaks in the tilt table test

Überprüfung auf Lecks beim Tilt Table Test

Accumulator (only FSE)

The 'Accumulator' is a technical term for the battery. It is built up of battery cells that can be connected in various series and parallel configurations. For the electrically powered Formula Student cars, the 'Accumulator' is the sole source of energy that enables the cars to drive. This is critical to safety if it is incorrectly designed or built.

To protect for this, it is checked before the teams may compete in the dynamic events. Overheating of the cells can lead to fire. A temperature-logging device is installed by the FSG scrutineers, to ensure that the monitoring of the cell temperature is accurate. The batteries are sealed once the inspection has been carried out. The teams must transport their 'Accumulator' on a specially designed trolley so that it can be moved away should there be any risk of the cells overheating.

Electrical Scrutineering (only FSE)

During electrical scrutineering, the electrical safety of the electric car is tested. That means all systems required by the regulations are checked in regard to their functional capacity. For example, system checks include the insulation-monitoring device, correct operation of the signal light (the Tractive System Active Light, which displays the status of the high voltage system) and the sound that indicates that the vehicle is ready to race. In addition, general safety aspects are checked, such as whether the wires have been laid correctly mechanically and whether the high voltage energy storage device is assembled according to regulation.

Batterie (nur FSE)

Der Akkumulator, kurz Akku, ist der technische Fachbegriff für die Fahrzeugbatterie. Diese besteht aus einer Vielzahl an Zellen, die in Reihe oder parallel geschalten sind. Für elektrische Formula Student Fahrzeuge ist der Akku die einzige Energiequelle, die das Fahrzeug antreibt. Daher ist der korrekte Aufbau des Bauteils essentiell für die Fahrzeugsicherheit.

Um eventuelle Fehlfunktionen und Ausfälle zu vermeiden, werden die Akkus vor den dynamischen Disziplinen genau geprüft. Bei Überhitzung der Zellen kann ein Brand entstehen, weswegen für die genaue Überwachung der Zelltemperatur durch die FSG Scrutineers Temperatursensoren angebracht werden. Die Teams sind zudem dazu verpflichtet, ihre Akkus auf speziellen Wägen fortzubewegen, um im Falle einer Überhitzung schnell abtransportiert werden zu können.

Electrical Inspection(nur FSE)

Während der Electrical Inspection wird die elektrische Sicherheit der Elektrofahrzeuge überprüft, d.h. alle durch das Regelwerk vorgeschriebenen Systeme werden auf ihre Funktionsfähigkeit getestet. Zu den geprüften Systemen gehören u.a. die Isolationsüberwachung, die korrekte Funktionsweise des Signallichts (Tractive System Active Light, das die Aktivität des Hochvoltsystems anzeigt) und der Signalton, der die Fahrbereitschaft des Fahrzeugs signalisiert (Ready To Drive Sound). Es werden aber auch allgemeine Sicherheitsaspekte wie z B. mechanisch einwandfrei verlegte Leitungen oder der regelkonforme Einbau des Hochvolt-Energiespeichers überprüft.

Tech and Safety (FSC and FSE)

For this inspection, all the components and accessories of the racecar that are considered relevant to safety according to the regulations are checked. These include the framework, wheel suspension, steering, braking, rims, and tires. Other details, such as the layout of the fuel lines, the fixture of the air intake system, the observance of appropriate cockpit size and the correct functioning of the kill switch are all checked. In addition to this, all drivers must show that when in a ready-to-race condition, i.e., strapped in to the driving seat wearing their full racing suit and helmet, they can exit their vehicle within five seconds.

Tilt Table (FSC and FSE)

The tilt table test checks whether any operating fluids are leaking and roll-over protection regulations are met. The car must be brought to the test in a ready to race condition, with all fluids and a full tank of petrol. The driver is strapped in and the car is set at an angle of 45 degrees. No fuel or other fluids are allowed to leak out at this angle. After this, the angle is increased to 60 degrees, which corresponds to a lateral acceleration force of 1.7g. The race car only passes this test if the upper wheels remain on the floor.

Tech and Safety (FSC und FSE)

Bei dieser Abnahme werden alle sicherheitsrelevanten Bau- und Zubehörteile des Rennwagens, die durch das Regelwerk vorgeschrieben werden, geprüft. Dazu gehören unter anderem die Rahmenstruktur, die Radaufhängung, Lenkung, Bremsen, Felgen und Reifen. Auch Details wie die Verlegung der Kraftstoffleitungen, die Befestigung des Ansaugsystems, die Einhaltung der Cockpitgröße oder die korrekte Funktionsweise der Notschalter werden geprüft. Zusätzlich müssen alle Fahrer zeigen, dass sie in einem fahrfertigen Zustand, d.h. voll eingekleidet und angegurtet, das Auto innerhalb von fünf Sekunden verlassen können.

Tilt Table (FSC und FSE)

Beim Tilt Table Test wird überprüft, ob keine Betriebsflüssigkeiten austreten und die Regularien zum Überrollschutz erfüllt werden. Die Fahrzeuge müssen startklar, mit allen Flüssigkeiten und vollgetankt, zum Test gebracht werden. Das Fahrzeug mit angeschnalltem Fahrer wird bis zu einem Winkel von 45 Grad geneigt. Bei diesem Winkel dürfen kein Kraftstoff oder andere Flüssigkeiten austreten. Danach wird die Neigung auf 60 Grad erhöht, was einer Querbeschleunigung von 1,7 g entspricht. Nur wenn die oberen Räder auf dem Boden bleiben, besteht der Rennwagen den Tilt Table Test.

The scrutineers must go through every point in their checklist

Die Scrutineers übrprüfen jeden Punkt auf ihrer Checkliste

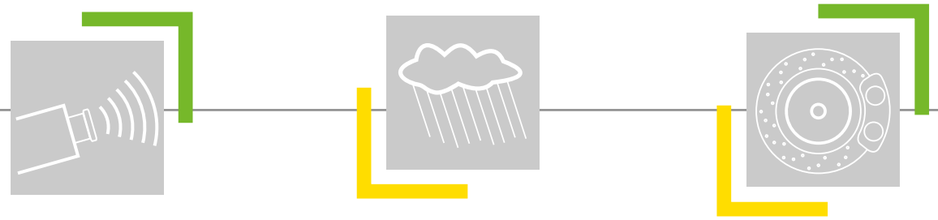
The team members need to explain their design to the scrutineers so they can understand the safety behind their concepts

Die Teams stellen ihre Konstruktion den Scrutineers, sodass diese das Sicherheitskonzept dahinter nachvollziehen können

Noise Test (only FSC)
The noise test checks that the car complies with the provisions for the acceptable noise level. In order to measure the volume, the engine is run in neutral at a rotation speed. The speed depends on the type of engine. In neutral, the noise level must not exceed 103 dBC or be any greater than 110 dBC at a specified rotation speed.

Rain Test (only FSE)
Rain can lead to critical situations for electric cars. In order to be allowed to operate during rainfall with no reservations, the FSE cars must undergo an artificial rain shower. During the artificial rainfall, the car's high voltage system is activated and the appropriate components can be checked to see if they are sufficiently insulated and protected from water.

Brake Test (FSC and FSE)
The brake test checks whether a braking system is able to lock all four wheels of the car simultaneously and bring the vehicle to a controlled stop. However, since the FSE cars can also use their electric motor braking system, if the driver is operating an electric vehicle, in addition they must deactivate the high voltage system after accelerating and then come to a complete stop with all four wheels locked in order to demonstrate that the mechanical braking system functions properly in the case of a fault in the high voltage system.



Noise Test (nur FSC)
Der Noise Test überprüft, ob das Fahrzeug den Vorschriften für die Einhaltung des Lärmpegels entspricht. Dazu wird bei laufendem Motor im Leerlauf, bei einer durch die Bauart des Motors vorgeschriebenen Drehzahl, die Lautstärke gemessen. Der Lärmpegel darf dabei im Leerlauf nicht höher als 103 dBC und nicht höher als 110dBC bei der vorgeschriebenen Drehzahl sein.

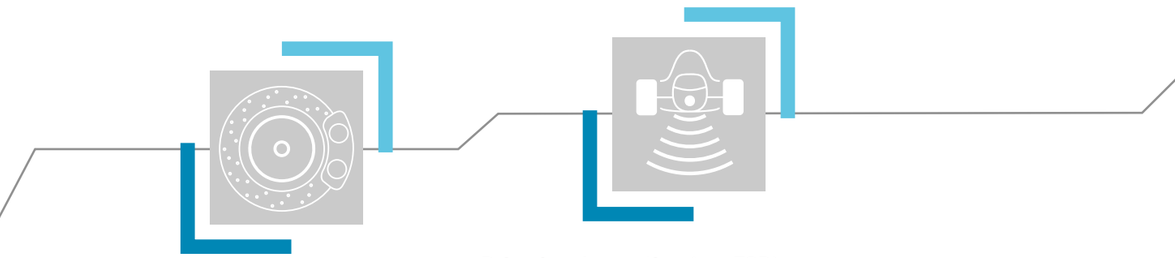
Rain Test (nur FSE)
Regen kann bei Elektrofahrzeugen zu kritischen Situationen führen. Damit die FSE-Fahrzeuge auch bei Niederschlägen vorbehaltlos fahren können, müssen sie sich einem künstlichen Regenschauer unterziehen. Während der künstlichen Beregnung des Fahrzeuges wird bei aktiviertem Hochvoltsystem kontrolliert, ob die verwendeten Komponenten ausreichend isoliert und gegen Regen geschützt sind.

Brake Test (FSC und FSE)
Der Bremstest dient zur Überprüfung, ob das Bremssystem in der Lage ist, alle vier Räder des Fahrzeugs gleichzeitig zu blockieren und dadurch das Fahrzeug zu einem kontrollierten Stillstand zu bringen. Die FSE-Fahrzeuge können den elektrischen Antrieb auch zum Bremsen verwenden. Um eine einwandfreie Funktion des mechanischen Bremssystems bei einem Fehler im Hochspannungssystem nachzuweisen, muss der Fahrer nach dem Beschleunigen das Hochvoltsystem deaktivieren und anschließend mit vier blockierenden Rädern zum Stehen kommen.

"FSD requires that first all the checks are completed for the base vehicle (Combustion or Electric), and then additional checks are completed for the autonomous features."

Brake Test (FSD)
Formula Student Driverless cars are equipped with an Emergency Brake System (EBS). This is actuated via the Remote Emergency System (EBS). This must be tested in order for the FSD cars to pass the brake test.

Driverless Inspection (FSD only)
In order to guarantee the safety of the autonomous vehicles in the operation and handling for all parties concerned, the team must fulfill some special requirements. Each vehicle must be equipped with a so-called RES (Remote Emergency System), which fulfills two functions. By means of this remote control, the required emergency brake system (EBS) can be triggered and the vehicle can be stopped in emergency situations. At the same time, the RES control system enables the "Go" signal to be sent to the vehicle at the start of the dynamic disciplines. Furthermore, all FSD vehicles are equipped with different coloured signal lamps, which indicate the respective operating states of the vehicle. In autonomous mode, a yellow signal is illuminated, whilst a blue light indicates the status of the RES. These systems must be tested during the Driverless Inspection.



Brake Test (FSD)
Formula Student Driverless Fahrzeuge sind mit einem Notfallbremssystem (EBS) ausgestattet, welches durch eine Fernbedienung aktiviert werden kann. Um den FSD Brake Test zu bestehen, muss die Funktionsfähigkeit des EBS per Fernbedienung nachgewiesen werden.

Driverless Inspection (nur FSD)
Um die Sicherheit der autonomen Fahrzeuge bei der Bedienung und Handhabung für alle Beteiligten zu gewährleisten, muss das Team einige besondere Anforderungen erfüllen. Jedes Fahrzeug muss mit einem sogenannten RES (Remote Emergency System) ausgestattet sein, das zwei Funktionen erfüllt. Mit dieser Fernbedienung kann das erforderliche Notbremssystem (EBS) ausgelöst und das Fahrzeug in Notsituationen angehalten werden. Gleichzeitig ermöglicht das RES-Steuerungssystem, dass das „Go" -Signal zu Beginn der dynamischen Disziplinen an das Fahrzeug gesendet wird. Darüber hinaus sind alle FSD-Fahrzeuge mit verschiedenfarbigen Signallampen ausgestattet, die die jeweiligen Betriebszustände des Fahrzeugs anzeigen. Im autonomen Modus leuchtet ein gelbes Signal, während ein blaues Licht den Status des RES anzeigt. Diese Systeme müssen während der Driverless Scrutineering getestet werden.

„Zuerst wird das Basisfahrzeug (Verbrenner oder Elektrik) überprüft und anschließend werden zusätzliche Checks am autonomen System durchgeführt."

The electric cars need to prove that the emergency stop is really cutting the power from the traction system

Beim Drücken des Notaus an den elektrischen Fahrzeugen musst sofort die Stromversorgung vom Antriebsstrang getrennt werden

Adherence to the Rules

Vehicles must conform to regulations and, from a technical point of view, be safe at all times, even after passing scrutineering. The authorised technical experts or the race stewards can remove a car from the competition at any time in the case of a breach of regulation or safety requirements, for example, if a car is leaking fluids, is too loud, or if the insulation is not up to standard.

The car cannot return to the competition until the fault has been repaired. Cars are also inspected again following the endurance race in order to exclude the possibility of a violation during the race. This is why the cars are placed in a parc fermé after the endurance competition, and the team members are not permitted to touch them until all the inspections have been successfully performed.

Geltungsbereich

Die Fahrzeuge müssen auch nach bestandenem Scrutineering zu jeder Zeit regelkonform und sicherheitstechnisch unbedenklich sein. Die offiziellen technischen Sachverständigen oder die Rennleitung können Fahrzeuge bei einem Verstoß gegen das Reglement oder die Sicherheitsanforderungen jederzeit aus dem Wettbewerb nehmen, z.B. wenn Flüssigkeiten austreten, das Fahrzeug zu laut oder die elektrische Isolation nicht gewährleistet ist. Die Fahrzeuge können erst dann wieder am Wettbewerb teilnehmen, wenn der Mangel behoben wurde. Nach dem Endurance-Rennen werden die Fahrzeuge erneut geprüft, um Regelverstöße während des Rennens ausschließen zu können. Hierfür werden die Fahrzeuge in einem „Parc-Fermé“ abgestellt und dürfen von den Teammitgliedern solange nicht mehr berührt werden, bis die letzte Abnahme erfolgt ist.

If a team fails any point of the inspection, they must fix the issue and return for re-inspection

Wird auch nur ein Punkt bei der Inspektion nicht erfüllt, muss das Team das entsprechende Problem beheben und erneut zur Inspektion antreten

It is critical for safety that the students understand the meaning of the different flags.

Aus Sicherheitsgründen ist es essentiell, dass die Studierenden die Bedeutung der verschiedenen Flaggen kennen.

Flags

During the dynamic events, flags are used to communicate with the drivers. The various colours and patterns have different meanings, and all drivers must understand and obey any flag signal they receive during the competition. Infringements of flag signals can be penalised with various penalties, ranging from time penalties to disqualification.

Your session has been started, enter the course!
Deine Fahrt beginnt. Fahr auf die Strecke!

Your session has been completed.
Exit the course!
Deine Fahrt ist beendet.
Verlass die Strecke!

Pull into the passing zone to be passed by a faster competitor!
Fahr in die Überholzone, damit ein schnelleres Fahrzeug passieren kann!

Pull into the penalty box for discussion concerning an incident that may cause a time penalty!
Fahr in die Kontrollzone zur Diskussion eines Vorfalls! Ggf. Zeitstrafe!

Pull into the penalty box for a mechanical inspection of your car!
Fahr in die Kontrollzone für eine Untersuchung des Fahrzeugs!

Flaggen

Bei den dynamischen Prüfungen werden zur Kommunikation mit den Fahrern Flaggen eingesetzt. Die verschiedenen Farben und Muster haben unterschiedliche Bedeutungen. Alle Fahrer müssen die Flaggen kennen und beachten, wenn sie diese während des Wettbewerbs gezeigt bekommen. Verstöße gegen geschwenkte Flaggen können mit verschiedenen Sanktionen geahndet werden, die von Zeitstrafen bis zur Disqualifikation reichen können.

Come to an immediate safe controlled stop on the course! Pull to the side of the course.
Komm sofort kontrolliert zum Stehen.
Halte die Strecke frei.

Something is on the track that should not be there. Be prepared for evasive maneuvers to avoid debris or liquids!
Es ist etwas Unerwartetes auf der Strecke. Sei bereit Flüssigkeiten oder Bruchstücken auszuweichen!

Something has happened beyond the flag station. No passing unless directed by the track marshals. Stationary: Danger! Slow down, be prepared to take evasive action. Waved: Great Danger! Slow down, evasive action is most likely required, be prepared to stop.
Etwas ist jenseits der Flagge passiert. Fahr nicht vorbei ohne Anweisung der Streckenposten. Flagge gehalten: Gefahr! Fahr langsam, sei bereit zum Ausweichen. Flagge geschwenkt: Große Gefahr! Fahr langsam, Ausweichen wird erforderlich sein. Sei bereit anzuhalten.

From the FSG racetrack...
Von der FSG Rennstrecke ...

Dr. Michael Hafner,
Leiter Automatisiertes Fahren und Aktive Sicherheit bei Mercedes-Benz

... to a great career
... zu einer großartigen Karriere

Dr Hafner, Mercedes-Benz is the number one premium manufacturer among automotive manufacturers and continues to dominate Formula 1, while at the same time facing quite a few challenges in terms of the future. What does all this have to do with Formula Student?
The successes that we have achieved in Formula 1, in our sales figures and with regard to quality, have not just come about by coincidence. A lot of hard work has gone into such results – certainly – but also consistently good work, coupled with a working culture that makes such quality possible. It is true to say that engineers are generally curious people, who like trying things out. Having the freedom to do so is important. At the same time, none of us enjoy "simply" developing something that then proves to be of no use to anyone at all, however ingenious the idea may be. It is the determination to deliver added value for the customer and a business case for the company with a development idea that ultimately leads to success.
And this is precisely the experience gained by the student teams in Formula Student Germany. Specialist lectures are all well and good, but they are only the start. The constant juggle between development and cost effectiveness in a real situation and with a real team offers an excellent way of preparing for a career in this field. And the students who become involved here, as a sideline to their degree course, do so with genuine commitment and passion.
These are the brains that we need to shape the transformation of the automotive industry. This is also why we have been keen supporters of Formula Student Germany for many years now.

Herr Dr. Hafner, Mercedes-Benz ist Premiumhersteller Nummer 1 unter den Automobilherstellern, dominiert die Formel 1 und hat aber auch einige Herausforderungen für die Zukunft vor sich. Was hat das alles mit der Formula Student zu tun?
Die Erfolge, die wir in der Formel 1, im Absatz sowie in der Qualität feiern dürfen, kommen ja nicht von ungefähr. Da steckt harte Arbeit dahinter – logisch – aber auch kontinuierlich gute Arbeit gepaart mit einer Arbeitskultur, die eine solche Qualität auch ermöglicht. Ingenieure sind in der Regel sehr neugierig und probieren Dinge gerne aus. Diese Freiheit ist wichtig. Gleichzeitig haben die wenigsten Freude daran „nur" etwas zu entwickeln, was dann niemand gebrauchen kann, auch wenn es noch so raffiniert ist. Der Wille einen Mehrwert für den Kunden und einen Business-Case für die Firma mit einer Entwicklung zu bedienen, führt zum Erfolg.

Und genau das ist es, was die Studierenden mit ihren Teams bei der Formula Student Germany erleben. Die Fachvorlesungen sind richtig und wichtig, bilden aber nur die Basis. Das Zusammenspiel der Entwicklung und Wirtschaftlichkeit in einem realen Fall und mit einem realen Team ist ein ausgezeichneter Weg sich auf den Karriereeinstieg vorzubereiten. Und die Studierenden, die sich neben dem Studium hier einbringen, machen es mit echtem Herzblut und Leidenschaft an der Sache.
Das sind genau die Köpfe, die wir brauchen, um den Wandel in der Automobilindustrie zu gestalten. Deshalb engagieren wir uns seit vielen Jahren bei der Formula Student Germany.

How far-reaching are the changes that you face, and what are the implications here for the development engineers of tomorrow? Aren't you just going to need information scientists, programmers and other IT specialists in future, who will be able to optimise the artificial intelligence in the "cerebrum" of industrial robots?
Increased networking, electrification and the automation of the vehicle, as well as the added need for flexible mobility, are changing our whole sector of industry. Each of these trends on its own has the power to stand our industry on its head. However, the real revolution lies in intelligently linking all of them. Interdisciplinary qualifications and ways of thinking therefore continue to be in high demand.
Programmers have been at work in our company for decades; pretty much since the introduction of the first electronic components as control units in our vehicles, in fact. Thanks to the factors mentioned above, there is now a bigger demand than ever. However, in most cases it is also vital that these programmers bring with them some experience of mechatronics and automotive engineering. By the same token, this is one of the few sectors where a programmer will not only be moving pixels around on a screen, but will also be able to create a sophisticated product in their development work that will ultimately find its place in the real world. As in my own field of autonomous driving for instance, this is something that a conventional IT employer will never be able to offer its employees.
In the end, we still need to design, develop, produce and sell our vehicles as an entire system. Yes, of course, we still need the conventional disciplines associated with mechanical engineering and mechatronics – but, ideally, coupled nowadays with IT or programming skills.

Formula Student sees the involvement of students alongside their regular studies, with a considerable amount of their free time invested in the projects. Would you rather see the students furthering their education by learning another programming language or attending lectures on driving dynamics instead?
For the further development of our driver assistance systems, but also of our fully automated vehicles, we need people who are naturally experts in their own specialist field, but who are also capable of taking a holistic approach. Competency in at least one programming language is certainly an essential requirement in some fields – and in others a plus point, at the very least. In Formula Student, I have noticed how the teams have to keep on being inventive in order to fight for the top places, year after year. The collaboration within cross-functional teams and the sharing of information with the teams coming up through the ranks are key factors in this respect. These are important and pivotal skills that we can definitely put to good use. Our fully automated vehicles, which we will be launching before the end of this year as part of a pilot project in San José, California, are not only being developed at our Silicon Valley site in the US, but also by teams here in Germany.

> **The constant juggle between development and cost effectiveness offers an excellent way of preparing for a career in this field.**

> **Das Zusammenspiel von Entwicklung und Wirtschaftlichkeit in der Formula Student ist ein ausgezeichneter Weg sich auf den Karriereeinstieg vorzubereiten.**

Wie weitreichend sind denn die Veränderungen, die Ihnen bevorstehen und was bedeutet das für die Entwickler von morgen? Brauchen Sie in Zukunft nur noch Informatiker, Programmierer und andere IT-Spezialisten, die die Künstliche Intelligenz im „Großhirn" der Industrieroboter optimieren?
Mit der zunehmenden Vernetzung, der Elektrifizierung und der Automatisierung des Fahrzeugs sowie dem Bedarf nach Flexibilität der Mobilität ändert sich einiges in unserer Branche. Jeder dieser Trends hat alleine das Potential, unsere Industrie auf den Kopf zu stellen. Die wahre Revolution steckt allerdings in der Verknüpfung all dessen. Interdisziplinäre Qualifikationen und Denkweisen sind also nach wie vor gefragt.
Programmierer haben wir schon seit Jahrzehnten bei uns in der Firma; quasi seit die ersten elektronischen Bauteile als Steuergeräte in unsere Fahrzeuge gekommen sind. Heute ist der Bedarf durch die eben genannten Punkte natürlich größer denn je. Allerdings ist es in dem meisten Fällen extrem wichtig, dass diese Programmierer auch Ahnung von Mechatronik und Fahrzeugtechnik mitbringen. Umgekehrt sind wir eine der wenigen Branchen, in denen ein Programmierer nicht nur Pixel auf einem Bildschirm verändert, sondern mit seinen Entwicklungen ein faszinierendes Produkt durch die echte Welt bewegen lässt. Gerade in meinem Bereich des Autonomen Fahrens ist das etwas, was klassische IT Arbeitgeber ihren Mitarbeitern nicht bieten können.
Letztendlich müssen wir unsere Fahrzeuge aber immer noch als Gesamtsystem konstruieren, entwickeln, produzieren und verkaufen. Die klassischen Disziplinen rund um Maschinenbau und Mechatronik benötigen wir selbstverständlich nach wie vor – gerne aber bereits gepaart mit IT oder Programmierkenntnissen.

In der Formula Student engagieren sich junge Studierende neben ihrem Studium und stecken viel Freizeit in ihre Projekte. Würden Sie es lieber sehen, wenn sich die Studierenden stattdessen mit einer weiteren Programmiersprache oder Fahrdynamikvorlesungen fortbilden würden?
Für die Weiterentwicklung unserer Fahrerassistenzsysteme aber auch unserer vollautomatisierten Fahrzeuge brauchen wir Leute, die sich natürlich in ihrem Fachgebiet gut auskennen, aber auch einen ganzheitlichen Ansatz verfolgen. Das Beherrschen mindestens einer Programmiersprache ist bei einigen Einsatzgebieten dabei auf jeden Fall ein Muss – bei anderen zumindest ein

Since 2017, Formula Student has also included a Driverless category (FSD). What is the biggest challenge facing the teams wishing to participate in this category? How do they meet the challenge of teaching a machine to drive?
First of all, I would just like to say that I am really envious of these teams. In the days when I was studying electrical engineering and industrial information technology at Karlsruhe University, I would have been so keen to seize an opportunity like this, but sadly such things didn't exist then. As I see it, there are several major challenges facing the FSD teams. They don't only have to develop the automated system, but also to integrate it into the vehicle as a whole. Because of the way university courses work, the teams experience a high level of fluctuation of their members . It is vital to take and build on the knowledge pulled together by the previous team – even if the make-up of the team as a whole changes completely. And last, but not least, computer scientists must work hand in hand with engineers. They need to learn to organize an interdisciplinary team and to lead it to success. One general challenge when it comes to automating vehicles is that of monitoring their surroundings. This is a function that is based on artificial intelligence and has been an integral part of our vehicle assistance systems for many years already. When it comes to highly automated driving, these systems now need to be capable of significantly more, for example, in order to be able to understand and interpret the full detail of a complex urban street scene. The key to this, in our view, is the highly sophisticated process of Deep Learning. This is actually based on ideas that have been around for quite some time, but which are only now revealing their full potential. These days we have vast quantities of training data at our fingertips, coupled with superb computing capacity, which mean that our automated vehicles are able to comprehend their surroundings almost as well as we humans can.

Computer scientists must work hand in hand with engineers.

Informatiker müssen Hand-in-Hand mit Ingenieuren arbeiten.

Connectivity, electrification or automatisation of the vehicle, as well as added need for flexible mobility are changing our whole sector of industry.

Vernetzung, Elektrifizierung und Automatisierung des Fahrzeugs, sowie der Bedarf nach flexibler Mobilität verändert einiges in unserer Branche.

Pluspunkt. In der Formula Student habe ich beobachtet, wie sich Teams immer wieder neu erfinden müssen, um Jahr für Jahr um die oberen Plätze kämpfen zu dürfen. Die Zusammenarbeit in Cross-Funktionalen Teams und die Informationsweitergabe an kommende Teams sind hier entscheidende Faktoren. Das sind wichtige und entscheidende Fähigkeiten, die wir auf jeden Fall gut gebrauchen können. Unsere vollautomatisierten Fahrzeuge, die wir dieses Jahr noch im Kalifornischen San José in einem Pilotprojekt starten lassen, werden nicht nur in den USA an unserem Standort im Silicon Valley entwickelt, sondern auch von Teams hier in Deutschland.

Seit 2017 gibt es bei der Formula Student auch eine Driverless Kategorie (FSD). Was ist für Teams, die in dieser Kategorie antreten wollen, die größte Herausforderung? Wie begegnen Sie der Herausforderung einer Maschine das Fahren beizubringen?
Als erstes muss ich hier einmal loswerden, dass ich schon sehr neidisch bin auf diese Teams. Als ich Elektrotechnik und Industrielle Informationstechnik an der Universität Karlsruhe studiert habe, hätte ich mich sofort für so eine Gelegenheit begeistert, aber die gab es damals leider noch nicht.
Ich sehe für die FSD Teams gleich mehrere große Herausforderungen. Sie müssen nicht nur das automatisierte System entwickeln, sondern es in das gesamte Fahrzeug integrieren. Bedingt durch das Studium haben die Teams eine hohe Fluktuation. Es ist essentiell, das Wissen des Vorgängerteams zu nutzen und darauf aufzubauen – auch wenn das ganze Team wechselt. Und last but not least, Informatiker müssen hand-in-hand mit Maschinenbauern arbeiten. Sie müssen lernen, ein interdisziplinäres Team zu organisieren und erfolgreich zu führen. Eine generelle Herausforderung beim Automatisieren von Fahrzeugen ist die Umfelderkennung. Sie basiert auf künstlicher Intelligenz und ist schon seit vielen Jahren ein integraler Bestandteil unserer Assistenzsysteme im Fahrzeug. Beim hochautomatisierten Fahren müssen diese Systeme nun deutlich mehr leisten, um z.B. eine komplexe Innenstadtszene in allen Details zu verstehen und zu interpretieren. Für uns ist der Schlüssel dazu hochmoderne Deep Learning Verfahren, die eigentlich auf recht alten Ideen basieren, aber erst heute ihr volles Potential entfalten können. Denn heute haben wir Zugriff auf eine große Menge an Trainingsdaten gepaart mit einer sehr hohen Rechenleistung, wodurch unsere automatisierten Fahrzeuge ihr Umfeld ähnlich gut verstehen wie wir Menschen.

And what do you see as the biggest challenges currently facing you in your role at Daimler before you really can put driverless vehicles on the road? These will also be issues that are important for the coming generation of engineers.
I would be very glad if it was "only" the technical challenges that we needed to resolve in order to allow more people to enjoy more efficient mobility courtesy of automated vehicles. However, there are several other issues at stake here before we can talk about the success of a new and revolutionary technology. Questions about social acceptance, as well as general megatrends in urban planning, or the legal situation in the various countries, not to mention in different states, have as much a part to play here as the technology, if we are to change something for the positive with self-driving vehicles. Fortunately these are not all issues that a participant in Formula Student or a novice development engineer with us needs to solve on their own – we are a large company team with a broad range of expertise. What is important to us, however, is that we should take an integrated approach to considering and tackling the issue. This is why, for example, we also have projects looking at the way that autonomous vehicles communicate with the outside world, since the pedestrian can no longer catch the driver's eye to establish whether they have been seen.

How long will it be, then, before I shall be able to let my car drive me to the Formula Student event at the Hockenheimring?
Unfortunately I still don't have a vehicle that can be used on public roads to offer you for August 2019, but it won't be too much longer before you'll be able to sit in the driver's seat watching a film as the car travels along the motorway, leaving the vehicle to do the driving.

Und was sind für Sie in Ihrer Aufgabe bei Daimler aktuell die größten Herausforderungen, um tatsächlich fahrerlose Fahrzeuge auf die Straße zu bringen? Das werden ja auch Themen sein, die für die kommende Ingenieursgeneration wichtig ist.
Ich wäre sehr froh, wenn es „nur“ die technischen Herausforderungen wären, die wir lösen müssen, um mehr Menschen an einer effizienteren Mobilität durch automatisierte Fahrzeuge teilhaben lassen zu können. Allerdings spielen da ja noch einige weitere Themen mit, wenn es um den Erfolg einer neuen, revolutionären Technologie geht. Genauso wie die Technologie sind gesellschaftliche Fragen der Akzeptanz sowie generelle Megatrends im Städtebau oder auch die Rechtslage in den unterschiedlichen Ländern oder gar der jeweiligen Bundesstaaten von Bedeutung, wenn wir mit selbst-fahrenden Fahrzeugen etwas zum Positiven verändern wollen. Nun sind das zum Glück nicht alles Themen, die ein Teilnehmer bei Formula Student oder ein neuer Entwickler bei uns alleine lösen muss – wir sind ja ein großes, kompetentes Team im Konzern. Uns ist aber wichtig, dass wir das Thema ganzheitlich denken und angehen. Daher haben wir zum Beispiel auch Projekte, die sich mit der Außenkommunikation von autonomen Fahrzeugen beschäftigen, da der Fußgänger dann nicht mehr in die Augen des Fahrers blicken kann, um festzustellen, ob er ihn gesehen hat.

In welchem Jahr kann ich mich denn nun von meinem Auto zum Formula Student Event an den Hockenheimring fahren lassen?
Für den August 2019 habe ich leider noch kein öffentlich verwendbares Fahrzeug im Angebot, das ich Ihnen anbieten kann, aber lange wird es nicht mehr dauern, bis Sie auf der Autobahn einen Film als Fahrer während der Fahrt schauen dürfen und dem Fahrzeug das Fahren überlassen können.

That's how it all started...

So fing alles an...

Two decades of Formula Student in Germany

20 years, 31 events in 7 countries with 19 racing cars over 20 top placings achieved ... these numbers summarize the history of the Baltic Racing Team from Stralsund (original name student-racing-team), the oldest Formula Student Team in Germany. But how did this happen? Who brought the competition Formula Student (FS) to Germany?

In the 1990s, FS was only established in the USA. In 1998, the fascination for this international design competition officially came to Europe, or more precisely, to England. The later patron of the Stralsund team, Prof. Dr.-Ing. Roßmanek, was also infected by this challenge. In addition, we talked to three members of the founding team and asked them what went through their minds 20 years ago. They gave us an insight into the initial phase of Formula Student in Germany and talked about their experiences.

Zwei Jahrzehnte Formula Student in Deutschland

In 20 Jahren bei 31 Events in 7 Ländern mit 19 Rennwagen über 20 Top Platzierungen erzielt ... diese knackigen Zahlen fassen die Geschichte des Baltic Racing Teams aus Stralsund (ursprünglicher Name student-racing-team), dem ältesten Formula Student Team aus Deutschland, zusammen. Doch wie kam es dazu? Wer holte die Formula Student nach Deutschland?

In den 1990er Jahren war die FS lediglich in den USA etabliert. Erst 1998 schwappte die Faszination für diesen internationalen Konstruktionswettbewerb offiziell nach Europa, genauer gesagt nach Silverstone (England) über. Angesteckt von diesem Engagement wurde auch der spätere Schirmherr des Stralsunder Teams, Herr Prof. Dr.-Ing. Roßmanek. Neben ihm haben wir drei Gründungsmitglieder ausfindig gemacht und gefragt, was ihnen vor 20 Jahren durch den Kopf ging. Sie geben uns einen Einblick in die Anfangsphase der Formula Student in Deutschland und lassen ihre Erfahrungen Revue passieren.

TY 2000

The first German Formula Student racing car made its race debut in Birmingham. Today you can visit it in the Technical State Museum Mecklenburg-Vorpommern in Wismar (phanTECHNIKUM).

Der erste deutsche Formula Student Rennwagen hatte sein Renndebüt im britischen Birmingham. Heute steht er im Technisches Landesmuseum Mecklenburg-Vorpommern in Wismar (phanTECHNIKUM).

TY 03/04

By optimising various components, weight was reduced. From 129 teams in Detroit, the team took 20th place and received the "Best European Team" award.

Durch die Optimierung verschiedener Bauteile wurde Gewicht reduziert. Von 129 Teams in Detroit belegte das Team den 20. Platz und erhielt die Auszeichnung „Best European Team".

"Formula Student is education": This quote must always be remembered when starting a new season or building a new car.

„Formula Student is education": Diesen Spruch muss man sich immer vergegenwärtigen, wenn eine neue Saison angefangen oder ein neues Auto gebaut wird.

Ulf Steinfurth


PR


US


FR


PJ

Interviewpartner sind:

Prof. Dr.-Ing. Peter Roßmanek (PR)
Professor of Automotive Engineering and Design at Stralsund University of Applied Sciences, Patron of the Stralsund Formula Student Team / Professor für Fahrzeugtechnik und Konstruktion an der Hochschule Stralsund, Schirmherr des Stralsunder Formula Student Teams

Ulf Steinfurth (US)
Laboratory engineer in the field of automotive engineering at the University of Applied Sciences Stralsund, Since 2006 responsible for the mechanical inspection at Formula Student Germany (FSG) / Laboringenieur im Bereich Fahrzeugtechnik an der Hochschule Stralsund, Mechanical Inspection bei der Formula Student Germany

Frank Röske (FR)
Head of Logistics, new vehicle and structural projects at Porsche Leipzig GmbH, Board Member of Formula Student Germany / Leiter Logistik Neue Fahrzeug- und Strukturprojekte bei der Porsche Leipzig GmbH, Board Member der Formula Student Germany.

Peter Jakowski (PJ)
Group Leader Engineering Application Test Center at Bosch Engineering GmbH, 13 years Ambassador Special Operation and Loss Prevention at Formula Student Germany (until 2018) / Gruppenleiter Engineering Application Testcenter bei der Bosch Engineering GmbH, 13 Jahre lang Ambassador Special Operation and Loss Prevention bei der Formula Student Germany (bis 2018)

TY 06

The new design was lighter and stronger. Some of the numerous innovations include a 3-fold stiffer frame, an improved chassis geometry and a further increase in engine performance.

Die Neukonstruktion ist leichter und stärker als alle Vorgänger. Zu den zahlreichen Neuerungen gehören ein 3-fach steiferer Rahmen, eine verbesserte Fahrwerksgeometrie und eine erneute Steigerung der Motorleistung.

TY 12

Without the rear frame, the design of the chassis became more compact. The chassis was redesigned from the ground up and brought in line with the new frame geometry. 2nd place was reached for the Cost Report as well as in the SkidPad at FSG. The team won 15th place overall.

Ohne einen Heckrahmen wurde die Bauform des Chassis kompakter. Das Fahrwerk wurde von Grund auf neu entwickelt, und in Einklang mit der neuen Rahmengeometrie gebracht. Sowohl im Cost Report als auch beim Skid Pad wurde bei der FSG der 2. Platz belegt. Am Ende wurde der 15. Platz mit nach Stralsund genommen.

FSG: What motivated you, Prof. Roßmanek, to bring the design competition to Germany in 1999?

PR: During a visit to Oxford Brookes University I discovered the motorcycle engine of a Honda CBR 600 on a workbench. I was enthusiastic about the idea, that students were building a racing car on their own. I'm convinced that this project is one of the best ones which exists for the interdisciplinary training of students.

FSG: Peter, you've been a driving force in the development of FS in Germany. What do you like about it?

PJ: The team spirit, I've never seen that before. That was also our motivation to found FSG in 2005. The fact that we already set a benchmark worldwide in Hockenheim in the first year shows that we did everything right.

FSG: Was motivierte Sie, Herr Prof Roßmanek, den Konstruktionswettbewerb 1999 nach Deutschland zu holen?

PR: Bei einem Besuch an der Oxford Brookes University habe ich den Motorradmotor einer Honda CBR 600 auf einer Werkbank entdeckt. Von der Idee, dass Studenten eigenständig ein Rennfahrzeug bauen, war ich begeistert. Ich bin überzeugt, dass dieses Projekt zum Besten gehört, was es für die fachübergreifende Ausbildung von Studenten gibt.

FSG: Peter, du warst von Anfang an dabei. Was gefällt dir an der FS?

PJ: Der Zusammenhalt der Teams, das habe ich so noch nie gesehen. Das war auch unsere Motivation 2005 die FSG zu gründen. Dass wir schon im ersten Jahr in Hockenheim weltweit eine Benchmark setzten, zeigt, dass wir alles richtig gemacht haben.

"In 1999, parts were still ordered in the paper catalogue and rule inquiries clarified via fax. The way of working was completely different from what it is today."

„1999 wurden Teile noch im Papierkatalog bestellt und Regelanfragen via Fax geklärt. Es herrschte eine ganz andere Arbeitsweise, als sie heutzutage existiert."

Frank Röske

Lighter, faster and better - this is how this year's racing car was presented to the public at the beginning of May. A big innovation this season is especially the newly develpped aerodynamic features. In addition, the team reached new dimensions: 83 members were pleased that the TY19 was running at the rollout ceremony

TY 19

TY 16

In this season the weight of the racing car was reduced by almost 5 kg compared to the previous year, because the frame became considerably lighter. The suspension was made adjustable and the anti-roll bar was also designed to be adjustable from the cockpit while driving.

Leichter, schneller und besser - so wurde er Anfang Mai der Öffentlichkeit präsentiert. Besonders das in dieser Saison entwickelte Aeropaket ist eine große Neuerung. Zudem erreichte das Team neue Dimensionen: 83 Mitglieder erfreuten sich über ein fahrenden TY19 auf der Enthüllung.

Das Gewicht wurde zum Vorjahr um knapp 5 kg verringert, da der Rahmen deutlich leichter wurde. Beim Fahrwerk wurde auf Verstellbarkeit gesetzt und der Stabilisator wurde auch während der Fahrt vom Cockpit aus verstellbar.

FSG: Let's take a look at the development of the Stralsund team. Mr. Steinfurth, has the staff structure of the team changed?

US: Only 15 students from the Faculty of Mechanical Engineering were part of the founding team. Today, numerous students from all faculties are involved. This is important, because today it is no longer enough to just build a racing car.

FSG: And the technical development, Frank?-

FR: The Stralsund team always assesses its existing possibilities appropriately and acts accordingly, which leads to the fact that they are always changing the basic concept. Nevertheless, each new team generation pursues its own philosophy. This can also be seen in this year's racing car, for the first time it has an aero package. I'm curious whether this will pay off on the track.

FSG: What is your final advice to the FS community?

PR: 1. Concentrate on the essential points. 2. Get the vehicle ready early, so you can test it. 3. Forget the gimmicks. 4. Focus on minimal optimizations in a season. 5. Never forget the respect among each other, and the fun.
US: Share your knowledge and talk to each other.
FR: Create experiences - because they will be remembered, not the results! Help yourselves, be fair and sporty.
PJ: Keep up the good work, the FS is a great chance to develop professionally, and as well personally.

FSG: Werfen wir einen Blick auf die Entwicklung des Stralsunder Teams. Herr Steinfurth, hat sich der personelle Aufbau des Teams verändert?

US: Bei der Gründung beteiligten sich nur Studierenden der Fakultät Maschinenbau, heute wirken zahlreiche Studenten aller Fakultät mit. Dies ist wichtig, denn heute reicht es nicht mehr, nur einen Rennwagen zu bauen.

FSG: Und die technische Entwicklung, Frank?

FR: Das Stralsunder Team schätzt seine vorhandenen Möglichkeiten immer angemessen ein und agiert entsprechend, wodurch sich im Grundkonzept wenig geändert hat. Dennoch verfolgt jede neue Teamgeneration ihre eigene Philosophie. Dies sieht man auch beim diesjährigen Rennwagen, erstmalig mit Aeropaket. Ich bin gespannt, ob sich das auf der Strecke auszahlt.

FSG: Was ist Ihrer/Euer abschließender Rat an die FS Community?

PR: 1. Konzentriert euch auf das Wesentliche. 2. Werdet frühzeitig mit dem Fahrzeug fertig, damit ihr es testen könnt. 3. Vergesst die Gimmicks. 4. Fokussiert euch auf minimale Optimierungen in einer Saison. 5. Vergesst nie den Respekt untereinander, und den Spaß. **US:** Teilt euer Wissen und redet miteinander.
FR: Schafft Erlebnisse - denn die bleiben in Erinnerung, nicht die Ergebnisse! Helft euch, seid fair und sportlich.
PJ: Macht weiter so, die FS ist eine super Chance sich fachlich, aber vor allem persönlich weiterzuentwickeln.

As FSG we say thank you for your courage to bring Formula Student to Germany. Without you, we all wouldn't know what to do with our free time!

Als FSG sagen wir Danke für Ihren/ Euren damaligen Mut, die Formula Student nach Deutschland zu holen! Ohne Euch wüssten wir wohl alle nicht, was wir heute mit unserer Freizeit anfangen sollten!

"The vision should be to reach the first place. Each team will then win in its own way."

„Die Vision sollte sein, den 1. Platz zu erreichen. Gewinnen wird dann jedes Team auf seine eigene Art und Weise."

Peter Jakowski

Awards 2019

Results:

	Formula Student	Combustion	Electric	Driverless
OVERALL	1st Place Overall	SUN	SUN	SUN
	2nd Place Overall	SUN	SUN	SUN
	3rd Place Overall	SUN	SUN	SUN
DYNAMICS	Acceleration Winner	SAT	SAT	SAT
	Autocross Winner	SAT	SAT	SAT
	Endurance Winner	SUN	SUN	–
	Skid Pad Winner	SAT	SAT	SAT
	TrackDrive Winner	–	–	SAT
	Most Fuel/Energy Efficient Car	SUN	SUN	SAT
STATICS	Business Plan Winner	SAT	SAT	SAT
	Cost and Manufacturing Winner	SAT	SAT	SAT
	Engineering Design Winner	SAT	SAT	SAT
SPECIAL AWARDS	FSD Daimler AI Autonomous	–	–	SAT
	FSD AID Rapid Development Award	–	–	SAT
	FSG BASF Best Use of 3D Printing Award		SAT	
	FSG Kube Crashbox Award		SAT	
	FSG Siemens Digital Twin Engineering Excellence Award		SAT	
	FSG Sportsmannship		SUN	

STATUS/STAND: 10.07.2019

Schedule 2019

Mon, 5th of August

08:00	C D E	Technical Inspection-, Registration- & Entrance Order Available	14	Ticket Centre
09:30 - 10:30	D E	Registration for 18 DV + 2 EV Teams, ASR, ESO, Drivers	14	Ticket Centre
10:00 - 12:00	D E	Entrance for 18 DV + 2 EV Team Vehicles + 7 Members	8	Pits
10:00 - 22:00	D E	Charging Tent available	2	Charging Tent
10:00 - 23:59	D E	Pits available	8	Pits
12:00 - 19:00	D E	Technical Inspections (A, D, E, M & P)	2 + 8	Charging Tent, Pits
14:30 - 16:30	E	Registration for 38 EV Teams, ESO & Drivers	14	Ticket Centre
15:00 - 20:00	E	Entrance for 38 EV Team Vehicles + 7 Members	8	Pits

Tue, 6th of August

07:00 - 22:00	D E	Charging Tent available	2	Charging Tent
07:00 - 23:59	D E	Pits available	8	Pits
07:45 - 12:30	C D E	Event Control	5	Event Control
08:00 - 12:15	D E	Technical Inspections (A, D, E, M & P)	2+3	Charging Tent, Dynamic Area
09:00 - 19:00	D	Emergency Brake System (EBS) Test	12	Start/Finish Line
13:00 - 19:00	C D E	Technical Inspections (A, D, E, M & P), Tilt, Rain, Noise, Brake	2+3	Charging Tent, Dynamic Area
13:00 - 19:00	D	Engine Test*	3	Dynamic Area
14:00 - 19:00	C D E	Event Control	5	Event Control
15:00 - 17:30	E	Registration for 60 CV Teams	14	Ticket Centre
15:30 - 19:00	E	Entrance for all CV Team Vehicles + All Members	0	Venue
15:30 - 23:59	C D E	Pits & Recreation Tent available	8+10	Pits, Recreation Tent
16:00 - 19:00	E	Driver Registration	5	Event Control
21:00 - 22:00	C D E	Team Welcome	7	Marquee Above Pits

Wed, 7th of August

06:00 - 22:00	D E	Charging Tent available	2	Charging Tent
06:00 - 23:59	C D E	Pits & Recreation Tent available	8+10	Pits, Recreation Tent
07:45 - 12:30	C D E	Event Control	5	Event Control
07:45 - 18:00	C D E	Ticket Centre	14	Ticket Centre
08:00 - 13:00	C D E	Technical Inspections (A, D, E, M & P), Tilt, Rain, Noise, Brake	2+3	Charging Tent, Dynamic Area
09:00 - 19:00	C D E	Engine Test	3	Dynamic Area
09:00 - 19:00	D	Emergency Brake System (EBS) Test	12	Start/Finish Line
10:45 - 18:00	C D E	FSG Academy On Site	11	South Stand
11:00 - 17:30	D E	Business Plan Presentation	1+9	BW Tower, Ravenol Tower
11:00 - 18:00	C	Special Awards	6	FSG Forum
11:00 - 18:50	D E	Cost Analysis, Engineering Design	7	Marquee Above Pits
13:00 - 20:00	D E	Team Photos	7	Marquee Above Pits
14:00 - 19:00	C D E	Event Control	5	Event Control
14:00 - 19:00	C D E	Technical Inspections (A, D, E, M & P), Tilt, Rain, Noise, Brake	2+3	Charging Tent, Dynamic Area
20:00 - 21:00	D E	Business Plan Presentation Finals	7	Marquee Above Pits

Thu, 8th of August

06:00 - 18:30	C D E	Recreation Tent available	10	Recreation Tent
06:00 - 22:00	D E	Charging Tent available	2	Charging Tent
06:00 - 23:59	C D E	Pits available	8	Pits
07:45 - 12:30	C D E	Event Control	5	Event Control
07:45 - 18:00	C D E	Ticket Centre	14	Ticket Centre
08:00 - 13:00	C D E	Technical Inspections (A, D, E, M & P), Tilt, Rain, Noise, Brake	2+3	Charging Tent, Dynamic Area
09:00 - 12:00	D	Emergency Brake System (EBS) Test	12	Start/Finish Line
09:00 - 14:00	D	Practice Track	3	Dynamic Area
09:00 - 16:15	C D E	FSG Academy On Site	11	South Stand
09:00 - 19:00	C D E	Practice Track / Engine Test	3	Dynamic Area
09:15 - 16:35	C	Cost Analysis, Engineering Design	7	Marquee Above Pits
09:30 - 16:00	C	Business Plan Presentation	1+9	BW Tower, Ravenol Tower
09:30 - 17:15	D	Special Awards	6	FSG Forum
11:15 - 17:30	C	Team Photos	7	Marquee Above Pits
14:00 - 19:00	C D E	Event Control	5	Event Control
14:00 - 19:00	C D E	Technical Inspections (A, D, E, M & P), Tilt, Rain, Noise, Brake	2+3	Charging Tent, Dynamic Area
15:30 - 18:30	D	Skid Pad	3	Dynamic Area
16:00 - 19:00	D	Emergency Brake System (EBS) Test*	3	Dynamic Area
18:30 - 19:30	C D E	Staging for Panoramic Photograph	3	Dynamic Area
19:15 - 21:45	D	Engineering Design Finals (not public)	10	Recreation Tent
19:15 - 21:45	E	Engineering Design Finals (not public)	6	FSG Forum
20:00 - 21:00	C	Business Plan Presentation Finals	7	Marquee Above Pits

Fri, 9th of August

06:00 - 22:00	D E	Charging Tent available	2	Charging Tent
06:00 - 23:59	C D E	Pits & Recreation Tent available	8+10	Pits, Recreation Tent
07:15 - 12:30	C D E	Event Control	5	Event Control
07:15 - 18:00	C D E	Ticket Centre	14	Ticket Centre
07:30 - 07:50	C D E	Team Briefing	7	Marquee Above Pits
08:00 - 12:00	C D E	Technical Inspections (A, D, E, M & P), Tilt, Rain, Noise, Brake*	2+3	Charging Tent, Dynamic Area
08:30 - 12:30	C E	Practice Track	3	Dynamic Area
08:30 - 14:00	C E	Skid Pad	3	Dynamic Area
08:30 - 18:30	C E	Practice Track / Engine Test	3	Dynamic Area
09:00 - 10:00	C D E	Design Review	7	Marquee Above Pits
09:00 - 12:00	C D E	Cost Finals	1	BW Tower 4.floor
09:00 - 17:00	D	Emergency Brake System (EBS) Test*	3	Dynamic Area
09:00 - 18:00	C D E	FSG Academy On Site	11	South Stand
09:30 - 13:30	D	Acceleration	12	Start/Finish Line
10:00 - 12:00	C D E	Design Feedback: Judges available	7	Marquee Above Pits
12:00 - 12:45		Press Guided Tour	1	Assembly at entrance BW Tower
12:30 - 14:00	D	Practice Track	3	Dynamic Area
13:00 - 14:00		VIP & Press Reception	1	BW Tower 5.floor
13:00 - 18:00	C D E	Technical Inspections (A, D, E, M & P), Tilt, Rain, Noise, Brake*	2+3	Charging Tent, Dynamic Area
14:00 - 18:30	C E	Practice Track	3	Dynamic Area
14:00 - 19:00	C D E	Event Control	5	Event Control
14:30 - 19:00	C E	Acceleration	12	Start/Finish Line
15:30 - 15:55	D	Autocross Course Walk	3	Dynamic Area
16:00 - 19:00	D	Autocross	3	Dynamic Area
19:30 - 22:00	C	Engineering Design Finals (not public)	6	FSG Forum

* on request

Schedule 2019

Sat, 10th of August

06:00 - 22:00	D E	Charging Tent available	2 Charging Tent
06:00 - 23:59	C D E	Pits available	8 Pits
07:15 - 12:30	C D E	Event Control	5 Event Control
07:15 - 18:00	C D E	Ticket Centre	14 Ticket Centre
07:30 - 07:50	C D E	Team Briefing	7 Marquee Above Pits
08:30 - 12:30	D	Trackdrive	3 Dynamic Area
08:30 - 18:30	C D E	Technical Inspections (A, D, E, M & P), Tilt, Rain, Noise, Brake*	2+3 Charging Tent, Dynamic Area
08:30 - 19:00	C E	Practice Track / Engine Test	3 Dynamic Area
10:00 - 14:00		Worldwide Formula Student Officials Meeting	1 BW Tower 4.floor
13:15 - 13:45	C E	Autocross Course Walk	3 Dynamic Area
14:00 - 19:00	C D E	Event Control	5 Event Control
14:00 - 19:30	C E	Autocross	3 Dynamic Area
19:30 - 20:30	C D E	Free BBQ powered by VW Group & AID	0 Venue
21:00 - 22:30	C D E	Awards Ceremony - Part I	7 Marquee Above Pits

Sun, 11th of August

06:00 - 17:00	C D E	Recreation Tent available	10 Recreation Tent
06:00 - 19:00	C D E	Pits available	8 Pits
06:00 - 19:00	D E	Charging Tent available	2 Charging Tent
07:15 - 12:30	C D E	Event Control	5 Event Control
07:15 - 18:00	C D E	Ticket Centre	14 Ticket Centre
07:30 - 07:50	C D E	Team Briefing	7 Marquee Above Pits
08:00 - 08:30	C E	Endurance Course Walk	3 Dynamic Area
08:30 - 15:00	C E	Practice Track / Engine Test	3 Dynamic Area
08:45 - 16:00	C E	Endurance	3 Dynamic Area
12:00 - 19:00	C D E	Dismantling of Pits	8 Pits
14:00 - 19:00	C D E	Event Control	5 Event Control
20:00 - 21:00	C D E	Awards Ceremony - Part II	7 Marquee Above Pits
21:00 - 23:59	C D E	MAHLE-Party	7 Marquee Above Pits

Abbreviations
CV - Internal Combustion Engine Vehicle, DV - Driverless Vehicle, EV - Electric Vehicle
Technical Inspections (A, D, E & M): Accumulator-, Driverless-, Electrical- & Mechanical Inspection

* on request

STATUS/STAND: 10.07.2019

Guided Tours

Exploring Formula Student Germany by yourself or on a Guided Tour

Welcome to Formula Student Germany. To help you make the most of your visit, we have prepared a tour for visitors, press and sponsors. You can follow the tour by following the numbered signs across the event site (see map above). If you wish, for a more personal experience, you can also sign up to be guided by one of our experienced tour guides.

Registering for a guided tour

If you would like to sign up for a guided tour, please head to the counter in the FSG forum, where you will be able to get more information on the timetable for the daily tours.

Exploring on your own

The information signs are numbered 1 to 11. Following them in order will take you from the large dynamic area to the technical inspection and then on to the pit lane. Along the way you will learn about the history of the competition as well as the different competitions running in parallel (Combustion, Electric, Driverless). Don't be shy to ask team members anything you would like to know about their car, however, please remember they are participating in a competition, so make sure not to hinder them! From the pit lane, the tour takes you back to the large dynamic area. The tour will finish back at the FSG Forum, where you will be able to learn more about the future of the FSG competition.

Entdecken Sie die Formula Student Germany auf eigene Faust oder als geführte Tour

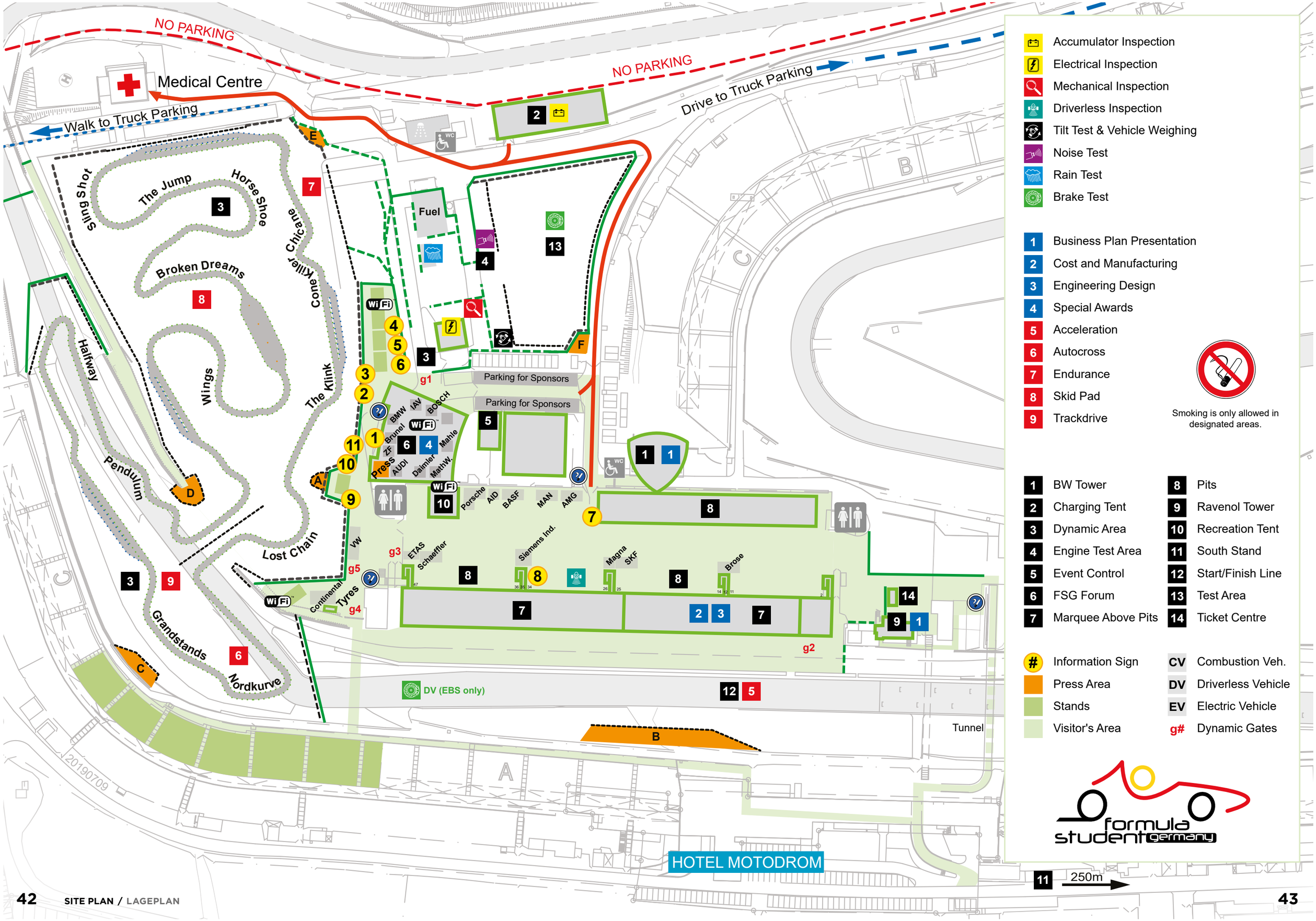
Herzlich Willkommen bei der Formula Student Germany! Um das Beste aus Ihrem Besuch zu machen, haben wir verschiedene Touren für Besucher, Presse oder Sponsoren vorbereitet. Die Tour verläuft entlang nummerierter Event-Stationen, quer über das Wettbewerbsgelände (siehe Karte). Für eine noch persönlichere Erfahrung können Sie sich gerne für eine geführte Tour bei einem unserer erfahrenen Tourguides anmelden.

Registrierung für eine geführte Tour

Wenn Sie sich für eine Führung anmelden möchten, wenden Sie sich bitte an den Counter im FSG Forum. Dort bekommen Sie weiterführende Informationen über die Uhrzeiten der täglichen Führungen.

FSG auf eigene Faust

Wenn Sie den Schildern der Reihe nach folgen (1-11), gelangen Sie vom großen fahrdynamischen Bereich (Dynamic Area) über die technische Abnahme (Technical Inspection) in die Boxengasse (Pit Lane). Auf dem Weg werden Sie einiges über die Geschichte des Events sowie die unterschiedlichen parallel stattfindenden Wettbewerbe (Combustion, Electric und Driverless) in Erfahrung bringen können. Nutzen Sie die Gelegenheit und stellen den Teammitgliedern gerne jede Frage, die Ihnen auf der Seele brennt. Vergessen Sie dabei aber bitte nicht, dass sich die Studierenden im Wettkampf befinden und nicht behindert werden sollten. Von der Pit Lane führt die Tour zurück zum großen fahrdynamischen Bereich und endet am FSG Forum. Hier angekommen, warten noch weitere Informationen zur Zukunft der Formula Student Germany auf Sie.


NO PARKING
NO PARKING
Medical Centre
Walk to Truck Parking
Drive to Truck Parking
Sling Shot
The Jump
Horse Shoe
Chicane
Killer Cone
Broken Dreams
Halfway
Wings
The Klink
Pendulum
Lost Chain
Grandstands
Nordkurve
Fuel
Parking for Sponsors
Parking for Sponsors
Press
Tunnel
DV (EBS only)
HOTEL MOTODROM
20190709
BMW
iAV
BOSCH
Brunel
ZF
AUDI
Daimler
MathW.
Mahle
Porsche
AID
BASF
MAN
AMG
VW
ETAS
Schaeffler
Siemens Ind.
Magna
SKF
Brose
Continental
Tyres
Accumulator Inspection
Electrical Inspection
Mechanical Inspection
Driverless Inspection
Tilt Test & Vehicle Weighing
Noise Test
Rain Test
Brake Test
1 Business Plan Presentation
2 Cost and Manufacturing
3 Engineering Design
4 Special Awards
5 Acceleration
6 Autocross
7 Endurance
8 Skid Pad
9 Trackdrive
Smoking is only allowed in designated areas.
1 BW Tower
2 Charging Tent
3 Dynamic Area
4 Engine Test Area
5 Event Control
6 FSG Forum
7 Marquee Above Pits
8 Pits
9 Ravenol Tower
10 Recreation Tent
11 South Stand
12 Start/Finish Line
13 Test Area
14 Ticket Centre
Information Sign
Press Area
Stands
Visitor's Area
CV Combustion Veh.
DV Driverless Vehicle
EV Electric Vehicle
g# Dynamic Gates
formula student germany
11 250m

The Volunteers of FSG

Die Ehrenamtlichen der FSG

It takes around 450 volunteers to bring Formula Student Germany to life every year. The team of volunteer's function like a well-oiled machine, tackling the ever-growing challenges of the annual event with honed skill and passionate dedication. The volunteers are divided into different groups according to their skill set.

For example, there are the scrutineers, the judges, the red shirts and the white shirts. These are people who handle the many tasks of planning, organising and running the event, as well as helping out and answering questions. The colour of their shirt will tell you what their role is at FSG.

Über 450 ehrenamtliche Helfer sind Jahr für Jahr an der Organisation und der Umsetzung der Formula Student Germany beteiligt. Wie eine gut geölte Maschine meistern sie mit Leidenschaft und Engagement die stetig wachsenden Herausforderungen, die das Event jedes Jahr aufs Neue mit sich bringt. Das eingespielte Team setzt sich aus verschiedenen Funktionsbereichen zusammen.

So gibt es beispielsweise die Scrutineers, die Juroren, die Red-Shirts und die White-Shirts, welche die Vielzahl an Aufgaben beim Planen, Organisieren und bei der Umsetzung vor Ort bewältigen und welche stets für Fragen rund um das Event zur Verfügung stehen. Anhand der Farbe ihres Shirts kann man leicht ihre Rolle bei der FSG erkennen.

white shirts

The **white shirts** are in charge of the yearlong task of planning the event and of ensuring that everything falls into place as it should on race day. They are the “go-to” people for sponsors, press, participants and visitors and they ensure that the competition runs without a hitch.

Die **White-Shirts** sind für die ganzjährige Planung der Veranstaltung und deren reibungslose Umsetzung an den Renntagen verantwortlich. Sie sind Ansprechpartner für Sponsoren, Medienvertreter, Teilnehmer und Besucher und stellen sicher, dass der Wettbewerb ohne Komplikationen verläuft.

red shirts

The **red shirts** have jurisdiction over event control and event support. The support team takes care of building up and taking down of every physical transformation that turns the Hockenheim Ring into Formula Student Germany. We need them to ensure that the event runs smoothly. They also act as the track marshals during dynamic events.

They are in charge of the event control team, serving as intermediaries between visitors, team members, sponsors and press, so that nobody on the FSG grounds can get left lost or stranded. The **red shirts** are the largest group of volunteers at FSG and are the ones who will do what it takes to overcome any challenges that might be faced during the event.

Die **Red-Shirts** sind für die Bereiche „Event Control“ und „Event Support“ zuständig. Das Support-Team kümmert sich um den Auf- und Abbau aller infrastrukturellen Bestandteile, die den Hockenheimring in die Formula Student Germany verwandeln. Sie sind die fleißigen Helfer, welche sicherstellen, dass das Event ohne Störungen verläuft. Darüber hinaus kommen die ehrenamtlichen Helfer als Streckenposten während der dynamischen Disziplinen zum Einsatz.

Zudem besetzen sie das Event Control-Team und bilden damit die Schnittstelle zwischen Besuchern, Teammitgliedern, Sponsoren und Medienvertretern. Sie sorgen dafür, dass niemand hilflos auf dem Gelände zurückbleibt. Die **Red-Shirts** stellen insgesamt die größte Gruppe ehrenamtlicher Helfer bei der FSG dar. Nur durch ihre Hilfe ist es überhaupt möglich, die vielseitigen und mitunter spontanen Herausforderungen während des Events zu meistern.

blue shirts

Since FSG is essentially a design competition, a team’s scoring in the static disciplines is a big factor in its overall standing. It is the job of the judges in their blue shirts to render these scorings. They look at the design, manufacturing quality and cost planning; they consider the economics of the project and whether the business plan is convincing. For this, they utilize their professional expertise, indispensable honesty and constructive criticism. Their feedback has resulted in the extensive improvements from the teams over the past years.

Da es sich bei der FSG im Wesentlichen um einen Konstruktionswettbewerb handelt, tragen die statischen Disziplinen in erheblichem Maße zur Gesamtwertung bei. Die in **blau gekleideten Juroren** bewerten die Entwicklung, Fertigungsgüte sowie das Kostenbewusstsein der Studenten. Sie betrachten die Wirtschaftlichkeit des Gesamt - projektes ebenso wie die Präsentation der detaillierten Geschäftspläne und nutzen dabei ihre Expertise und unvergleichlich ehrlich sowie konstruktive Kritik, welche bereits in vergangenen Jahren positiv zur Weiterentwicklung der Studenten beigetragen hat.

scrutineers

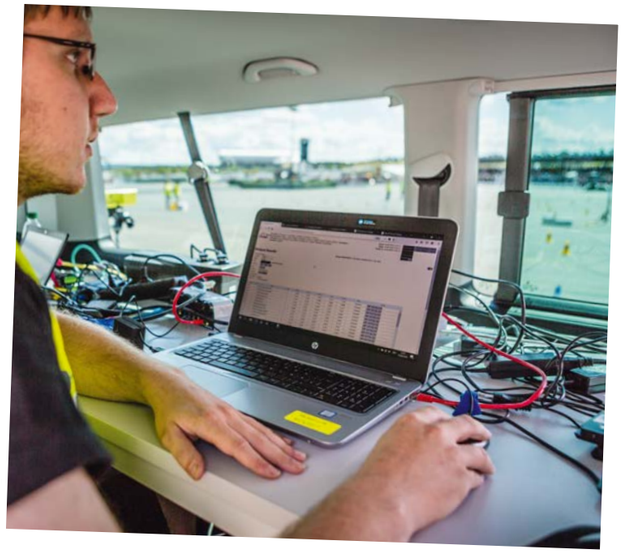
The **scrutineers** - the folks in **green** - are there to guarantee that all the vehicles are safe. They accomplish this by meticulously checking the cars for potential safety hazards and patiently assisting the teams with any technical problems (at the event as well as throughout the year). A team may not participate in the dynamic events with - out receiving the go-ahead from our **green-shirted** volunteers.

Die **Scrutineers** – die „Leute in **Grün**" – stellen die Sicherheit aller teilnehmenden Fahrzeuge sicher. Sie überprüfen die Boliden der Teilnehmer akri - bisch genau auf etwaige Sicherheitsmängel und stehen den Teams bei technischen Problemen mit ihrer Expertise helfend zur Seite (sowohl am Event selbst, wie auch während des Jahres). Als Team darf man ohne die Freigabe unserer **grün gekleideten** Helfer nicht an den dynamischen Disziplinen teilnehmen.

IT experts

Behind the scenes we have the **IT experts**, who are tasked with timekeeping during the dynamic disciples as well as ensuring that all teams are given a fair and equal assessment. Not only this, but it is thanks to them that everyone at FSG can enjoy a high-speed Internet connection through - out the entire event site!

Ebenfalls oft im Verborgenen arbeiten unsere in schwarz gekleideten **IT Spezialisten**, welche für die Zeitnahme bei den dynamischen Disziplinen verantwortlich sind und sicherstellen, dass jedes Team eine faire und gerechte Bewertung erhält. Doch nicht nur das: Dank ihnen steht allen Anwesenden bei FSG über das gesamte Eventgelände eine Highspeed-Internet-Verbindung zur Verfügung!



media

Finally, we have the FSG **media team**, whose contributions through their video and image materials of exceptional quality and creativity, allow us to relive the most stunning and unforgettable moments of the event again and again, long af - ter the smoke from the tires of the race cars has cleared.

Zu guter Letzt leistet das ebenfalls in **schwarz gekleidete Media-Team** in Form von Videos und Bildern seinen Beitrag, und sorgt mit beeindruckender Kreativität und Qualität dafür, dass wir die schönsten und unvergesslichsten Momente des Events auch lange nachdem sich der letzte Rauch qualmender Reifen verzogen hat, noch einmal durchleben können.

It is our great pleasure to prepare a week of incomparable FSG excitement and entertainment for visitors and sponsors alike, for veteran participants and for those who are entering the event for the first time. This year, we are happy to once again be at your service with advice and assistance!

Es ist uns Jahr um Jahr ein großes Vergnügen diese Woche an unvergleichbarer FSG Begeisterung und Unterhaltung für Besucher und Sponsoren gleichermaßen wie für langjährige oder auch neuen Teilnehmern auf die Beine zu stellen. Und so freuen wir uns, Ihnen auch in diesem Jahr wieder mit Rat und Tat zur Seite zu stehen.

Formula Student Germany Team 2019

CHRISTIAN AMERSBACH
OT (FS-Driverless)

SARAH BATTIGE
OT (Electrical Inspection)

CHRISTOPH BEISSWANGER
OT (Mechanical Inspection)

MATTHIAS BRUTSCHIN
OT (Event Support)

BARBARA DECKER-SCHLÖGL
OT (Event Support)

MATHIAS GEBHARDT
OT (Driverless Inspection)

HINRICH GREFE
OT (Event Support)

STEFFEN HEMER
EC (FS-Driverless)

TANJA HOFMANN
OT (Security)

RAINER KÖTKE
Board (Finance), EC (Dynamics)

ANKE LACHMANN
OT (VIP Lounge & Culina)

PHILIPP BANDOW
OT (Special Tasks)

KONRAD BAYER
OT (Event Support)

RAPHAELA BIHR
OT (Business Plan Presentation)

MATTHÄUS DECKER
OT (Event Support)

SIMON DENSBORN
OT (Electrical Inspection)

NICOLE GEIER
OT (Registration & Ticket Centre)

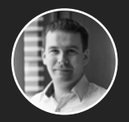
SVEN GRUNDNER
OT (Back Office)

JUDITH HENZEL
OT (Special Awards)

SEBASTIAN HOPPE
EC (Statics) & OT (Cost Event)

JOHANNES KRATZEL
EC (Event Support)

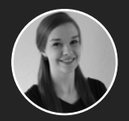
PETER LEIPOLD
OT (Design Event)



FABIAN LIESCH
OT (IT & TK)

STIG MEJLBJERG
Dynamics

KONRAD PAULE
EC (FS-Academy) & Pit Marshal



LEA PISSARRECK
OT (Event Control)

TORSTEN RILKA
OT (Scoring & VSV)

BASTIAN SCHÄFER
Dynamics

JOCHEN SCHMIDT
OT (Dynamics)

KARSTEN STAMMEN
OT (Dynamics)

ESTHER TROMP
OT (Event Manager Assistant)

LUDWIG VOLLRATH
Board (External Relations)

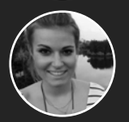
DANIEL MAZUR
Board (Management)

ROB OPDAM
EC (Technical Inspection)

LENA PAULE
OT (Communications)

JOST PHILIP PÖTTNER
OT (Design Event)

FRANK RÖSKE
Board



CATHARINA SCHIFFTER
OT (Guided Tours & Communications)

SEBASTIAN SEEWALDT
EC (Rules) & Pit Marshal

MARTIN STOLLBERGER
OT (Driverless Inspection)

JET TUITERT
OT (Mechanical Inspection)

WiFi: Hockenheimring
Code: 19322019

Judges 2019

Autonomous Design & Engineering Design

AERTS, Joris / **AHOLA**, Mikko / **AHRENHOLZ**, Benjamin / **ALAKSHENDRA**, Veer / **ANDERSON**, Leigh / **BACHAR**, Abdelaziz / **BÄNZIGER**, Timo / **BEYER**, Cornelia / **BREINLINGER**, Philipp / **BREMKAMP**, Joerg / **CARLESS**, Owen / **CRAMER**, Stephanie / **CZERWIONKA**, Paul / **DECKERS**, Jean-Noel / **DENCKER**, Peter / **DITTRICH**, Rudolf / **DÖLLE**, Norbert / **EELMAN**, Stephan / **ENDER**, Stefan / **ENZWEILER**, Markus / **EVANS**, David / **EWERT**, Sebastian / **FISCHER**, Florian / **FISCHER**, Florian / **FLEMMING**, Erik / **FÖLLMER**, Patrik / **FRIES**, Benedikt / **GARDUNO**, Luis / **GEMEINHARDT**, Sascha / **GINETE**, Joao / **GOELLNER**, Julian / **GOY**, Florian / **GRAF**, Michael / **HAHN**, Christoph / **HAHN**, Rene / **HAHNEMANN**, Kristina / **HALSDORF**, Georges / **HANIGK**, Martin / **HEIDRICH**, Stephan / **HENNINGS**, Thomas / **HERRMANN**, Andreas / H**ICKSON**, Alex / **HO**, Victor / **HÖLZGEN**, Andre / **HOMOCEANU**, Silviu / **KÄCHELE**, Andreas / **KALANKE**, Philipp / **KERBER**, Michael / **KLINK**, Holger / **KOHL,** Daniel / **KOHNS**, Lukas / **KÖNIG**, Thomas / **KOOLMANN**, Carsten / **KOPANAKIS**, Alexander / **KORTEN**, Mike / **KRAMER**, Jochen / **KRAUS**, Mike / **KUFER**, Dominik / **LATTKE**, Benedikt / **LECHTHALER**, Albrecht / **LENZ**, David / **LIEBST**, Fabian / **LOPEZ**, Jose / **LUSTIG**, Frank / **MARTIN**, Joe / **MATA**, Núria / **MILKE**, Burkhard / **MISSLER**, Christian / **MONTALAND**, Patrice / **MUEMMLER**, Rainer / **MÜLLER**, Sebastian / **MUR**, Lukas / **MUSCHIK**, Enzo / **MUUSERS**, Daniel / **NAIK**, Amol / **NOWICKI**, Daniel / **OEHLER**, Christoph / **OEHLER**, Claus / **OSTERTAG**, Ralf / **PAIER**, Michael / **PETRY**, Markus / **PETZ**, Andreas / **PHERSSON**, Luke / **PIECYK**, Thomas / **PITTS**, James / **PLAKHOTNICHENKO**, Andrei / **PLOOG**, Mareike / **RAAIJMAKERS**, Marvin / **RAIHAN**, Md Dinar Ibn / **REETZ**, Volker / **RETTNER**, Cornelius / **RICHTER**, Christian / **ROUELLE**, Claude / **RUHDORFER**, Benedikt / **SACHSE**, Mick / **SAITO**, Takuya / **SATTLER**, Steve / **SAYOVITZ**, Steve / **SCHÖNBERG**, Christopher / **SCHROTH**, Hans / **SEIB**, Timo / **SENGSTOCK**, Harald / **SERNÉ**, Ton / **SITE**, Triantafyllia-Maria / **STABROTH**, Waldemar / **STARR**, Rodrigo / **STELZIG**, Michael / **STOLLE**, Ludwig / **TESCH**, Anke Martina / **TEUFEL**, Simon / **TUEZKOE**, Andras / **VAN MOORSEL**, Len / **VÖLKL**, Timo / **WEBER**, Martin / **WEBER**, Thomas / **WEIK**, Steffen / **WEINGART**, Robert / **WITTICH**, Mark / **WÖHLER**, Konrad / **WUEBBOLT-GORBATENKO**, Benjamin / **WUNSCHHEIM**, Lukas / **ZEISLER**, Jöran

Business Plan Presentation

BIHR, Bernhard / **BJEKOVIC**, Robert / **BRUNNER**, Daniela / **BURKHARDT**, Thomas / **D'HAEN**, Jonas / **EHMKE**, Christian / **EICKHOFF**, Mathias / **ESSER**, Klaus / **FAHR**, Alexander / **FERKEN**, Reiner / **FUEST**, Florian / **GAIER**, Michael / **GREINER**, Alexander / **HAHN**, Thomas / **HAYN**, Bernhard / **HEIDEMEYER**, Peter / **HELDNER**, Jens / **HERBERTH**, Helena / **HERRMANN**, Jesko / **HODGKINSON**, Philip / **HODGKINSON**, Raymond / **JUNG**, Christoph / **KAHLE**, Philipp / **KESSENICH**, Martin / **KINSKI**, Andreas / **KLUG**, Jens / **LANGE**, Stephan / **LEYH**, Michael / **MAIDORN**, Gerd / **MEZGER**, Henning / **MOREL**, Romain / **MUELLER**, Andreas / **NÄTHER**, Sylvio / **NIEDWOROK**, Christian / **NIEMEYER**, Reinhard / **ORTWEIN,** Valerie / **PETERS**, Jan / **PORSCH**, Stefan / **PRINZ**, Michael / **RICHTER**, Svenja / **SCHNEIDER**, Tom / **SLEDZINSKI,** Timo / **STOCKHEIM**, Andreas / **STRASSER**, Carina / **TABATABAI**, Stefan / **ULLERICH**, Stefan / **VADEHRA**, Bernhard Prem / **WEINELT**, Dieter / **WOLF**, Alexander

Cost and Manufacturing

BERTHOLD, Maria / **BERTRAM**, Michael / **BHARTI**, Devesh / **BITTNER**, Konrad / **BRAUN**, Roman / **BRENDEL**, Sebastian / **BRONTSCH**, Daniel / **BUOB**, Manuel / **DAHLKE**, Michael / **DONDO**, Paolo / **EGENTER**, Vera / **GIORGIONI**, Carlo / **GÖHNER**, Lara / **GRUNDNER**, Harald / **HAGL**, Markus / **HANFELD**, Stefanie / **HAUB**, Dennis / **HERTH**, Martin / **KLEIN**, Christian / **KOCH**, Richard / **KÜHNE**, Alexander / **KURZEN**, Michael / **LAUCH**, Kurt / **LEHR**, Mario / **MEIER**, Peter / **MERKL**, Julia / **MÜLLER**, Karsten / **NEUMANN**, Bernd / **PÄLMER**, Reinhard / **PETRICH**, Anja / **PILTZING**, Roger / **PRATI**, Giovanni / **REBER**, Franziska / **SCHIEDEK-JACHT**, Jan / **SCHLEPPI**, Roman / **WAFFLER**, Florian / **WANNEMACHER**, Christoph / **WIELSCH**, Stefan / **WILDEBOER**, Dominic / **WÖRZ**, Wolf

Redshirts and Scrutineers

2019

Redshirts

ABDELMAKSOUD, Heba / **ABDELWAHAB**, Kareem Gamal / **AST**, Maximilian / **BACH MELLERGAARD**, Simon / **BAGER**, Magnus / **BALDYGA**, Julia / **BARRABAS**, Sascha / **BAUFELD**, Aaron / **BHASKAR**, Narendran / **BOLÓN BRUN**, Natalie / **BORRMANN**, Daniel / **CALVO SERRA**, Victor / **CARNICERO CORTÉS**, Àlex / **DE SANTOS ROVIRA**, Pol / **DEMELE**, Antonia / **DEMEURICY**, Paul / **DESINGER**, Karina / **DIETRICH**, Franziska / **DINESH KUMAR**, Satyavarapu / **EHRLICH**, Jonathan / **ELMASRY,** Yehia / **FINDEISEN**, Jan / **FLEMMING**, Erik / **FREUDENBERG**, Liz / **FREY**, Dennis / **GALBANY MERCADER**, Marti / **GRASSHOFF**, Anna / **GRUNENBERG**, Kathrin / **HAUPENTHAL**, Katharina / **HEINZ**, Nikolaus / **HEUTER**, Pascal / **HOFMANN**, Peter / **JANSSEN**, Nele / **JEITNER**, Timo / **KAMBACH**, Sam / **KLEIN**, Christian / **KOHLER**, Fabian / **KOVÁCS**, Dóra / **KRAUSE**, Samuel / **KRÜGER**, Stephan / **KULESZ**, Dawid / **LAFOZ**, Mireia / **LANSNICKER-DIETRICH**, Bärbel / **LERINGER**, Nora / **LESCHNIEWSKI**, Ann-Catrin / **LIEDTKE**, Diana / **LILIE**, Ky Nam / **LORENZEN**, Morten / **MAJ**, Lukasz / **MARTYNUS**, Oliver / **MCCARRISON**, Joe / **MÍNGUEZ BARBERÁ**, Marta / **MÜLLER**, Gábor / **MÜLLER,** György / **MÜLLER**, Lars / **NGUYEN**, Thuy / **PANDEY**, Rahul / **PÉREZ MENDOZA**, Ana Cristina / **PETERS**, Jannik / **PISSARRECK**, Mona / **PLANA GARCÍA**, Victoria / **POLT**, Markus / **RAO**, Mandar / **SABATÉ ARROYO**, Gerard / **SARRÓ VERDÚ**, Alejandro / **SAYOVITZ**, Steve / **SCHNEIDER**, Maximilian / **SCHWARZER**, Johannes / **SITE**, Triantafyllia-Maria / **STEFANUTTI**, Renan / **SUTHAR**, Dhruv / **TEIXIDÓ SANGENÍS**, Carlota / **TEZOTO FIGUEIROA**, Ana Clara / **THALHÄUSER**, Dana / **TÓTH**, Álmos / **TRANTA**, Bjoern / **ULRICH**, Denise / **URPI**, Oriol / **VAN SCHIE**, Sebastiaan / **VAUDLET**, Oliver / **WAGNER**, Vivien / **WEIEN**, Mira / **WEINGART**, Robert / **WEITZ**, Klara / **WIEDEMANN**, Jana / **WIEDEMANN**, Timo / **WILDEBOER**, Dominic / **WINKELMANN**, Daniel / **ZIPS**, Stefanie

Scrutineers

ANDREWS, Marie-Lene / **BÄUERLEIN**, Sonja / **BERNINGHAUS**, Patrick / **BISCAMPS DALMAU**, Josep / **BRECHTMANN**, Nick / **BÜSSING**, Thomas / **CLAUSSNITZER**, Eric / **CLEMENS**, Oliver / **DIETZEL**, Michael / **FETZER**, Matthias / **GIEST**, Carl Johann / **GOLLOWITZ**, Lena / **GÖTZ**, Oliver / **GROH**, Jonas / **GUMBIN**, Ivan / **HAEDECKE**, Tobias / **HAUPTMANN**, Klara / **HÖRSCH**, Moritz / **JUX**, Benedict / **LEEB,** Matthias / **LORENZ**, Martin / **LUBKOWITZ**, Victor / **MAUL**, Ralf / **MUSCHALLE**, Carsten / **OCHSENDORF**, Nils / **OEHMKE**, Martin / **PLETSCHKE**, Tobias / **RIES**, Eveline / **RÖMMELMAYER**, Christopher / **SCHALL**, Marcel / **SCHIMPITZ**, Christian / **SCHMUCK**, Lennart / **SCHOLZ**, Juergen / **SCHÖNEWOLF**, Stefan / **SCHUCKMANN**, Dennis / **STEINFURTH**, Ulf / **STEMMLER**, Alexander / **THEOFANIS**, Konstantinos / **THOMASSEN,** Kevin / **TIEMANN**, Maik / **TRESP**, Benjamin / **VALENCIA SANCHEZ**, Ivan / **VANDENHENDE**, Wouter / **VELZ**, Nicolas / **WAGNER**, Florian / **WICHTERICH**, Tobias / **WISCHNEWSKI**, Alexander / **WITTICH**, Mark / **WRAGE**, Christian

Communications & Media, Timekeeping & IT 2019

Communications & Media

AUGUSTO MEHL, Carolina / **BECKER**, Nathalie / **BRAUSER**, Austin / **DE**, Shidhartha / **DE JONG,** Stef / **DEMETZ**, Martin / **GOSALA**, Nikhil Bharadwaj / **HÄRTL**, Jonas / **HEGEDUS**, Miki / **JEHLE**, Jonas / **KLEIN**, Sinan Felix / **MARCHEWICZ**, Christoph / **MARU**, Vivek / **PAPENHUIJZEN**, Thijs / **PETERS**, Oliver / **PORTEE**, Philipp / **RANKIN**, Alastair / **RITTER**, Kristina / **SCHINDLER**, Corvin B. / **SCHULZ**, Elena / **STACH**, Theresa / **STAUDTE**, Moritz / **STRATMANN**, Jennifer / **URPI**, Andrea

Timekeeping & IT

GARLICHS, Keno / **GERNERT**, Björn / **HAUFFE**, Björn / **MICHALOWSKI**, Lars / **REIMERS**, Dennis / **SCHLICHTER**, Jan / **SCHRÖDER**, Yannic / **STAMPRATH**, Christoph / **TIMMERMANS**, Tristan / **VAN BALEN**, Johannes / **VAN LEEUWEN**, Tom / **VAUDLET,** Philipp

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Design
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Photos*
Formula Student Germany:
Maximilian Böhm, Shidhartha De, Karol Hajek, Vivek Maru, Oliver Peters, Alastair Rankin, Elena Schulz, Daniel Sturm & Wan Zhao
* if without reference; excluding team profiles

Team profiles
Text and pictures provided by the teams (July 2018)

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Team-Profile
Text und Bilder bereitgestellt von den Teams (Juli 2018)

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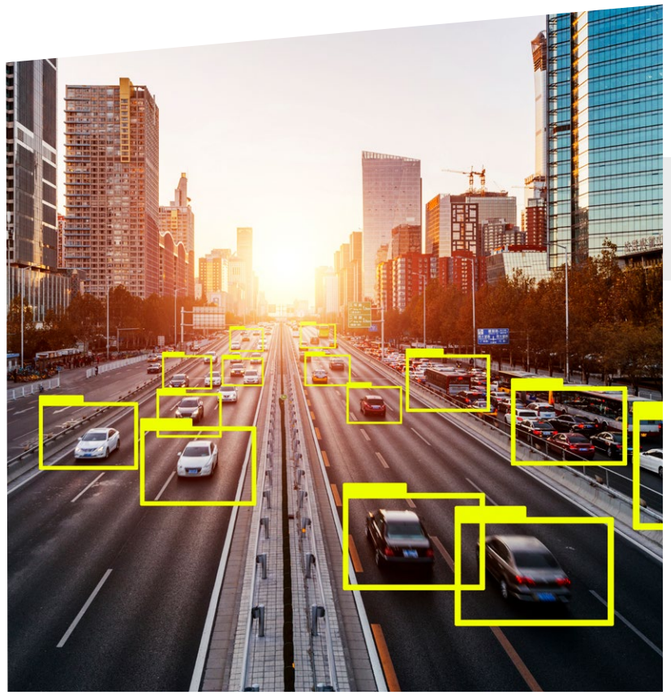


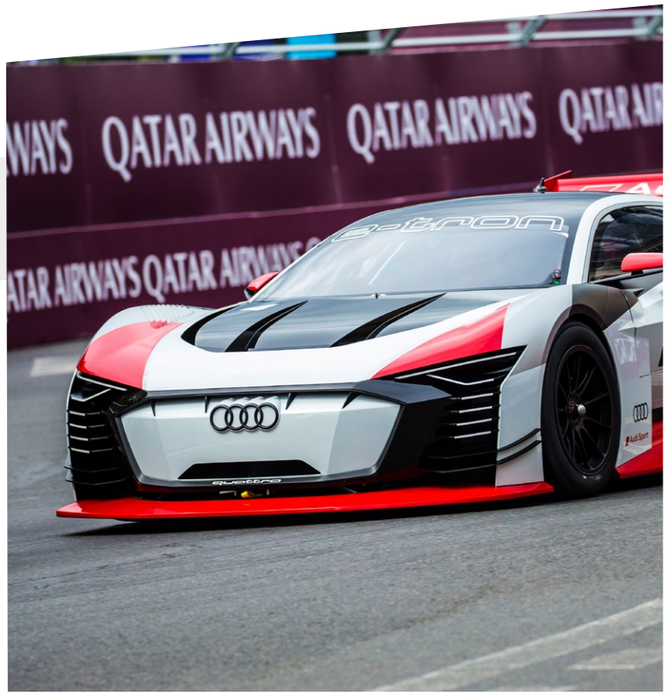
autonomous intelligent driving

ALEXANDRE HAAG
CTO, Autonomous Intelligent Driving GmbH

We at AID are bringing together the world's top software, robotics, AI and automotive talents to create a future where autonomous driving is embraced by humans. We believe that our technology will become the backbone of a universal self-driving system. That is why we are looking for the world's most unique minds to help us teach cars about people.

Wir vereinen Experten auf den Gebieten Software, Robotik, KI und Automotive, um eine Zukunft zu gestalten, in der das autonome Fahren einen festen Platz im Leben der Menschen einnimmt. Unsere Technologie wird zum Rückgrat eines universellen autonomen Fahrsystems. Wir suchen weltweit Experten, die uns helfen, Autos etwas über Menschen beizubringen.

DR. JOCHEN HABERLAND
Head of Recruiting / HR International, AUDI AG



The fascination of Formula Student Germany: to us, being there means being part of a truly special atmosphere that we would not want to miss for anything. This is where we meet young, ambitious people from all over the world who are just as enthusiastic about automotive technology as we are at Audi.

Faszination Formula Student Germany: Dabei zu sein bedeutet für uns, Teil einer ganz besonderen Atmosphäre zu sein, die wir um keinen Preis missen möchten. Hier treffen wir junge und ambitionierte Menschen aus aller Welt, die von automobiler Technik genauso begeistert sind wie wir bei Audi.

BASF
We create chemistry

HANS-PETER BERINGER
Vice President, Head of Business Management Transportation, BASF SE

BASF's engineering plastics are widely used in the automotive industry for example in vehicles range from bodywork and chassis to interior trim and engine components. BASF 3D Printing Solutions specializes on Additive Manufacturing and will present this year's "Best Use of 3D Printing Award 2019". Good luck to all teams!

Die BASF bietet eine Vielzahl von Kunststofflösungen für die Automobilindustrie an, angefangen beim Karosseriebau, über das Fahrwerk bis hin zu Innenausstattung und Motoranbauteilen. BASF 3D Printing Solutions ist auf Additive Fertigung spezialisiert und vergibt den diesjährigen „Best Use of 3D Printing Award 2019". Wir wünschen allen viel Erfolg.

BMW GROUP

Rolls-Royce Motor Cars Limited

OLIVER FERSCHKE
Head of HR Marketing BMW Group

The BMW Group is very enthusiastic about its involvement in the Formula Student Germany. The challenges the teams face during the course of a season are also always faced by the BMW Group. We are, therefore, pleased when qualified participants from all over the world gain their first practical experience in the BMW Group.

Mit großer Begeisterung engagiert sich die BMW Group in der FSG. Die Herausforderungen, mit welchen sich die Teams im Laufe einer Saison konfrontiert sehen, beschäftigen auch uns bei der BMW Group immer wieder. Daher freuen wir uns, wenn qualifizierte Teilnehmer aus dem In- und Ausland ihre ersten Praxis-Erfahrungen in der BMW Group sammeln.

BOSCH
Invented for life

HEIDI STOCK
Human Resources Management – Talent Acquisition and Diversity

At Bosch, our vision is to transform our products into smart assistants for all humans by using artificial intelligence – as we do with autonomous driving. Behind this vision stand associates with individual competencies, mindsets and experiences – as diverse, as the teams of FSG. That's why we have supported FSG for many years.

Unsere Vision bei Bosch ist, mit künstlicher Intelligenz unsere Produkte zu intelligenten Assistenten der Menschen zu machen. Wie beim automatisierten Fahren. Dahinter stecken Mitarbeiter*innen mit individuellen Kompetenzen, Denkweisen und Erfahrungen – so vielfältig, wie die Teams der FSG, die wir jedes Jahr gerne unterstützen.

brose
Excellence In Mechatronics

MARTIN SCHNEIDER
Vice President Recruitment and Marketing Brose Group

We offer dedicated students who are technology enthusiasts the chance to take on responsibility at an international company and actively shape the future of the automobile. At FSG, we meet people who have what it takes to be successful: commitment, team spirit, and the will to win!

Wir bieten engagierten und technikbegeisterten Studierenden die Möglichkeit, in einer internationalen Firma Verantwortung zu übernehmen und die Zukunft des Automobils aktiv mitzugestalten. Bei der FSG treffen wir Menschen, die alles das mitbringen, was es braucht um erfolgreich zu sein: Einsatzbereitschaft, Teamgeist und den Willen zu gewinnen.

Brunel

MARKUS ECKHARDT
General Manager

Brunel has been supporting the FSG since 2006. The aspiring engineers are especially important to us as they are full of imagination, passion and team spirit. Like us, they strive for technological advances in the automotive industry and together, we share the passion for realizing multifaceted engineering projects.

Bereits seit 2006 unterstützt Brunel die FSG. Denn die angehenden Ingenieurinnen und Ingenieure sind voller Ideenreichtum, Begeisterung und Teamgeist und leben den technologischen Fortschritt der Automobilindustrie ebenso wie wir. Gemeinsam teilen wir die Leidenschaft für die Umsetzung vielfältiger Projekte im Engineering.

Continental
The Future in Motion

BARBARA TEXTER
Head of Employer Branding Germany, Continental AG

For almost 150 years, Continental has been working on motorized individual mobility of the future. In order to continue this success story, we are constantly looking for qualified technical and management personnel. Top talent of the kind we are seeking can be found at the Formula Student competition.

Seit fast 150 Jahren arbeitet Continental erfolgreich an der individuellen Mobilität der Zukunft. Um diese Erfolgsstory weiterzuschreiben sind wir ständig auf der Suche nach qualifizierten Fach- und Führungskräften. Diese Toptalente finden wir beim internationalen Konstruktionswettbewerb Formula Student.

DAIMLER

DR. ANNA-MARIA KARL
Head of Global Talent Sourcing, Daimler AG

Digitalization, electric mobility, autonomous driving, shared economy – all these factors change the branch tremendously. Therefore it is even more important to support top talents and to exchange ideas with them. Because we want to develop the best products together – today and in the future. Therefore Formula Student offers a perfect platform.

Digitalisierung, Elektromobilität, autonomes Fahren, Shared-Economy – all das verändert unsere Branche wie nie zuvor. Die Förderung von Top Talenten und der direkte Austausch mit ihnen sind umso wichtiger. Denn wir wollen heute und in Zukunft gemeinsam die besten Produkte entwickeln. Die Formula Student bietet dafür eine perfekte Plattform.

ETAS

FRIEDHELM PICKHARD
President ETAS GmbH

Team spirit, commitment, passion for technology & innovation – these are the qualities that ETAS and the Formula Student teams have in common. We are feverish with our 30 teams when they show what they can do with their engineering skills, their heart and soul under the toughest conditions. We wish all teams the success to be at the forefront.

Teamspirit, Engagement, Leidenschaft für Technik & Innovation – das sind die Eigenschaften, die ETAS und die Formula Student-Teams verbinden. Wir fiebern mit unseren 30 Teams, wenn sie mit Ingenieurskunst und Herzblut unter den härtesten Bedingungen zeigen, was sie können. Wir wünschen allen Teams den Erfolg, ganz vorne mit dabei zu sein.

automotive engineering iav

CHRISTIAN WILLENBERG
Talent Acquisition & Recruitment

With over 7,500 members of staff, IAV is one of the world's leading providers of engineering services to the automotive industry. The company can look back on more than 35 years of experience in developing innovative concepts and technologies for future vehicle generations. For further information about IAV, go to www.iav.com/en/careers

IAV ist mit über 7.500 Mitarbeitern weltweit einer der führenden Engineering-Partner der Automobilindustrie. Das Unternehmen entwickelt seit über 35 Jahren innovative Konzepte und Technologien für zukünftige Fahrzeuggenerationen.
Weitere Infos zu IAV erhalten Sie über unser Karriereportal www.iav.com/karriere

GABRIELE VASIL
Manager Talent Attraction & Employer Branding Europe, Magna International

Magna's innovation and technology are transforming vehicles and the future of mobility. We are committed to supporting the next generations and the education of future automotive pioneers. We believe in the development and nurturing of bold young minds in science, engineering, and technology.

Magna verändert durch Innovationen und Technologie die Zukunft des Automobils und der Mobilität. Wir engagieren uns in der Nachwuchsförderung und der Ausbildung zukünftiger Pioniere in der Automobilindustrie. Wir glauben an die Entwicklung und Unterstützung mutiger, junger Talente vornehmlich im Ingenieurswesen, in der Wissenschaft und Technik.

MONIKA SCHMIDT
Head of Talentmanagement, New Work & Employer Branding

Respect, team spirit, determination, costumer focus and integrity - these are the corporate values that our employees experience. For ideas that inspire. For changes that move. Every day we want to overcome borders and to continually make our products that little bit better. We are at home all around the world.

Respekt, Teamgeist, Entschlossenheit, Kundenorientierung und Integrität – das sind unsere Unternehmenswerte, die wir hier bei MAN leben. Für Ideen, die begeistern. Für Veränderungen, die bewegen. Tag für Tag möchten wir Grenzen überwinden und unsere Produkte noch ein bisschen besser machen. Dabei sind wir in der Welt Zuhause

ANNE HAWKINS
MAHLE // Head of HR Marketing and Employer Branding Germany

Some of the concepts that come out of the Formula Student Event are showcases what talented and enthusiastic talents can achieve by giving them the resources they need – turning visions into innovative and convincing ideas! Our aim is to assist these aspiring engineers in achieving their goals! #StrongerTogether

Einige der Konzepte, die aus der Formula Student hervorgehen, zeigen, was ehrgeizige und begeisterungsfähige Talente erreichen können, wenn ihnen die nötigen Ressourcen gegeben werden – aus Visionen werden innovative und überzeugende Lösungen! Unser Ziel ist es, diese angehenden Ingenieure bei der Erreichung ihrer Ziele zu unterstützen!

DR. CHRISTOPH HAHN
Automotive Competition Technical Lead

Employing a Model-Based Design approach to the automotive design process enables teams to design, test, validate and share their models within one environment. Using industry-standard tools such as MATLAB and Simulink help students tackle real engineering problems. www.mathworks.com/fsg

Mit MATLAB und Simulink lösen Teams der Formula Student Germany reale, automobiltechnische Probleme. Studenten, die modell-basierte Entwicklung einsetzen, entwickeln schneller und besser. Modell-basierte Entwicklung (Model-Based Design) erlaubt Lösungen zu testen und zu validieren bevor diese im Fahrzeug eingesetzt werden. www.mathworks.com/fsg

PORSCHE

KONSTANZE MARINOFF
Director Human Resource Marketing

It's equally essential for Porsche and all Formula Student teams: To work with dedication, to fight for the best solution, day after day, to courageously explore new approaches and to face the competition with fairness and respect. We wish all participating teams exciting and successful days at the Hockenheimring.

Für Porsche, genauso wie für alle Formula Student Teams, gilt: Mit Herzblut bei der Sache sein, Tag für Tag für die beste Lösung kämpfen, mutig neue Wege gehen und sich mit sportlicher Fairness dem Wettbewerb stellen. Wir wünschen allen teilnehmenden Teams spannende und erfolgreiche Tage am Hockenheimring und freuen uns auf den persönlichen Austausch!

SCHAEFFLER

CORINNA SCHITTENHELM
Chief Human Resources Officer

Team spirit, commitment and passion for technology - these are the qualities that our employees and the Formula Student teams have in common. As a sponsor we are in close contact with the teams and support them with our know-how. The participants are gladly seen applicants, in order to join us in shaping the mobility for tomorrow.

Teamgeist, Engagement und Leidenschaft für Technik – das sind Eigenschaften, die unsere Mitarbeiter und die Formula-Student-Teams verbinden. Als Sponsor stehen wir in engem Kontakt mit den Teams und unterstützen diese mit unserem Know-how. Die Teilnehmer sind gern gesehene Bewerber, um mit uns gemeinsam die Mobilität für morgen zu gestalten.

SIEMENS
Ingenuity for life

THORSTEN WALZ
Manager Academic Business Germany

Team spirit, an infectious enthusiasm and the impressive professionalism of all the teams – that is what distinguishes the FSG. Siemens PLM Software is very proud of being the sponsor of this extraordinary competition since 2015 and is looking forward to the week in Hockenheim, which is a real highlight for us. Come and talk to us – it's worth it!

Teamgeist, eine ansteckende Begeisterung und die beeindruckende Professionalität aller Teams – das ist es, was die FSG auszeichnet. Siemens PLM Software ist sehr stolz darauf, seit 2015 Sponsor dieses außergewöhnlichen Wettbewerbs zu sein und freut sich auf die Woche in Hockenheim, die für uns ein echtes Highlight ist. Kommen Sie mit uns ins Gespräch – es lohnt sich!

SKF®

CHRISTIAN FOERSTER
Manager Talent Academy

Our vision: 'A world of reliable rotation'. To make this a reality, we are working on optimized solutions for a wide range of applications. It requires experience, knowledge, flexibility & creativity. This is exactly what the FS teams bring with them. At SKF, young engineers who think ahead are offered the chance to help shape the future.

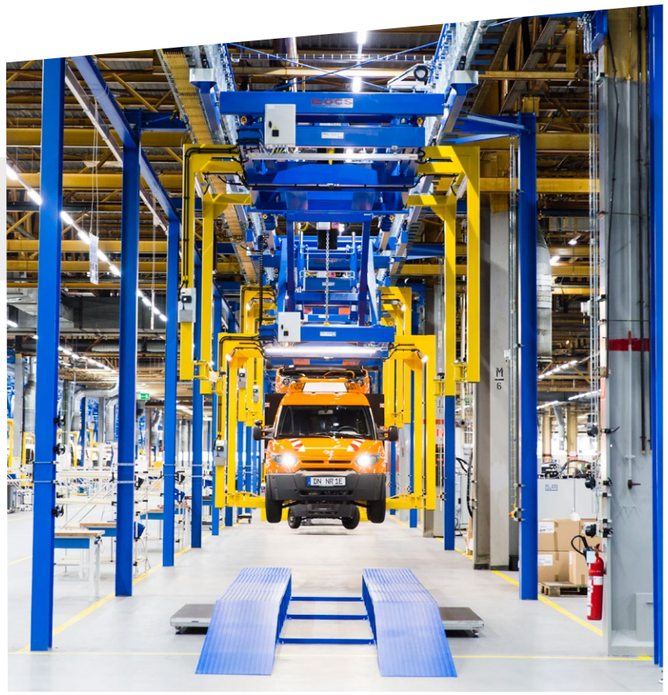
Unsere Vision: "Eine Welt in zuverlässiger Rotation". Um sie zu verwirklichen, arbeiten wir an optimierten Lösungen für verschiedenste Anwendungen. Dafür sind Erfahrung, Wissen, Flexibilität & Kreativität nötig. Genau das bringen die FS-Teams mit. Jungingenieuren & IT'lern, die weiterdenken, bietet SKF die Chance, den Fortschritt mitzugestalten.

STREETSCOOTER

SANDRA WEISSGERBER
Head of HR & Organisational Development

Together we can achieve something exceptional - every single day. This mindset made us the European market leader in the electronic commercial vehicle segment. As a revolutionary car manufacturer with start-up dynamics, we develop new standards in efficiency, economy and functionality. Join our team and shape the future of mobility yourself!

Gemeinsam Außergewöhnliches leisten – und das jeden Tag. Dies macht uns zum europaweiten Marktführer im elektronischen Nutzfahrzeugsegment. Als revolutionärer Automobilhersteller mit Startup-Dynamik setzten wir neue Maßstäbe in Effizienz, Wirtschaftlichkeit und Funktionalität. Werde Teil unseres Teams und gestalte selbst die Zukunft der Mobilität!



VDI

DIPL.-ING. CHRISTOF KERKHOFF
VDI-Society Automotive and Traffic Systems Technologies

VDI, the Association of German Engineers, is proud to be a partner and supporter for Formula Student Germany since the very beginning. This competition is a model for other programs we run to stimulate interest in the engineering profession and to lend a hand to the future generation, and our members follow it keenly every year.

Der Verein Deutscher Ingenieure (VDI) ist stolz darauf, die Formula Student Germany seit Ihren Anfängen als ideeller Träger und Unterstützer zu begleiten. Dieser Wettbewerb ist ein Vorbild für andere Programme, mit denen wir das Interesse für Technikberufe wecken, den Nachwuchs fördern und er begeistert unsere Mitglieder jedes Jahr aufs Neue.

Volkswagen

PROF. DR. STEFAN GIES
Head of Product Line Mid/Full Size, Volkswagen AG

Volkswagen rethinks and shapes the future of mobility. To achieve this, we need young people who will join us and drive electric mobility, autonomous driving and digitization forward. At Formula Student, we find top talents, can get in touch with them and are able to show career opportunities at Europe's largest car manufacturer.

Volkswagen denkt und gestaltet die Mobilität der Zukunft neu. Dafür brauchen wir Nachwuchs, der mit uns die Themen Elektromobilität, autonomes Fahren und Digitalisierung vorantreibt. Bei der Formula Student finden wir Top-Talente, können mit ihnen ins Gespräch kommen und ihnen Karrierechancen beim größten Automobilhersteller Europas aufzeigen.

ZF

MARTIN FRICK
Head of Employer Branding / Talent Attraction

ZF is a global technology company, enabling the next generation of mobility and offering integrated solutions for vehicle manufacturers, mobility providers and start-up companies in the fields of transportation and mobility. We support Formula Student to give the participants early insights in our activities that shape the future of mobility.

ZF ist ein weltweit aktiver Technologiekonzern. Mit seinem Technologieportfolio bietet ZF Lösungen für Automobilhersteller, Mobilitätsanbieter und neu entstehende Unternehmen im Bereich Transport und Mobilität. Bei der Formula Student engagieren wir uns, um den Teilnehmern Einblicke zu geben, wie wir die Mobilität der nächsten Generation gestalten.

Impressions

Accelerate!

FSG swag

Smiles

Everything is awesome

We the sponsors

Talk about talkers!

Prepping for Trackdrive

Got to capture it all!

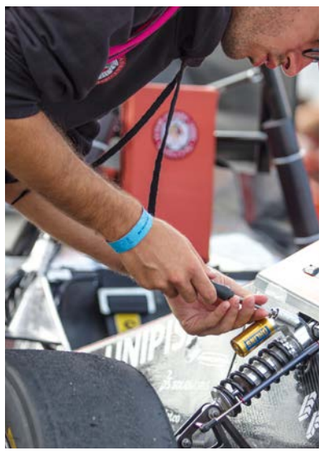
Found a minion!

And then you wait...

International

Moose on a mission

Spectators



Adjustment is everything

Time for a powernap

They're catching up!


Baden-Württemberg Center
SACHS
ontinental
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MAGNA
SKF
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Deloitte.
WEINGARTEN

@FSGeV

@FormulaStudentG

formulastudentgermany

Briefing

Let's go racing

Posers!

Time keeping...

Wheelchair friendly racing

Healthy snacks

What do all these cables do?!

Need for speed!

Recreation

Pure passion

Why scrutineering is important award

Ready...set....go!

Winners!

The adrenaline builds...

We are all winners

Champions

FSG 2021

A new Chapter
Ein neues Kapitel

The requirements of engineers are constantly changing. For Formula Student Germany (FSG), it has always been important to take on these new requirements and technological developments. Traditionally built with internal combustion engines, electric drives then came into focus. In the meantime, autonomous driving is playing an increasingly important role and the interaction of hardware and software is becoming ever more complex. In order to develop both in combination, the understanding of the other subject area is essential.

The goal of FSG is to encourage teams to be as interdisciplinary as possible and cover multiple areas of application. It is also to network important specialist knowledge and to promote greater cooperation amongst each other. Everyone in the team should have the opportunity to focus in their field of expertise, whether it's mechanical engineering, drivetrain, aerodynamics or software. Today, many FSD teams focus almost exclusively on only the driverless aspects, whilst with the classic Formula Student cars, software plays a lesser role.

From 2021, the 'Acceleration' event at FSG will become the first discipline that will only be completed without a driver. The plan is that the Skidpad event will follow in 2022 as a purely driverless event. This will mean that there will once again be two competition classes at FSG: Formula Student Combustion with Combustion Engines and Formula Student Electric with Electric Drives - both of which will then be the possible baseline for the autonomously driven car technologies.
So, in 2021, the acceleration race will be “Driverless”. There will also be an additional “Driverless Title” with which all interested teams would be able to have in order to race in the well-known disciplines “Skid Pad”, “Auto Cross” and “Track Drive”.
In the medium and long term, there will be events that will continue to run with a driver.
Of course, it is important for FSG to provide a path for the teams to reach these new levels. The Driverless Workshop in Munich in May was quickly booked up with 59 teams from 12 countries and offered many lectures highlighting the individual aspects of autonomous driving in FSG applications. The experienced “Driverless” teams were open-minded, participated in the workshop and passed on their knowledge. This included many recommendations for books, papers and existing open source software libraries. All content can be found under “Academy” on the FSG homepage.
The existing Driverless teams already have a good network amongst themselves. This year, the e-gnition team from the TU Hamburg organised the Autonomous Racing Workshop for the second time. Once again, it became clear that in the FS “Driverless” world, a very open approach to know-how is being practiced and that this is essential in order to advance.
FSG sees it as it important that the rules are released well in advance. That's why the 2021 rules along with the 2020 rules will be released as early as the autumn of this year.
In addition, the point distribution will honour slower acceleration times for the introductory period (expected to be the first two years), to ensure that despite slower acceleration times, the event is still worthwhile for the overall competition.
The FSG team knows that this is a big challenge. Through their experience (95 percent of the FSG organisation participated in competitions during their student days), they know that the most is to be gained from the biggest challenges and are looking forward to an exciting new chapter!

Die Anforderungen an Ingenieure verändern sich ständig. Und uns, der Formula Student Germany (FSG), war es schon immer wichtig, diese neuen Anforderungen und technologischen Entwicklungen aufzugreifen. Nach dem Start mit Verbrennungsmotoren, rückten elektrische Antriebe in den Fokus. Mittlerweile spielt das autonome Fahren eine immer größere Rolle und das Zusammenspiel von Hard- und Software wird immer komplexer. Um beides in Kombination zu entwickeln, ist das Verständnis für das jeweils andere Themengebiete unerlässlich.

Das Ziel der FSG ist, dass die Teams möglichst interdisziplinär aufgestellt sind und viele Anwendungsbereiche abdecken, nicht zuletzt um wichtiges Spezialwissen zu vernetzen und die verstärkte Zusammenarbeit untereinander zu fördern. Jeder im Team soll die Chance haben, sich auf sein Fachgebiet zu konzentrieren, egal ob es sich um Maschinenbau, Antriebe, Aerodynamik oder Software handelt. Heute liegt bei vielen FSD Teams der Fokus nahezu ausschließlich auf den fahrerlosen Aufgaben, bei den klassischen Fahrzeugen wiederum spielt das Thema Software eine geringere Rolle.

Ab 2021 ist das Beschleunigungsrennen (Acceleration) die erste Disziplin, die nur noch ohne Fahrer absolviert wird. Geplant ist, dass 2022 das Skidpad Event als rein fahrerlose Disziplin folgen soll. Bei der FSG gibt es dann zwei Wettbewerbsklassen: Formula Student Combustion mit Verbrennungsmotoren und Formula Student Electric mit elektrischen Antrieben – beide beschäftigen sich zusätzlich mit den Technologien autonom fahrender Autos. Im Jahr 2021 also wird das Beschleunigungsrennen „driverless“.
Es wird einen zusätzlichen „Driverless-Titel“ mit den bekannten weiteren Disziplinen „Skid Pad“, „Auto Cross“ und „Track Drive“ geben, um den alle interessierten Teams mitfahren können.
Es wird aber auch mittel- und langfristig weiterhin Disziplinen geben, die nur mit Fahrer zu absolvieren sind.
Natürlich ist es uns ein Anliegen, den Einstieg zu erleichtern. Der Driverless Workshop im Mai in München war mit 59 Teams aus zwölf Ländern schnell ausgebucht und hat in vielen Vorträgen die einzelnen Aspekte des fahrerlosen Fahrens in der FSG-Anwendung beleuchtet. Die erfahrenen „Driverless Teams“ zeigen sich aufgeschlossen, haben am Workshop teilgenommen und ihr Wissen weiter gegeben, auch mit vielen Empfehlungen für Bücher, Papers und bereits existierenden Open Source Softwarebibliotheken. Alle Inhalte finden sich unter „Academy“ auf der Homepage.
Untereinander pflegen die bestehenden Driverless-Teams bereits eine gute Vernetzung. In diesem Jahr veranstaltete das Team e-gnition der TU Hamburg schon zum zweiten Mal den Autonomous Racing Workshop. Dort wurde erneut deutlich, dass im „Driverless-Bereich“ ein sehr offener Umgang mit Know-How gelebt wird und dieser unerlässlich ist, um das Thema voranzutreiben.

Wir halten es weiterhin für wichtig, dass die Regeln weit im Voraus feststehen. Deshalb planen wir, die 2021-Regeln gleichzeitig mit den 2020-Regeln schon im Herbst dieses Jahres zu veröffentlichen.
Außerdem werden wir für die Einführungszeit (wir erwarten die ersten zwei Jahre) eine Punktverteilung einführen, die auch langsamere Beschleunigungszeiten honoriert, damit sich alle beendeten Läufe durchaus lohnen.
Wir wissen, dass das eine große Herausforderung bedeutet. Doch aus eigener FSG-Erfahrung (95 Prozent der FSG-Organisation hat zu Studienzeiten selbst an Wettbewerben teilgenommen) wissen wir, dass wir an den größten Herausforderungen auch am meisten gelernt haben. Wir freuen uns auf ein spannendes neues Kapitel!

Multiple Choice Game

1 How many teams participated in the first ever Formula Student Germany pre-Event back in 2005?

- 5
- 16
- 6

2 What years did Formula Student Electric run the Endurance event as a night race?

- 2010 & 2011
- 2011 & 2012
- 2009 & 2010

3 What year was Formula Student Driverless born?

- 2015
- 2016
- 2017

4 Which country started Formula Student and in what year?

- United Kingdom, 1981
- United States of America, 1983
- United States of America, 1980

5 Which team has won the most competitions at FSG?

- TU Delft
- Uni Stuttgart
- TU Delft and Uni Stuttgart have both won the same number of competitions at FSG

6 In the history of FSG, what is the highest number of cones knocked down for a single FSG autocross lap?

- 73
- 25
- 16

7 What is this part of the track named after?

- There is a dip which if you hit at the right angle it makes FSG cars fly
- Every person who walks over that part of the track must jump
- One particular FSG car famously jumped over a cone at this section of the track

8 What is the/are the name/names of the FSG Commentators?

- Miki, Austin, Stef and Thijs
- I don't know, but they are funny
- Arguably the best commentating team
- All of the above

1) 3. ANTWORT /// 2) 1. /// 3) 2. /// 4) 3. /// 5) 3. /// 6) 3. /// 7) 1. /// 8) 4.

FSG - and then?

FSG - und dann?

What to do after the Formula Student competition?

For many Formula Student Teams the season is coming to an end after the events in summer. Some might have thought about where the journey might take him or her afterwards. Leaving aside the budget holiday in Spain: Back to Uni? One more season of FS or even start a professional career?

As a prospective graduate, one often asks themselves what path to take after finishing their academic education. The countless opportunities on the open job markets actually cause more uncertainty in the decision-making.

On the other hand, the chances were never that good. Besides the growing access to the global job market, the fast-paced development of the automotive industry opens many doors. Trends like alternative powertrains, autonomous systems and even different concepts of mobility, do not only alter a vehicle's design but ultimately transform the business model of a whole industry. Consequentially, traditional job profiles are changing and profiles evolve that do not even exist today.

Besides the technical evolution, key competences of the Formula Student competition are recognized by the companies to be important. For instance, the ability to work in cross-functional teams or an agile and iterative way of developing products is highly valued.

To show you how differently careers can evolve, we asked FSG Alumni about their careers and what skills developed in the competition are helpful in their daily job.

Was kommt nach der Formula Student?

Mit den Formula Student Events im Sommer geht für viele Teams eine spannende Saison zu Ende. Der Ein oder Andere hat sich sicher schon gefragt, wo die Reise nach der Zeit im Team hingeht. Und mal vom Pauschalurlaub in Spanien abgesehen: Zurück an die Uni? Eine weitere Saison Formula Student, oder doch der Einstieg ins Berufsleben?

Als angehender Absolvent steht man oft vor der Frage, welchen beruflichen Weg man einschlagen soll. Die unzähligen Möglichkeiten am heutige Arbeitsmarkt sorgen dabei oft für noch mehr Unsicherheit bei der Entscheidungsfindung.

Andererseits waren die Chancen noch nie so gut wie heute. Neben einem zunehmend globalen Arbeitsmarkt, eröffnen die Entwicklungen innerhalb der Automobilindustrie viele Türen. Themen wie alternative Antriebskonzepte, autonome Systeme und die Entwicklung von neuen Mobilitätskonzepten haben nicht nur Einfluss auf die technische Umsetzung eines Fahrzeugs, sondern verändern auch nachhaltig das Geschäftsmodell einer gesamten Industrie. Dem folgt der radikale Wandel traditioneller Berufsbilder und die Entwicklung neuer Job-Profile, welche wir heute vielleicht noch gar nicht kennen.

Trotz der sich ändernden fachlichen Anforderungen, werden die Schlüsselkompetenzen der Formula Student als immer wichtiger bei den Unternehmen angesehen. Zum Beispiel das Arbeiten in crossfunktionalen Teams, oder agile, iterative Produktentwicklung werden mehr und mehr geschätzt.

Um die verschiedensten beruflichen Wege aufzuzeigen, haben wir FSG Alumni nach Ihrem Werdegang gefragt.Außerdem hat uns interessiert, welche Fähigkeiten, die sie zu Formula Student-Zeiten entwickelt haben, ihnen im Berufsleben am meisten weiterhelfen.

"Which of the skills that you have developed during the Formula Student competition helped you in your professional career and why?"

„Welche Fähigkeiten die du während dem Formula Student Wettbewerb angeeignet hast, haben dir am meisten in deiner professionellen Karriere geholfen und warum?"

Chris Patton

former FS Team member of /
ehemaliges FS Teammitglied bei:
Global Formula Racing, Oregon State University

area of responsibility in the FS team /
Aufgabenbereich im FS Team:
Vehicle Dynamics and Simulation
Fahrdynamik und Simulation

Current position/ employer
Aktuelle Stelle /Arbeitgeber
Dynamics Engineer at SpaceX

Developed skills/ angeeignete Fähigkeiten
Besides technical skills in numerical simulation and coding, Formula Student taught me to assess risk and to deal with failure. Also, I made a lot of friends during that time. Many of whom are now my professional colleagues.

Neben technischem Wissen, zum Beispiel in numerischer Simulation und Programmierung, habe ich gelernt, Risiken einzuschätzen und mit Niederlagen umzugehen. Während dieser Zeit habe ich außerdem viele Freunde gefunden, mit denen ich heute auch als Kollegen zusammenarbeite.

Thomas Hennings

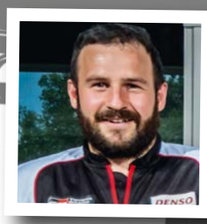
former FS Team member of /
ehemaliges FS Teammitglied bei:
Rennteam Uni Stuttgart (2006-2010)

area of responsibility in the FS team /
Aufgabenbereich im FS Team:
Several, from chassis to drivetrain as team member and manager / Antriebsstrang./ Chassis

Current position/ employer
Aktuelle Stelle /Arbeitgeber
Head of Sales and Application Engineering at/bei MAHLE

Developed skills/ angeeignete Fähigkeiten
To run a project and motivate team members while keeping the time line, budget and still win the race. Not to lose focus on the overall targets.

Ein Projekt zu leiten, das Team zu motivieren den Zeitplan und das Budget im Auge zu behalten und dabei trotzdem noch den Wettbewerb gewinnen.



Luke Phersson

former FS Team member of /
ehemaliges FS Teammitglied bei:
Monash Motorsport

area of responsibility in the FS team /
Aufgabenbereich im FS Team:
Aerodynamics/Vehicle Dynamics/ Management

Current position/ employer
Aktuelle Stelle /Arbeitgeber
LMP1 Simulation and Performance Engineer at Toyota Motorsport GmbH

Developed skills/ angeeignete Fähigkeiten
Analysing problems from first principles is critical, as it allows you to properly understand the trade-offs and interactions inherent in any engineering problem.

Probleme von der Basis her zu analysieren ist wesentlich. So können Zielkonflikte und Wechselbeziehungen, die jedem ingenieurstechnischen Problem vorkommen, richtig verstanden werden.

Georges Halsdorf

former FS Team member of /
ehemaliges FS Teammitglied bei:
Ecurie Aix Formula Student Team
RWTH Aachen e.V.

area of responsibility in the FS team /
Aufgabenbereich im FS Team:
- Design Front Axle / Entwicklung Frontachse
- Group Leader Suspension / Leitung der Fahrwerkentwicklung
- Chairman / Vorsitzender des Vereins

Current position/ employer
Aktuelle Stelle /Arbeitgeber
System Project Lead bei ZF Group

developed skills/ angeeignete Fähigkeiten
How to motivate Team Members and how to communicate successfully with the Team.
Wie man die Mitglieder motiviert und erfolgreich in einem Team kommuniziert.

Björk Halldorsdottir

former FS Team member of /
ehemaliges FS Teammitglied bei:
University of Iceland

area of responsibility in the FS team /
Aufgabenbereich im FS Team:
Team Leader Team SPARK –
Formula Student Iceland

Current position/ employer
Aktuelle Stelle /Arbeitgeber
Associate at SYSTEMIQ

Developed skills/ angeeignete Fähigkeiten
In my opinion, the most valuable skill acquired in FS is dealing with uncertainty. You can plan, analyse and prepare all you want, but when when things take a one-eighty, you have to respond quickly and effectively to be successful at the job.
Meiner Meinung nach ist die wichtigste Eigenschaft, die ich mir während der Formula Student angeeignet habe, mit Unsicherheit umgehen zu können. Man kann planen, analysieren und vorbereiten so viel man will, aber wenn sich alles plötzlich um 180 Grad dreht, muss man schnell reagieren um erfolgreich zu sein.

Thomas Herzog

former FS Team member of /
ehemaliges FS Teammitglied bei:
WHZ Racing Team Zwickau

area of responsibility in the FS team /
Aufgabenbereich im FS Team:
Project Leader Economy
Wirtschaftlicher Projektleiter

Current position/ employer
Aktuelle Stelle /Arbeitgeber
CEO Pendix GmbH

Developed skills/ angeeignete Fähigkeiten
Looking back to Formula Student, one of the key skills was developing a team spirit that only non-monetary events can develop. It's like Olympic games in a special area and you are fighting with and against the best in the world. Bringing this to a professional career at Pendix GmbH helped us building up sustainable relationships to suppliers, customers and especially employees.
Beim Blick zurück an die Formula Student ist mir vor allem der Teamspirit in Erinnerung geblieben, den nur eine Veranstaltung hervorbringen kann, bei der es nicht vorrangig um Geld geht. Es ist vergleichbar mit Olympischen Spielen, denn du kämpfst mit und gegen die Besten der ganzen Welt. Diesen Teamgedanken in ein professionelles Arbeitsleben zu übertragen hat uns wesentlich dabei geholfen die Pendix GmbH nachhaltig bei Lieferanten, Kunden und vor allem Mitarbeitern zu etablieren.

Michel Berendes

former FS Team member of /
ehemaliges FS Teammitglied bei:
e-gnition Team Hamburg

area of responsibility in the FS team /
Aufgabenbereich im FS Team:
Vehicle Dynamics
Entwicklung Fahrdynamik

Current position/ employer
Aktuelle Stelle /Arbeitgeber
Product Manager at Ibeo Automotive Systems GmbH

developed skills/ angeeignete Fähigkeiten
Through Formula Student I experienced how one common goal can motivate an entire team and how this spirit helps to achieve something great. The goal and the energy I still feel today: the autonomous future on our roads.
In der Formula Student erlebte ich, wie ein gemeinsames Ziel ein gesamtes Team motivieren kann und wie dieser Spirit hilft, etwas Großes zu erreichen. Diese Energie und das gemeinsame Ziel sehe ich auch heute noch: die autonome Zukunft auf unseren Straßen.

Alia Hall

former FS Team member of /
ehemaliges FS Teammitglied bei:
KA-Racelng. , Karlsruhe Institute for Technology

area of responsibility in the FS team /
Aufgabenbereich im FS Team:
Founding member and team manger

Current position/ employer
Aktuelle Stelle /Arbeitgeber
Continental AG, Project Manager

Developed skills/ angeeignete Fähigkeiten
I gained confidence. It allowed me to speak up and to question things. As a result, it strengthened my German language skills, improved my understanding in different fields of Engineering and taught me that if I don't know something I can learn about it!
Ich habe an Selbstvertrauen gewonnen, was mir geholfen hat, Dinge anzusprechen und in Frage zu stellen. Dadurch verbesserten sich meine Deutschkenntnisse sowie mein Verständnis für verschiedene technische Bereiche. Und ich weiß jetzt, dass ich Dinge lernen kann, die ich nicht verstehe.

All the presented Alumni took a very different path in their professional career: the supplier industry, motorsports, aerospace engineering, autonomous-driving technology or even an own start-up. Nevertheless, they agree that team spirit, a common goal and good communication is key to build a high-performing team and a winning strategy. The ability to comprehensively analyse and understand both engineering as well as project management problems presents a big advantage. Although job profiles are rapidly changing, the competition still prepares the Students for their professional career in best way possible.

Die vorgestellten Alumni schlugen unterschiedlichste berufliche Wege ein: die Zuliefererindustrie, Motorsport- oder Raumfahrttechnik, Autonomes Fahren oder sogar ein eigenes Start-Up. Nichtsdestotrotz sind sich alle einig, dass Team Spirit, ein gemeinsames Ziel und gute Kommunikation der Schlüssel für ein leistungsstarkes Team und eine erfolgreiche Strategie sind. Die Fähigkeit sowohl ingenieurstechnische als auch Projekt Management-Probleme umfassend zu analysieren und zu verstehen, ist ein weiterer großer Vorteil. Auch wenn sich Job Profile heutzutage so schnell ändern wie noch nie: Die FSG bereitet die Studenten bestmöglich auf ihre berufliche Karriere vor.

Participating Formula Student Combustion TEAMS 2019

Teams

Car	City/University	Country	Pit	Page
202	Graz TU	Austria	T-79	99
204	Corvallis OSU	United States	T-64	97
208	Milano PT	Italy	43-A	104
211	Changchun JLU	China	43-B	96
212	Rochester OU	United States	T-67	108
215	Pune SKNCOE	India	35-C	107
216	Ankara METU	Turkey	T-57	93
218	Arcavacata di Rende UNICAL	Italy	T-55	93
219	Haifa Technion	Israel	46-B	100
221	Gießen UAS THM	Germany	37-A	99
222	Karlsruhe KIT	Germany	41-C	102
225	Athens TU	Greece	40-C	94
226	Southampton U	United Kingdom	T-74	109
227	Roma U Tor Vergata	Italy	T-85	108
229	Stuttgart U	Germany	37-C	110
231	München UAS	Germany	T-66	105
235	Maribor U	Slovenia	T-76	104
238	Graz UAS	Austria	40-B	99
239	Heilbronn UAS	Germany	T-51	101
242	Darmstadt UAS	Germany	T-83	97
243	Pisa U	Italy	46-A	107
244	Ulm UAS	Germany	T-80	110
248	Bochum U	Germany	T-65	95
249	Erlangen U	Germany	38-A	98
254	Vellore VIT	India	T-78	111
258	Paderborn U	Germany	41-A	106
260	Kempten UAS	Germany	44-C	102
261	Bath U	United Kingdom	T-63	94
262	Regensburg OTH	Germany	41-B	107
265	Wiesbaden UAS	Germany	T-52	112

Car	City/University	Country	Pit	Page
268	Liuzhou GXUST	China	T-68	103
270	Coburg UAS	Germany	T-72	97
272	Dortmund TU	Germany	T-75	98
274	Brno TU	Czech Republic	T-71	96
278	St. Petersburg PT	Russia	T-59	109
279	Győr U	Hungary	34-B	100
285	Padova U	Italy	46-C	106
288	Bologna U	Italy	T-84	95
291	Sevilla U	Spain	T-77	108
293	Chennai IITM	India	44-A	96
294	Esslingen UAS	Germany	40-A	98
306	Białystok TU	Poland	T-56	95
311	Montréal ETS	Canada	T-70	105
313	Berlin TU	Germany	T-50	94
314	Vigo U	Spain	T-53	111
317	Lund U	Sweden	34-C	104
319	Stralsund UAS	Germany	35-A	109
324	Ancon U	Italy	T-58	93
325	Wrocław TU	Poland	T-62	112
340	Istanbul YTU	Turkey	38-C	101
343	Konstanz UAS	Germany	44-B	103
347	Mumbai DJSCE	India	T-82	105
363	Aachen UAS	Germany	T-60	92
369	Hamburg UAS	Germany	35-B	101
372	Hamburg HSU	Germany	37-B	100
373	Leganés UC3M	Spain	T-81	103
377	Volos U	Greece	T-69	111
379	Pforzheim U	Germany	43-C	106
395	Valéncia UPV	Spain	38-B	110
399	Karlsruhe UAS	Germany	T-54	102

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Participating Formula Student Electric TEAMS 2019

Teams

Car	City/University	Country	Pit	Page
11	Terrassa ESEIAAT	Spain	10-A	124
13	Berlin TU	Germany	23-B	114
15	Madrid TU	Spain	17-C	120
18	Liuzhou UAS	China	19-C	120
19	Karlsruhe KIT	Germany	12-A	117
20	Lisboa ISEL	Portugal	10-C	119
21	Bayreuth U	Germany	14-A	113
23	Amberg OTH	Germany	12-C	113
26	Stuttgart U	Germany	20-A	124
27	Mumbai Somaiya	India	12-B	121
28	Kassel U	Germany	22-C	117
31	München TU	Germany	23-A	121
32	Ravensburg DHBW	Germany	16-C	122
33	Zürich ETH	Switzerland	04-C	125
35	Wolfenbüttel UAS Ostfalia	Germany	07-C	125
36	Chemnitz TU	Germany	04-B	114
40	Eindhoven TU	Netherlands	16-A	115
42	Darmstadt TU	Germany	23-C	115
45	Sankt Augustin UAS	Germany	22-A	123
50	Lisboa IST	Portugal	17-B	119
51	Sevilla U	Spain	20-C	123
53	Lemgo UAS	Germany	06-A	118
54	Barcelona UPC	Spain	14-B	113
59	Dresden TU	Germany	04-A	115
63	Trondheim NTNU	Norway	17-A	125
67	New Delhi IIT	India	25-A	122

Car	City/University	Country	Pit	Page
68	Mannheim UAS	Germany	06-C	121
76	Jinzhou LUT	China	09-C	117
85	Freiberg TU	Germany	14-C	116
91	Braunschweig TU	Germany	09-B	114
97	Schweinfurt UAS	Germany	20-B	123
98	Helsinki UAS	Finland	10-B	116
99	Aachen RWTH	Germany	16-B	112
121	Thessaloniki U	Greece	07-B	124
122	Leuven KU	Belgium	19-A	119
127	Lausanne EPFL	Switzerland	06-B	118
153	Kiel UAS	Germany	07-A	118
161	Göttingen HAWK	Germany	19-B	116
169	Ljubljana U	Slovenia	22-B	120
185	Padova U	Italy	09-A	122

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Participating Formula Student Driverless TEAMS 2019

Teams

Car	City/University		Country	Pit	Page
411	Dresden TU	ELECTRIC	Germany	29-C	128
414	Budapest TU	ELECTRIC	Hungary	29-B	127
419	Karlsruhe KIT	ELECTRIC	Germany	26-C	129
426	Stuttgart U	ELECTRIC	Germany	26-B	130
431	München TU	ELECTRIC	Germany	31-C	129
433	Zürich ETH	ELECTRIC	Switzerland	31-A	131
442	Darmstadt TU	ELECTRIC	Germany	26-A	128
454	Barcelona UPC	ELECTRIC	Spain	28-A	127
463	Trondheim NTNU	ELECTRIC	Norway	25-C	131
469	Ravensburg DHBW	ELECTRIC	Germany	32-C	130
471	Stockholm KTH	ELECTRIC	Sweden	29-A	130
478	Hamburg TU	ELECTRIC	Germany	28-B	129
485	Delft TU	ELECTRIC	Netherlands	25-B	128
489	Tallinn TU UAS	ELECTRIC	Estonia	28-C	131
499	Aachen RWTH	ELECTRIC	Germany	31-B	127
538	Berlin HTW	COMBUSTION	Germany	32-B	126
549	Erlangen U	COMBUSTION	Germany	32-A	126
560	Weingarten UAS	COMBUSTION	Germany	34-A	126

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Formula Student Team profiles

25 nations
3380 students

60 teams Combustion

40 teams Electric

18 teams Driverless

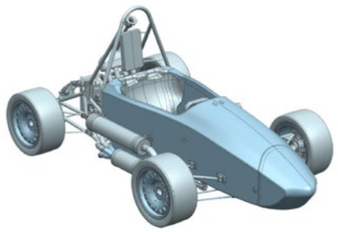
3 Combustions / **15** Electric

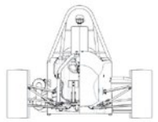
AACHEN

University of Applied Sciences Aachen

Car 363 **Pit T-60** **WRL 342** Germany

The FS19 is the third car of this monocoque row. It's lighter, we have a new engine control unit and there is still no duct tape on the car. The first two cars were grey and white. Following the colors of our university, the FS19 is colored in charming mint royal! Once again, the FS19 has been built by a minimum amount of people - the concept simply proved itself! Not convinced? Come over and have a look at our „hammock tents" - that's certainly something you can only endure in a good team!





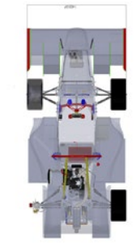
FRAME CONSTRUCTION Composite CFRP Monocoque / Steel Rear Frame
MATERIAL IMS carbon fiber and balsa sandwich w/ epoxy, high strength steel for rear frame
OVERALL L / W / H 2563mm / 1445mm / 1137mm
WHEELBASE / TRACK (Fr / Rr) 1540mm / 1240mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 100kg / 105kg
SUSPENSION Double unequal length A-arm, pushrod/ pullrod actuated. Adjustable dampers.
TYRES (Fr / Rr) 205/470 R13, Continental C17 Slick
WHEELS (Fr / Rr) 7,5x13, 32mm offset, single piece Al Rim
ENGINE Modified YZF-R6 RJ09
BORE / STROKE / CYLINDERS / DISPLACEMENT 65,5mm / 44,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 12,4:1
FUEL SYSTEM sequential manifold injection, custom fuel rail
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 12000 rpm/ 8500rpm
DRIVE TYPE chain drive (520)
DIFFERENTIAL limited slip (Drexler) pre load:30-35NM
COOLING sidemounted radiator, electric water pump (LIN controlled)
BRAKE SYSTEM 4-Disk system, self developed rotors with 196/ 186mm diameter, ISR machined Al calipers
ELECTRONICS Cosworth Antares 8xx ECU with race spec wiring harness, lightweight OLED-display

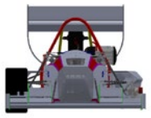
ANCON

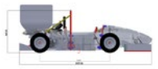
Università Politecnica delle Marche

Car 324 **Pit T-58** **WRL 236** Italy

Polimarche was born in 2013, inside Università Politecnica delle Marche. We are not just a 60 people team driven by passion, but a family of industrial and information engineering and economics students. Do you like compromises? We don't think so, take a look at the specs of Peacock 4M. It's the game changer, our masterpiece. A full monococque carbon fiber that embraces a powerful Ktm lc-4 turbo engine,a sophisticated Aero and Suspension package. Small weight, dream big. #keeppushing #P4M







FRAME CONSTRUCTION Carbon fiber monocoque (sandwich structure) and steel tube for hoops
MATERIAL Carbon fiber Twill T700 600gr and 200 gr,Aluminium honeycomb 5052 1/8" 20 mm.
OVERALL L / W / H 3033mm / 1422mm / 1100mm
WHEELBASE / TRACK (Fr / Rr) 1600mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 130kg / 138kg
SUSPENSION Double unequal length A-Arm. Push rod actuated Anti Roll bar (U-bar)
TYRES (Fr / Rr) 16" x 7.5" - 10" Hoosier R25B
WHEELS (Fr / Rr) 7" x 10", ET +23 mm, 4 Flat Nut Al Rim
ENGINE Turbocharged KTM 690 LC4 2013/2014
BORE / STROKE / CYLINDERS / DISPLACEMENT 102mm / 84,5mm / 1 cylinder / 690cc
COMPRESSION RATIO 10:1
FUEL SYSTEM Indirect injection, two parallel injectors in front of engine
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 8000 rpm/ 5000rpm
DRIVE TYPE KTM gearbox/Chain 520/aluminium sprocket
DIFFERENTIAL limited slip differential no preload, with 3 configuration
COOLING Water and oil radiators in each sidepod, with water cooling electric fan
BRAKE SYSTEM Floating rotors,188mm dia. Front caliper Brembo 4p, rear AP 2p, adjustable brake balance
ELECTRONICS HighspeedCAN 2.0 B-1Mbit/s,Multifuncional SteeringWheel,TelemetryGPS 2.4GHz streaming WLAN

ANKARA

Middle East Technical University

Car 216 **Pit T-57** **WRL 494** Turkey

Our team is one of the numbered Formula Student teams in the Turkey. The main aim is to combine our engineering and business skills to build a race car of our dreams. At the very first beginning, passionate students came together to form this team with the idea of creating something that will count as a notable and promising project. Today, we stand here as a rapidly developed team with our second manufactured car which will race at FSG and FSCz: DEVRIM19FNSS.

FRAME CONSTRUCTION Tubular space frame
MATERIAL E235 (St-37) steel round tubing 16 to 30 mm
OVERALL L / W / H 3025mm / 1470mm / 1300mm
WHEELBASE / TRACK (Fr / Rr) 1525mm / 1270mm / 1220mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 163kg / 174kg
SUSPENSION Double unequal length A-Arm.Pull rod(Fr)/ Push rod(Rr) actuated vertical spring and damper
TYRES (Fr / Rr) Pirelli Slickdm 225/550-13
WHEELS (Fr / Rr) 8x13, 22mm offset 3 pc Al Rim
ENGINE 2009 Honda CBR 600RR
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 12.2:1
FUEL SYSTEM Student des, manufactured by professionals, fuel injection, port injection
FUEL gasoline
MAX POWER/TORQUE DESIGN 13000 rpm/ 7000rpm
DRIVE TYPE chain driven, 525 size chain
DIFFERENTIAL clutch pack limited slip, 100Nm preload, 1.4 bias ratio
COOLING Twin side pod mounted radiators with thermostatic controlled electric fans
BRAKE SYSTEM 4-Disk, Stainless Steel, hub mounted, 220mm outer diam. 125mm inner diam, vented
ELECTRONICS Custom built data logger

ARCAVACATA DI RENDE

Università della Calabria

Car 218 **Pit T-55** **WRL 86** Italy

Unical Reparto Corse (URC) from University of Calabria was founded in 2005. Eight cars has been realized up to now and every car that we made was better than the previous one. Our team takes part every year in FSAE Italy competition. One of our best achievements so far it's the first place in Acceleration Event, since three years, between the italian teams. With our new car we will take part for the first time in FSG competition. So see if you can keep up with us!

FRAME CONSTRUCTION Steel tubular space frame
MATERIAL 25CrMo4 steel
OVERALL L / W / H 2948mm / 1400mm / 1210mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 145kg / 147kg
SUSPENSION Double unequal lenght wishbone, pull rod
TYRES (Fr / Rr) Continental 205/470 R13,
WHEELS (Fr / Rr) 7.0/13, 30mm offset
ENGINE Triumph Street Triple 675
BORE / STROKE / CYLINDERS / DISPLACEMENT 74mm / 52,3mm / 3 cylinders / 675cc
COMPRESSION RATIO 12.9:1
FUEL SYSTEM Electronically controlled fuel injection system, sequential fuel injection
FUEL 98 octane
MAX POWER/TORQUE DESIGN 10000 rpm/ 7500rpm
DRIVE TYPE 520 chain
DIFFERENTIAL Clutch type limited slip differential
COOLING 1 mounted 43mm depth core,340x300 mm radiator , electric pump, electric fan
BRAKE SYSTEM 4 pistons, 25mm dia., self developed rotors, 25mm dia., floating, cast Iron, hub mounted,
ELECTRONICS Electropneumatic Shifting System, traction control, launch control

ATHENS

National Technical University of Athens

Car 225 **Pit 40-C** **WRL 171** Greece

Prom Racing of the National and Technical University of Athens arrives for its maiden participation in FSG. Bringing forth our fourth racecar P19 „Delia“, we are hoping to shake up the competition. Coming from our best year yet in 2018, our team, having manufactured its first CFRP monocoque chassis and by making several other performance changes is expecting to be very competitive this year. Our car is going to be light and lit.

FRAME CONSTRUCTION CFRP Monocoque Construction with steel roll bars
MATERIAL Prepreg Carbon Fiber and Aluminium honey-comb
OVERALL L / W / H 2870mm / 1550mm / 1190mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1238mm / 1150mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 108kg / 122kg
SUSPENSION Double unequal length A-Arm, pullrod actua-ted springs/ dampers
TYRES (Fr / Rr) 16x7.5- 10 Hoosier LC0/ 16x7.5- 10 Hoosier LC0
WHEELS (Fr / Rr) 7.0x10, 22mm offset, OZ Central-Lock Magnesium/ 7.0x10, OZ Central-Lock Magnesium
ENGINE KTM 500 EXC (2012)
BORE / STROKE / CYLINDERS / DISPLACEMENT 95mmmm / 72mmmm / 1 cylinder / 510cc
COMPRESSION RATIO 11.8:1
FUEL SYSTEM Port injection system, Deatschwerks injec-tor, regulator and fuel pump
FUEL E 85
MAX POWER/TORQUE DESIGN 9500 rpm/ 6200rpm
DRIVE TYPE Chain
DIFFERENTIAL Limited Slip Differential
COOLING Engine internal water pump,radiator mounted in the end of the diffuser with 2 fans controlled by ECU
BRAKE SYSTEM 4-Disk system, floating rotors, electric adjustable brake balance
ELECTRONICS Dash display,80 data channels logged @60Hz, self-developed telemetry software

BATH

University of Bath

Car 261 **Pit T-63** **WRL 69** United Kingdom

Team Bath Racing (TBR) is the combustion powered Formula Student team from the University of Bath. TBR was formed in 2000 and has consistently been one of the UK's top performing teams, with 13 event wins, 5 times top-ranked British team at FSUK and 1 competition win (FS Czech 2016). This year's car develops on last year's success and includes the team's first DRS system and launch control. The team would like to thank their sponsors and university for their continued support.

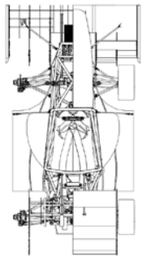
FRAME CONSTRUCTION Full composite monocoque
MATERIAL CFRP skins (woven prepreg w/epoxy matrix) with aluminium and nomex cores. Aluminum FRH, steel MRH.
OVERALL L / W / H 2863mm / 1400mm / 1192mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1200mm / 1180mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 129kg / 134kg
SUSPENSION Converging unequal length double wishbo-nes with anti-roll bar. (pull rod front, push rear)
TYRES (Fr / Rr) Hoosier LC0 16.0 x 7.5-10
WHEELS (Fr / Rr) OZ Magnesium wheel 7.5x10, 22mm offset
ENGINE KTM 690cc LC4 Duke
BORE / STROKE / CYLINDERS / DISPLACEMENT 102mm / 84,5mm / 1 cylinder / 690cc
COMPRESSION RATIO 12.6:1
FUEL SYSTEM Bosch EV14 injectors at port and pre-com-pressor
FUEL E85
MAX POWER/TORQUE DESIGN 7500 rpm/ 6000rpm
DRIVE TYPE Chain drive, 520 PCD
DIFFERENTIAL Solid rear axle (spool)
COOLING Side mounted (LHS) dual core (2 x 1") cross flow radiator, 313cfm fan
BRAKE SYSTEM Floating, ø180mm, 4mm thick, stainless steel, drilled discs with AP Racing Calipers
ELECTRONICS Cosworth IPS32, Pectel SQ6 ECU, with 32 outputs. Sealed, 26AWG wiring loom

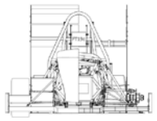
BERLIN

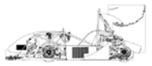
Technische Universität Berlin

Car 313 **Pit T-50** **WRL 91** Germany

The FT19c is the 14th car in the evolution of FaSTTUBe racecars. It's focus is set on variability, reliability and aerodynamic design. The tur-bocharged one cylinder engine gives the car a boost of 85hp. For the second time the team is building two cars simultaneously.







FRAME CONSTRUCTION Tubular Steel Frame
MATERIAL 25CrMo4
OVERALL L / W / H 2926mm / 1551mm / 1190mm
WHEELBASE / TRACK (Fr / Rr) 1575mm / 1221mm / 1221mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 133kg / 116kg
SUSPENSION Double unequal length A-Arm. Push rod (Fr) and Pull rod (Rr) actuated spring and damper.
TYRES (Fr / Rr) 16.0x7.5-10 Hoosier LC0 / 16.0x7.5-10 Hoosier LC0
WHEELS (Fr / Rr) 7x10, 22mm offset, 1 pc Al-Mg Rim
ENGINE 2007 BMW G 450 X
BORE / STROKE / CYLINDERS / DISPLACEMENT 98mm / 59,6mm / 1 cylinder / 449cc
COMPRESSION RATIO 12,5:1
FUEL SYSTEM Self build aluminium tank, external fuel pump, two injectors, pressure regulator
FUEL E85
MAX POWER/TORQUE DESIGN 7500 rpm/ 7000rpm
DRIVE TYPE Chain drive, original gearbox
DIFFERENTIAL Self designed rigid axle
COOLING Self build water-intercooler and cooler in the side box with fan mounted
BRAKE SYSTEM 4-Disk floating syst, hub mounted, 143mm(FR), 113mm(RA), ISR Calipers, Cockpit adjustable
ELECTRONICS Self developed Body Control Unit, Bosch MS4, electr. throttle, wastegate, shifting system

BIAŁYSTOK

Białystok University of Technology

Car 306 **Pit T-56** **WRL 64** Poland

Cerber Motorsport was founded in 2011 by group of enthusiasts from Bialystok University of Technology. We are the first Polish team to stand on the Formula Student podium. CMS-06 is the 6th car built by our team and the 2nd to participate in Formula Student Germany. The main new technical solution of CMS-06 is underbody floor with diffusor. In comparison with previous car, CMS-06 has lighter chassis with increased torsional stiffness. Special thanks to our sponsors and to all who suppor-ted us!!!

FRAME CONSTRUCTION Composite monocoque with rear steel subframe
MATERIAL Carbon fibre, aluminum honeycomb, 4130 alloyed steel
OVERALL L / W / H 2952mm / 1454mm / 1190mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1200mm / 1180mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 132kg / 132kg
SUSPENSION Double A-Arm, Push-rod actuated damper, adjustable T-bar(front)/blade(rear) sway bar
TYRES (Fr / Rr) Hoosier R25B 18x7.5-10
WHEELS (Fr / Rr) 7.0x10, magnesium central lock moun-ted OZ racing
ENGINE Honda CBR600RR PC40
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 12.2:1
FUEL SYSTEM Self-designed fuel rail, Honda OEM fuel pressure regulator
FUEL Ron 98
MAX POWER/TORQUE DESIGN 13430 rpm/ 9500rpm
DRIVE TYPE Chain drive
DIFFERENTIAL Drexler Formula SAE v2 Limited Slip
COOLING Sidepod mounted dual radiator, fan mounted to air duct
BRAKE SYSTEM 4-Disk system, self-developed fully floa-ting vented rotors, bias-bar adjusted
ELECTRONICS Digital multifunctioning self-designed steering wheel, self-developed PMU, launch control

BOCHUM

Ruhr University Bochum

Car 248 **Pit T-65** **WRL 316** Germany

One Team – One Mission – One Car: The RUB 19– RUB Motorsports ne-west single seater FS racing car. We want our car to be as light, fast and reliable as possible. With this vision we developed our incredible new race car. A completely new chassis, a whole new aerodynamic package and the change to a new engine are the results of past 12 months of de-dicated work. Special thanks to our sponsors and our university for their commitment and great support!

FRAME CONSTRUCTION single piece full monocoque
MATERIAL CFRP, Rohacell foam core
OVERALL L / W / H 3080mm / 1508mm / 1190mm
WHEELBASE / TRACK (Fr / Rr) 1540mm / 1235mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 116kg / 148kg
SUSPENSION double unequal length wishbone, pullrod actuated horizontally oriented spring and damper
TYRES (Fr / Rr) Hoosier 18.0 x 6.0 - 10 R25B
WHEELS (Fr / Rr) Aluminium 3-piece Keizer Rim (center lock), 10 inch
ENGINE KTM 450 SX-F 2019
BORE / STROKE / CYLINDERS / DISPLACEMENT 95mm / 63,4mm / 1 cylinder / 449cc
COMPRESSION RATIO 12.6:1
FUEL SYSTEM Bosch MS3 Sport sequential injection and single coil ignition system
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 9000 rpm/ 7500rpm
DRIVE TYPE 4-speed conventional dog-clutch gearbox
DIFFERENTIAL Drexler limited slip differential, Preload 0-70 Nm
COOLING side mounted water and oil radiator, single fan
BRAKE SYSTEM 4/2 piston ISR calipers, 196mm/182 mm self developed rotors, adjustable brake balance
ELECTRONICS fully sealed Harness, Electric Shifting, Clut-ching, Throttle and Brake Balance adjustment

BOLOGNA

University of Bologna

Car 288 **Pit T-84** **WRL 189** Italy

Innovation, history, passion and will to win: this is UniBo Motorsport. Since 2010 our project, in cooperation with the University of Bologna and many Italian automotive companies of the MotorValley around Bologna, is a concrete reality. The team helped students not only from engineering to express their desire to test one's strengths and achieve competitive results. UBM19 Evoluta represents the will to innovate and push to the limits our knowledge.

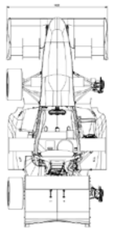
FRAME CONSTRUCTION Hybrid: front monocoque with composite sandwich, rear steel tubes spaceframe.
MATERIAL Monocoque: CFRP sandwich with aluminium and Nomex honeycomb core. Rear frame:: 25CrMo4 steel tubes.
OVERALL L / W / H 2915mm / 1440mm / 1150mm
WHEELBASE / TRACK (Fr / Rr) 1580mm / 1200mm / 1160mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 128kg / 145kg
SUSPENSION Double whisbones, push rod actuation, helicoidal springs, blade adjustable anti roll bar.
TYRES (Fr / Rr) 18x7,5-10 Hoosier R25B / 18x7,5-10 Hoosier R25B
WHEELS (Fr / Rr) 7
ENGINE Suzuki GSX-R 600 K6-K7
BORE / STROKE / CYLINDERS / DISPLACEMENT 67,0mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 14,5
FUEL SYSTEM Student built fuel injection system, common rail.
FUEL Ethanol E85
MAX POWER/TORQUE DESIGN 11500 rpm/ 8500rpm
DRIVE TYPE Sequential 4-speed gearbox.
DIFFERENTIAL Drexler Clutch Pack Limited Slip Differen-tial.
COOLING Laterally mounted radiators with PWM control-led fans.
BRAKE SYSTEM 4-Disk system, self designed rotors, adjus-table brake bias, Brembo calipers.
ELECTRONICS Custom ECU and telemetry system. Multi-functional steering wheel and touchscreen dashboard.

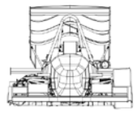
BRNO

Technical University of Brno

Car 274 **Pit T-71** **WRL 20** Czech Republic

The history of TU Brno Racing starts at 2010. With the nearly 40 team members, we aren't the biggest team, but what we lose in numbers we gain back in enthusiasm and strong heart. We have built nine race cars named Dragon since 2010. The newest one, Dragon 9, with new suspension concept, optimized aero package, CFRP monocoque in front and one cylinder turbocharged dragon heart at the back is demonstrably the fastest one. You are invited to see this beast in his pit anytime. Spitting Dragon!





FRAME CONSTRUCTION Front - carbon fiber & honeycomb monocque; rear - steel tube space frame
MATERIAL
OVERALL L / W / H 2929mm / 1426mm / 1172mm
WHEELBASE / TRACK (Fr / Rr)
1528mm / 1200mm / 1170mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 120kg / 129kg
SUSPENSION Double unequal length CFRP A-Arm, pull-rod/push-rod, roll/heave systém
TYRES (Fr / Rr) 205x45 R13, Continental C19
WHEELS (Fr / Rr) 7x13, ET30mm
ENGINE Husqvarna FE 501 - Turbocharged
BORE / STROKE / CYLINDERS / DISPLACEMENT
95mm / 72mm / 1 cylinder / 510cc
COMPRESSION RATIO 9,5:1
FUEL SYSTEM port fuel injection - Bosch injectors (EV12 353 g/min 2-Spray and EV14 765 g/min
FUEL E85
MAX POWER/TORQUE DESIGN 10500 rpm/ 8500rpm
DRIVE TYPE 3 gear transmission, Chain
DIFFERENTIAL Drexler formula student limited slip
COOLING Side-mounted water and oil cooling custom radiators, electric fan
BRAKE SYSTEM 4-Disk system, self developed rotors with 210mm diameter, adjustable brake balance, ISR
ELECTRONICS Traction control, Launch control, Auto upshift, Calibration switches, LifeRacing F88 ECU

CHANGCHUN

Jilin University

Car 211 **Pit 43-B** China

Gspeed Formula Racing Team of Jilin University was established in 2009, the cradle of Chinese vehicle engineers. We have participated in the Formula Student China for 10 consecutive years and won the Chinese Championship in 2018. For 10 years, we developed Dry Sump Lubrication System, ABS+EBD, single cylinder supercharged engine.etc and carried out wind tunnel experiments, K&C experiments, rain tire flooding pavement experiment. Now, we bring the new 2019 Gspeed V10 to FSG.

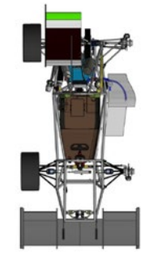
FRAME CONSTRUCTION Monocoque & tubular space semi-frame
MATERIAL CFRP prepreg M40J/CFRP prepreg T700/ 4130 steel tubing 14 to 25mm
OVERALL L / W / H 2984mm / 1460mm / 1185mm
WHEELBASE / TRACK (Fr / Rr)
1590mm / 1220mm / 1180mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 123kg / 144kg
SUSPENSION Double unequal length A-Arm. Push rod actuated horizontally oriented spring with 3rdspring
TYRES (Fr / Rr) 18.0x7.5-10 R10, Hoosier R25B/18.0x7.5-10 R10, Hoosier R25B
WHEELS (Fr / Rr) 7.5x10, 9.5mm offset, 3 pc Al Rim/7.5x10, 9.5mm offset, 3 pc Al Rim
ENGINE 2013 KTM 690 1 cylinder
BORE / STROKE / CYLINDERS / DISPLACEMENT
102mm / 84,5mm / 1 cylinder / 690cc
COMPRESSION RATIO 12.6:1
FUEL SYSTEM Student designed, port injection with dual injectors, semi-sequential
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 8000 rpm/ 3000rpm
DRIVE TYPE 520(22mm)chain
DIFFERENTIAL clutch pack limited slip, 25Nm preroad, 2.5 bias ratio
COOLING Single side pod mounted radiator with thermostatic controlled electric fan
BRAKE SYSTEM 4-Disk system, self developed rotors with 194mm diameter,adjustable brake balance, Caracin
ELECTRONICS ETC, ABS, DC servo Motor shifting, auto-blipping lambda, boost and knock control, TC and lc

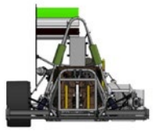
CHENNAI

Indian Institute of Technology Madras

Car 293 **Pit 44-A** **WRL 179** India

We - Raftar Formula Racing, the 35 memeber team from IIT Madras, are into our 8th year in the Formula Student arena. Having learnt from the past victories and experiences we have come to FSG 19 with our most reliable and fastest car yet. We have mainly focused on our goal of data driven design along with huge improvements in the composites and powertrain division to reduce the weight of the car. We are ready to #BLOOD.SWEAT.GASOLINE it out to show some great performance this year. #PEACE.POTIYA





FRAME CONSTRUCTION Tubular Space Frame
MATERIAL ST 52
OVERALL L / W / H 2995mm / 1424mm / 1190mm
WHEELBASE / TRACK (Fr / Rr)
1540mm / 1176mm / 1100mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 128kg / 128kg
SUSPENSION Double unequal length A-arms, pull rod actuated (front), push-rod actuated (rear)
TYRES (Fr / Rr) 152x67B10 MRF ZTD1_C / 152x67B10 MRF ZTD1_C
WHEELS (Fr / Rr) 7x10, 50mm offset, 1 pc Carbon Fibre/ 7x10, 50mm offset, 1 pc Carbon Fibre
ENGINE KTM Duke 390 2015
BORE / STROKE / CYLINDERS / DISPLACEMENT
89mm / 60mm / 1 cylinder / 373cc
COMPRESSION RATIO 12.88:1
FUEL SYSTEM Bosch PFI injection
FUEL 98 Octane unleaded gasoline
MAX POWER/TORQUE DESIGN 9000 rpm/ 7500rpm
DRIVE TYPE Sequential Gearbox
DIFFERENTIAL Salisbury type limited slip differential
COOLING Side mounted single core radiator with 330 cfm electric fan
BRAKE SYSTEM 4-Disk system, custom rotors, adjustable brake bias, Wilwood GP200 calipers
ELECTRONICS Custom wiring harness & DAQ sensors layout, Electropneumatic Shifting system

COBURG

University of Applied Sciences Coburg

Car 270 **Pit T-72** **WRL 4** Germany

The Bengal cat is a domesticated cat breed created the Asian leopard cat and the Egyptian Mau and has a wild appearance and may show spots or marbling.The C-19 Bengal is based on a hybrid chassis consisiting of a monocoque and steel tube rear frame, 16 inch Hoosier tires and runs a four-cylinder Yamaha engine equipped with variable suction tube length and electronic throttle control. Its aerodynamic package consists of short main-profiles, undertrays on both sides, and flaps up to the headrest.

FRAME CONSTRUCTION hybrid chassis; rear spaceframe decoupled from main structure, front monocoque
MATERIAL 200g/m² twill weave carbon fiber, 173g/m² twill weave aramid fiber, 150g/m² unid
OVERALL L / W / H 3013mm / 1373mm / 1172mm
WHEELBASE / TRACK (Fr / Rr)
1542mm / 1157mm / 1129mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 97kg / 146kg
SUSPENSION Double unequal lengt A-Arm/ pullrod actuated spring and damper/ adjustable u-shape ARB
TYRES (Fr / Rr) 16x7,5-10, Hoosier LCO/16x7,5-10, Hoosier LCO
WHEELS (Fr / Rr) 16x7,5-10, Hoosier WET
ENGINE Modified Yamaha R6 RJ05
BORE / STROKE / CYLINDERS / DISPLACEMENT
65,5mm / 44,5mm / 4 cylinders / 600cc
COMPRESSION RATIO 16:1
FUEL SYSTEM Multipoint fuel injection with Bosch EV14 and Bosch MS6, Hydramat
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 12300 rpm/ 8200rpm
DRIVE TYPE 520 Roller-Chain Drive
DIFFERENTIAL Drexler Slip Differential with reworked Locks; preload 30Nm - TBR = 4.00
COOLING
BRAKE SYSTEM
ELECTRONICS

CORVALLIS

Oregon State University

Car 204 **Pit T-64** **WRL 6** United States

Global Formula Racing is an internationally collaborative Formula Student team from Oregon State University and DHBW Ravensburg. Each year we build two cars, one combustion, and one electric, sharing chassis, aerodynamics and suspension packages. In addition, we are also competing with a driverless car this season. GFR19c features an in-direct acting suspension package designed for the 16“ Hoosier tire. We look forward to seeing you in Hockenheim and answering any questions you may have!

FRAME CONSTRUCTION CFRP monocoque with steel front and main roll hoops
MATERIAL Toray T700, aluminum and nomex core, varying thickness
OVERALL L / W / H 2788mm / 1350mm / 1190mm
WHEELBASE / TRACK (Fr / Rr)
1535mm / 1145mm / 1145mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 102kg / 115kg
SUSPENSION Double unequal length a-arms, push rod actuated air spring and damper, adjustable ARB
TYRES (Fr / Rr) Hoosier 16x7.5-10 LCO
WHEELS (Fr / Rr) Student designed 3 peice Al-CFRP rim
ENGINE KTM 450 SX-F
BORE / STROKE / CYLINDERS / DISPLACEMENT
95mm / 63,4mm / 1 cylinder / 450cc
COMPRESSION RATIO 12,75:1
FUEL SYSTEM Honda CRF450R injector, in tank fuel pump
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 10000 rpm/ 8500rpm
DRIVE TYPE Chain drive
DIFFERENTIAL Drexler limited slip differential
COOLING Side mounted oil and water radiators
BRAKE SYSTEM ISR and AP calipers, tilton master cylinders, student designed rotors
ELECTRONICS Motec ECU and data acquisition, live telemetry, custom design CAN to sensor interface

DARMSTADT

University of Applied Sciences Darmstadt

Car 242 **Pit T-83** **WRL 65** Germany

Having gathered knowledge and lots of experience over the past years, the team is aiming higher than ever. To help improve overall performance, we redesigned our monocoque and the aerodynamics package. We're incredibly excited to experience Formula Student Germany once again. Now, we are ready to compete with the best teams of the world and are looking forward to a great event! A special thanks goes to our supporters, who make this amazing experience possible!

FRAME CONSTRUCTION Monocoque + rear tubular steel space frame
MATERIAL CFRP + S235
OVERALL L / W / H 2940mm / 1430mm / 1170mm
WHEELBASE / TRACK (Fr / Rr)
1540mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 130kg / 128kg
SUSPENSION Double wishbone unequal length with pull/ push rod actuation, 3-way adjustable dampers
TYRES (Fr / Rr) Hoosier R25B, Hoosier R25B
WHEELS (Fr / Rr) Keizer 10×6.25, Keizer 10×6.25
ENGINE Modified KTM 450 SXF
BORE / STROKE / CYLINDERS / DISPLACEMENT
95mm / 72mm / 1 cylinder / 510cc
COMPRESSION RATIO 13,35:1
FUEL SYSTEM Bosch single port injection EV14
FUEL E85
MAX POWER/TORQUE DESIGN 8800 rpm/ 6600rpm
DRIVE TYPE Chain driven RWD motorcycle-type gearbox
DIFFERENTIAL Drexler LSD, 30Nm pre-load, adjustable locking ratio
COOLING Vertically mounted 12x8 core water radiator at the sides with controlled fans
BRAKE SYSTEM 4-disk system with 200mm diameter (front/rear), fixed calipers, adjustable brake balance
ELECTRONICS self-designed: Power Distribution Unit, Sensorboard, Display Unit, Live-Telemetry

DORTMUND

Technical University of Dortmund

Car 272 **Pit T-75** **WRL 406** Germany

Founded in 2005, GET racing comes right from the heart of Germany's famous Ruhrgebiet, Dortmund. Located at the TU Dortmund University, students from different courses come together to exceed the possibilities of their otherwise quite theoretical studies by facing the challenges of participating in Formula Student events. After starting from scratch last season to build a reliable foundation for the next years, this year we thoughtfully tweaked our car to tie in with last season's success.

FRAME CONSTRUCTION steel space frame
MATERIAL 1,0038
OVERALL L / W / H 3043mm / 1390mm / 1050mm
WHEELBASE / TRACK (Fr / Rr)
1550mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) kg / kg
SUSPENSION actuated oriented spring and damper
TYRES (Fr / Rr) 205x70-13, Hoosier R25B
WHEELS (Fr / Rr) 7.0x13 1pc Al Rim
ENGINE Yamaha R6 RJ05/09
BORE / STROKE / CYLINDERS / DISPLACEMENT
65,5mm / 44,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 12,4
FUEL SYSTEM programmable ECU with sequential injection and individual ignition
FUEL 98 octane gasoline
MAX POWER/TORQUE DESIGN rpm/ rpm
DRIVE TYPE 4-speed dogbox transmission
DIFFERENTIAL Torque sensitive limited slip bevel gear differential
COOLING Side-mounted self-designed radiator with 300mm fan
BRAKE SYSTEM 4-Disk system, self developed rotor with 222mm diameter, adjustable brake balance, ISR 4
ELECTRONICS custom built data logger based on raspberry pi 3, datastreaming via LTE

ERLANGEN

Friedrich-Alexander-Universität Erlangen-Nürnberg

Car 249 **Pit 38-A** **WRL 84** Germany

High-Octane Motorsports e.V., founded in 2007, is participating for the 12th time in the Formula Student Combustion competition. 60 students of the Friedrich-Alexander University Erlangen-Nuremberg have been working together to build our newest racecar, the FAUmax my. We continued our work of the last season and worked on perfecting last years concept. Therefore we implemented an electronic clutch as well as an special designed differential combined with our bevel gear drive.

FRAME CONSTRUCTION CFRP full monocoque in sandwich structure
MATERIAL Plascore aluminium honeycomb; carbon fibre skins 2mm;
OVERALL L / W / H 2889mm / 1554mm / 1193mm
WHEELBASE / TRACK (Fr / Rr)
1530mm / 1240mm / 1150mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 105kg / 118kg
SUSPENSION double wishbone with direct acting pushrods
TYRES (Fr / Rr) 16x7.5 LC0 Hoosier / 16x7.5 LC0 Hoosier
WHEELS (Fr / Rr) 6.0x10, 1pc CFRP / 6.0X10, 1pc CFRP
ENGINE Modified KTM SX-F 450
BORE / STROKE / CYLINDERS / DISPLACEMENT
95mm / 72mm / 1 cylinder / 510cc
COMPRESSION RATIO 15,1:1
FUEL SYSTEM Low Pressure Bosch-intake runner system
FUEL E85
MAX POWER/TORQUE DESIGN 9500 rpm/ 7500rpm
DRIVE TYPE Bevel Gear
DIFFERENTIAL limited slip differential, self developed housing
COOLING Single side, double direction flow aluminium core radiator
BRAKE SYSTEM four self-designed rotors,
ELECTRONICS Dezentralized control units, electo mechanic shifting & electric clutch

ESSLINGEN

University of Applied Sciences Esslingen

Car 294 **Pit 40-A** **WRL 40** Germany

After a hard and instructive season of 2018, we decided to change some parts of our concept again. With a new 2-zylinder engine, we still trust our 2018 concept. Additonally, a new suspension system together with a new monocoque and a new aerodynamic package, Stallardo ‚19 is again way different from its predecessor. It's hard to predict what the new season will bring, but with an stable and experienced team we are chasing the top five placement again. Keep an eye on Rennstall!

FRAME CONSTRUCTION Modular chassis consisiting of a one piece monocoque and a tubular rear frame
MATERIAL CFRP Monocoque with alumnium honeycomb, steel rear frame
OVERALL L / W / H 3010mm / 1452mm / 1185mm
WHEELBASE / TRACK (Fr / Rr)
1600mm / 1218mm / 1173mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 120kg / 143kg
SUSPENSION pushrod actuated SLA, KW FS heave damper, self designed roll damper, rear wheel steering
TYRES (Fr / Rr) 20x7-13 FSAE Goodyear
WHEELS (Fr / Rr) 20x7-13 FSAE Goodyear
ENGINE Modified KTM LC8C
BORE / STROKE / CYLINDERS / DISPLACEMENT
88mm / 58mm / 2 cylinders / 706cc
COMPRESSION RATIO 13,5:1
FUEL SYSTEM fuel injection, walbro GSL392
FUEL E 85
MAX POWER/TORQUE DESIGN 8800 rpm/ 5500rpm
DRIVE TYPE Chain drive, Sequential 4-speed gearbox
DIFFERENTIAL Drexler clutch pack limited slip, adjustable preload and bias ratio
COOLING custom u-flow water radiator in right sidepod and straight flow oil radiator at left rear
BRAKE SYSTEM floating rotors, 220mm OD, 142mm ID, adjustable brake balance
ELECTRONICS Monocoque integrated harness, self-made ECU platform, Telemetry with smartphone App

GIESSEN

Technische Hochschule Mittelhessen UAS

Car 221 **Pit 37-A** **WRL 117** Germany

We proudly present to you the F21-19. 15 team-members, as well as several highly supportive sponsors, were involved in the production of our race-car „Gina". For the first time in the history of THM Motorsport, we were capable of building an aerodynamic package. Additive manufactured parts of our suspension system in conjunction with weigth optimization of our engines´ elements are only the most noteworthy optimizations wich make „Gina" a fast, and hopefully successful, race-car.

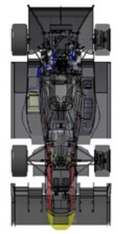
FRAME CONSTRUCTION One piece tubular spaceframe
MATERIAL E235 round tubes 12-25mm diameter
OVERALL L / W / H 2950mm / 1440mm / 1145mm
WHEELBASE / TRACK (Fr / Rr)
1550mm / 1260mm / 1210mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 138kg / 148kg
SUSPENSION Double unequal length A-Arm. Push rod actuated spring and damper units.
TYRES (Fr / Rr) 205/470 R13, Continental C19
WHEELS (Fr / Rr) 7.0x13, 30 mm offset, 1pc Mg Rim
ENGINE Modified Honda CBR600RR (PC40)
BORE / STROKE / CYLINDERS / DISPLACEMENT
69mm / 42,5mm / 4 cylinders / 636cc
COMPRESSION RATIO 14:1
FUEL SYSTEM sequential fuel injection
FUEL ROZ 98
MAX POWER/TORQUE DESIGN 11000 rpm/ 9000rpm
DRIVE TYPE chain drive, 3-speed modified gearbox
DIFFERENTIAL Drexler formula student limited slip differential
COOLING left mounted water radiator with fan, right mounted oil radiator
BRAKE SYSTEM 4-Disk system with ISR calipers, self developed rotors, fully adjustable brake balance
ELECTRONICS self designed battery, custom gear detection, live telemetry and display system

GRAZ

Graz University of Technology

Car 202 **Pit T-79** **WRL 21** Austria

We are the TU Graz Racing Team from Austria and are participating for the 15th consecutive time at FSG with our this years car, called Fiona. Coming into second place for the last two years made us more hungry than ever for a victory at FSG! To achieve this goal, we redesigned our whole car and are now looking forward to compete with the best in the world. Being a team with very young team members, we allways try to implement this young spirit into our TANKIA. Come and visit us at our pit!



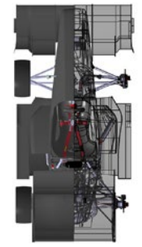
FRAME CONSTRUCTION one piece CFRP monocoque
MATERIAL carbon fibre prepregs, Nomex and aluminium honeycombs, structual foam
OVERALL L / W / H 2885mm / 1430mm / 1174mm
WHEELBASE / TRACK (Fr / Rr)
1550mm / 1180mm / 1180mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 105kg / 123kg
SUSPENSION double unequal length A-arms, pushrod actuated horizontally oriented spring and damper
TYRES (Fr / Rr) 16.0 x 7.5 - R10, Hoosier LC0 / 16.0 x 7.5 - R10, Hoosier LC0
WHEELS (Fr / Rr) 7.5 x 10.0, 2 piece, 3 spoke design, CFRP superlightweight
ENGINE KTM SX-F 450/500
BORE / STROKE / CYLINDERS / DISPLACEMENT
95mm / 72mm / 1 cylinder / 500cc
COMPRESSION RATIO 15.13:1
FUEL SYSTEM inlet manifold injection
FUEL E85 ethanol
MAX POWER/TORQUE DESIGN 9000 rpm/ 7500rpm
DRIVE TYPE chain
DIFFERENTIAL Drexler LSD
COOLING aluminium core water cooler with fan + oil-water-heat exchanger
BRAKE SYSTEM 4 disk system, self designed rear and front brakes, electric adj. brake balance
ELECTRONICS multifunctional steering wheel, electric clutch actuation, self designed live telemetry

GRAZ

University of Applied Sciences Joanneum Graz

Car 238 **Pit 40-B** **WRL 35** Austria

joanneum racing graz and its members - the weasels - have been building race cars since 2003. Students from the U.A.S. Joanneum Graz form the every year alternating team. All the race cars have been boosted and finally reached the 2nd place in the WRL in August 2016. Due to the focus on weight reduction, better aero balance and a more efficient engine a revival is coming soon. This is the main goal of the jr19.



FRAME CONSTRUCTION CFRP monocoque sandwich construciton
MATERIAL High strength and modulus carbon fibre prepags, Rohacell and aramid honeycomb core
OVERALL L / W / H 2970mm / 1494mm / 1180mm
WHEELBASE / TRACK (Fr / Rr)
1580mm / 1280mm / 1240mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 129kg / 134kg
SUSPENSION Double unequal length A-Arm, pull and push rod actuated spring/damper, Adj. Roll bar
TYRES (Fr / Rr) Continental 205/470 R13 - 34M
WHEELS (Fr / Rr) 7 inch wide, one piece handlaminated CFRP Rim
ENGINE Modified Rotax 602 ACE with turbocharger
BORE / STROKE / CYLINDERS / DISPLACEMENT
74mm / 69,7mm / 2 cylinders / 599cc
COMPRESSION RATIO 09:01
FUEL SYSTEM Port injection system, Bosch injectors, one injector per cylinder, aluminum rail
FUEL 98 octance unleaded gasoline
MAX POWER/TORQUE DESIGN 6000 rpm/ 4000rpm
DRIVE TYPE via gearwheels, integrated in gearbox
DIFFERENTIAL 2010 DREXLER limited slip differential integrated in gearbox
COOLING two side pod mounted one core radiators
BRAKE SYSTEM 4-Disk system, floating, heat-treated laser cut rotors with 240 and 208 mm diameter, steel
ELECTRONICS Multifunctional steering wheel with display, Motorsport ABS, Electropneumatic Shifting Sys

GYŐR

Széchenyi István University Györ

Car 279 **Pit 34-B** **WRL 125** Hungary

Arrabona Racing Team was founded in 2014 by 14 ambitious students from the Szechenyi Istvan University of Gyor. Now, we have 42 passionate team members driving forward the most successful Hungarian combustion engine FS team. This year it's our sixth car, and ART_06 was designed and built with one design principle: „Evolution not revolution!" We further improved our aero package and the ergonomics of the car, while also making smaller adjustments, making ART_06 our most advanced FSAE car so far.

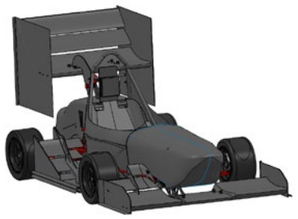
FRAME CONSTRUCTION Tubular steel space frame
MATERIAL 25CrMo4
OVERALL L / W / H 2925mm / 1405mm / 1200mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 113kg / 122kg
SUSPENSION Double unequal length A-Arm, Pullrod actuated spring and damper.
TYRES (Fr / Rr) 470x34 R13, Continental C18 Slick / 470x34 R13, Continental C18 Slick
WHEELS (Fr / Rr) 7x13, 30mm offset 1ps Mg Rim / 7x13, 30mm offset 1ps Mg Rim
ENGINE SZEngine EVO6+
BORE / STROKE / CYLINDERS / DISPLACEMENT 95mm / 72mm / 1 cylinder / 510cc
COMPRESSION RATIO 14,3
FUEL SYSTEM HP-Tech fuel pump, Systec fuel pressure regulator and filter, KTM Injector
FUEL gasoline
MAX POWER/TORQUE DESIGN 8000 rpm/ 5800rpm
DRIVE TYPE 520 Chain
DIFFERENTIAL Clutch pack limited slip differential, 45 Nm preload
COOLING Single sidepod mounted radiator, with thermostatic controlled electric fan
BRAKE SYSTEM 4-Disk-system, Water-jet cut steel rotors, ISR Calipers (25mm, Fr: 4, Rr: dual)
ELECTRONICS Self-designed solid-state power distribution unit, live-telemetry via 3.5G

HAIFA

Technion - Israel Institute of Technology

Car 219 **Pit 46-B** **WRL 227** Israel

Formula Technion is building its seventh racecar. With a lot of potential in last year's car, a lot of effort was invested in the car's reliability to ensure that the team has a fast, yet reliable car at FSG 2019. With tight system packaging and integration optimization, the FT19C weighs a mere 128 kg and the team is eager to test it on track against the tough competition from around the world.



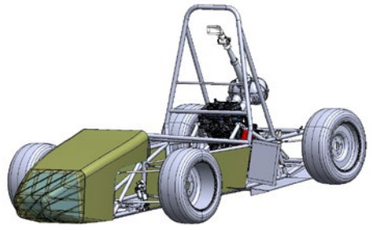
FRAME CONSTRUCTION Hybrid spaceframe
MATERIAL Docol R8 with CFRP inlays and rear Ti-Gr9 structure
OVERALL L / W / H 2865mm / 1360mm / 1185mm
WHEELBASE / TRACK (Fr / Rr) 1525mm / 1150mm / 1120mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 98kg / 98kg
SUSPENSION double unequal length A-Arm. Pull rod. Horizontally oriented spring and damper
TYRES (Fr / Rr) Hoosier 16.0 x 6.0 - 10
WHEELS (Fr / Rr) 10
ENGINE 2019 KTM SX-F 450
BORE / STROKE / CYLINDERS / DISPLACEMENT 95mm / 63,4mm / 1 cylinder / 449cc
COMPRESSION RATIO 12.75:1
FUEL SYSTEM Motec M130 ECU with self-developed fuel pump control
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN rpm/ rpm
DRIVE TYPE 520 Chain
DIFFERENTIAL Drexler FS Limited Slip Differential
COOLING Twin side-mounted radiators under seat
BRAKE SYSTEM 4-disk system
ELECTRONICS Wiring harness sealed to IP67, electrohydraulic anti-roll system, electronic shifting

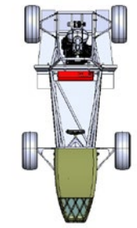
HAMBURG

Helmut Schmidt University of Federal Armed Forces Hamburg

Car 372 **Pit 37-B** **WRL 552** Germany

The comparatively small Eleven-O-Six Racing Team with 25 members consists mostly of officers and officer candidates. For the first time in team´s history, we use a 2-cylinder in-line engine instead of 4 cylinders. By using a diffusor, we dare our first step in using aerodynamic devices. We used 3D-printed molds for our bodywork.





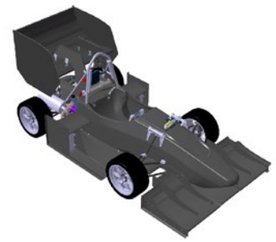
FRAME CONSTRUCTION
MATERIAL
OVERALL L / W / H 2827mm / 1327mm / 1257mm
WHEELBASE / TRACK (Fr / Rr) 1651mm / 1227mm / 1072mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 111kg / 166kg
SUSPENSION Double unequal length A-Arm. Pull rod system in the front and push rod system at the rear
TYRES (Fr / Rr) 205x55 R13 Hoosier R25B
WHEELS (Fr / Rr) 7x13, 18mm offset, 2 pc Al Rim
ENGINE Yamaha MT07
BORE / STROKE / CYLINDERS / DISPLACEMENT 80mmmm / 68,6mm / 2 cylinders / 689cc
COMPRESSION RATIO 11.5:1
FUEL SYSTEM Student design/ build, fuel injection
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 9000 rpm/ 6500rpm
DRIVE TYPE
DIFFERENTIAL
COOLING double radiator with thermostatic controlled electric fan
BRAKE SYSTEM 4-Disk system, self developed rotors with 240mm diameter
ELECTRONICS

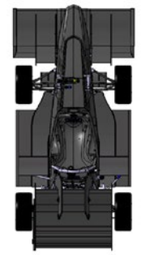
HAMBURG

University of Applied Sciences Hamburg

Car 369 **Pit 35-B** **WRL 291** Germany

HAWKS Racing...15 years of unmistakable design and uncompromising performance. In 2019 we present for the second time a racing car with V2 engine...H15 aka. „VERA".After the conversion to a V2 engine and winning the „Most Innovative Powertrain" award at FSG2018, we have further developed the engine and will now show what it is capable of on the race track.We are looking forward to FSG2019 in HAWKenheim.





FRAME CONSTRUCTION full body monocoque
MATERIAL 200 gsm twill 2/2 / E323 epoxy prepreg, aluminium honeycomb, IG-F foam
OVERALL L / W / H 2994mm / 1460mm / 1185mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 128kg / 156kg
SUSPENSION double equal length A-Arms with push rod, decoupled roll, heave damper spring
TYRES (Fr / Rr) double equal length A-Arms with push rod, decoupled roll, heave damper spring
WHEELS (Fr / Rr) 7x13-22mm offset, CFRP rim
ENGINE Suzuki SV650 `99-`02
BORE / STROKE / CYLINDERS / DISPLACEMENT 81mm / 62,6mm / 2 cylinders / 645cc
COMPRESSION RATIO 11,5:1
FUEL SYSTEM student built, port fuel injection, one injector per runner, full sequential
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 7500 rpm/ 7000rpm
DRIVE TYPE student designed bevel gear drive
DIFFERENTIAL Limited slip differential (Drexler), acc. 40° -> 60%, decelleration 50° -> 42%
COOLING twin side open mounted radiators, electric water pump and electric fans
BRAKE SYSTEM 4-Disk-system, self designed, rotors with 250mm diameter, adjustable bias bar
ELECTRONICS Traction control, launch control, electronic throttle control, Vector data logger with GPS

HEILBRONN

Heilbronn University

Car 239 **Pit T-51** **WRL 301** Germany

HHN Racing is sending the HNR19 into the race. We did not hesitate to tackle bigger changes to make our 5th car faster than the HNR18. First up is the new suspension system, which strives to improve drivability by reducing steering forces. This year we're back to spring-dampers and worked hard to get the geometry and setup right. After years of big noses, we're proud to say that the HNR19 comes with a fresh look and improved aerodynamics. Just one hour apart, FSG is a home match for us!

FRAME CONSTRUCTION Welded steel spaceframe with water jet cutted aluminium endplate
MATERIAL E355 steel tubing, 7075 Aluminium endplate, Aluminium honeycomb crashstructure
OVERALL L / W / H 2920mm / 1405mm / 1188mm
WHEELBASE / TRACK (Fr / Rr) 1525mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 124kg / 132kg
SUSPENSION Double A-Arm, Push rod actuated dampers, adjustable in compression and in rebound range
TYRES (Fr / Rr) 205/470 R13, Continental 34M front & rear
WHEELS (Fr / Rr) OZ Formula Student 13
ENGINE Modified Husqvarna SMR 510
BORE / STROKE / CYLINDERS / DISPLACEMENT 97mm / 67,8mm / 1 cylinder / 501cc
COMPRESSION RATIO 13,3:1
FUEL SYSTEM Bosch fuel injection EV14 L-Valve in student designed housing in manifold
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 9000 rpm/ 6500rpm
DRIVE TYPE Chaindrive
DIFFERENTIAL Drexler Adjustable limited slip differential
COOLING left side mounted, single core, 240mm x 200mm, single electric fan rear mounted
BRAKE SYSTEM 4-Disk system, self-developed rotors with front 218 mm and rear 208 mm diameter, adj. brak
ELECTRONICS Bosch MS6 ECU; electropneumatic shifting & clutch; Telemetry; Instruments with RGB-LEDs

ISTANBUL

Yıldız Technical University

Car 340 **Pit 38-C** **WRL 226** Turkey

YTU Racing, founded in 2011, within TU Yıldız, one of the most significant and oldest universities of Turkey. YTR-06 built on the experience of prior five cars and their glories, once again competing in Formula Student Germany. Runner-up of last year's acceleration event has come with more sophisticated aerodynamics, changes in base concept, a better suspension geometry, shorter and more rigid chassis and a total of 91 hp. Beating this beast, YTR-06, is going to be a lot harder than before.

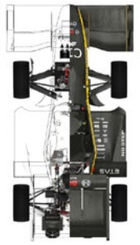
FRAME CONSTRUCTION Tubular Space Frame
MATERIAL S460MC, FE E355, E235
OVERALL L / W / H 2943mm / 1441mm / 1180mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1200mm / 1150mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 122kg / 149kg
SUSPENSION Double unequal length converging AArm, Push rod actuated
TYRES (Fr / Rr) 175X55 R13, Hoosier R25B / 195X45 R13, Hoosier R25B
WHEELS (Fr / Rr) 7.0X13,30 mm negative offset / 7.0X13,30 mm negative offset
ENGINE 2008 Honda CBR600RR
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 12.2:1
FUEL SYSTEM Multipoint injection with low pressure common rail system
FUEL 98 Octane Unleaded Gasoline
MAX POWER/TORQUE DESIGN 10250 rpm/ 10250rpm
DRIVE TYPE Chain Drive
DIFFERENTIAL Limited Slip Differential
COOLING Two symetric radiators located behind the chassis and between rear wheels.
BRAKE SYSTEM 4-Disk system, self developed rotors, adjustable brake balance
ELECTRONICS Traction Control, Launch Control, Automatic Gear Shifting, Monitored Via Telemetry

KARLSRUHE

Karlsruhe Institute of Technology

Car 222 | **Pit 41-C** | **WRL 133** | Germany

"One team–three cars!" KA-RaceIng is designing, manufacturing and competing with an FSC, FSE and FSD car. After two years full of problems, we finally started to focus on reliability. Keeping this goal in mind, we changed some minor details, like a new camshaft, a new and unique upright concept and a new monocoque. With these small changes, we were able to increase power by nearly 25% and increase our downforce by over 15%. You see, we did everything possible to build a reliable car.



FRAME CONSTRUCTION Hybrid Chassis with a CFRP monocoque frontmodule and a steel tubular rearend
MATERIAL UHM UD fibers and HM twill prepregs, aluminium & aramid honeycombs
OVERALL L / W / H 2925mm / 1566mm / 1165mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1220mm / 1220mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 107kg / 131kg
SUSPENSION Double unequal length CFRP A-Arm. Push rod actuated coil spring and KW damper with arb.
TYRES (Fr / Rr) 205/470 R13, Continental C19
WHEELS (Fr / Rr) 7
ENGINE KTM 450SX-F
BORE / STROKE / CYLINDERS / DISPLACEMENT 95mm / 63,4mm / 1 cylinder / 450cc
COMPRESSION RATIO 10,6:1
FUEL SYSTEM intake manifold injection
FUEL E85
MAX POWER/TORQUE DESIGN 9500 rpm/ 5500rpm
DRIVE TYPE gearbox
DIFFERENTIAL limited Slip differential
COOLING two rear mounted radiators with electric fans
BRAKE SYSTEM 4-Disk system, FEM optimized rotors, adjustable brake balance
ELECTRONICS multifunctional steering wheel, graphical driver interface, electronic clutch actuation

KARLSRUHE

University of Applied Sciences Karlsruhe

Car 399 | **Pit T-54** | **WRL 30** | Germany

High Speed Karlsruhe has participated in the Formula Student Event since 2007. In 2019 the 50 team members built the 13th generation combustion race car, the F-113. The F-113 is equipped with new suspension kinematics, a reworked cooling system, new brake system as well as E85 fuel system. Our team is unique as we built as much as possible with our own hands. E.g. team members also program and operate CNC machines. Despite the fact that we are a small team, we achieve top 10 results.

FRAME CONSTRUCTION full CFRP monocoque
MATERIAL carbon fibre with aluminium honeycomb core
OVERALL L / W / H 2890mm / 1435mm / 1185mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1180mm / 1180mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 110kg / 112kg
SUSPENSION Double unequal length A-Arm. Pull rod actuated horizontally oriented spring and damper
TYRES (Fr / Rr) Hoosier 16.0x7.5 - 10 R25B
WHEELS (Fr / Rr) 6.0x10, 4mm offset, 2pc Al/C Rim
ENGINE Modified Suzuki RM-Z
BORE / STROKE / CYLINDERS / DISPLACEMENT 100mm / 62,1mm / 1 cylinder / 493cc
COMPRESSION RATIO 15,2:1
FUEL SYSTEM Bosch MS6.1, sequential fuel injection and spark ignition
FUEL E85
MAX POWER/TORQUE DESIGN 9000 rpm/ 7500rpm
DRIVE TYPE chain drive
DIFFERENTIAL clutch pack limited slip, 10Nm preload, adjustable ratios
COOLING 2 rear mounted radiators and 2x 200mm electric fans
BRAKE SYSTEM 4-Disk system, self developed brake 3-piston calipers (FA & RA), adjustable brake balance
ELECTRONICS 10 self-developed control/sensor units, electropneumatic shifting system, WIFI Telemetry

KEMPTEN

UAS Kempten

Car 260 | **Pit 44-C** | **WRL 427** | Germany

We are Infinity Racing from Kempten (GER). This year we aim for beating the teams record from 2014 with our new car, TRIXI.

FRAME CONSTRUCTION Front: Composite Monocoque; Rear: Steel Spaceframe
MATERIAL carbon-fibre composite; E355+C1 steel round tubing
OVERALL L / W / H 3000mm / 1400mm / 1220mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1220mm / 1156mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 137kg / 132kg
SUSPENSION Double unequal length A-Arm. Pull rod in front, push rod at rear
TYRES (Fr / Rr) 205/470 R13, Continental/ 205/470 R13, Continental
WHEELS (Fr / Rr) 7.47x13, OZ magnesium rim/ 7.47x13, OZ magnesium rim
ENGINE 2005 Yamaha R6 RJ 09 4 cylinder DOHC
BORE / STROKE / CYLINDERS / DISPLACEMENT 65,5mm / 44,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 12.4:1
FUEL SYSTEM Student built ,fuel injection, sequential
FUEL 98 octane unlead gasoline
MAX POWER/TORQUE DESIGN 13000 rpm/ 9800rpm
DRIVE TYPE chain drive chain typ: Enuma 520MRD6
DIFFERENTIAL Drexler clutch pack limited slip FS 2010,10Nm preload, 1200Nm maximum torque
COOLING Twin side pod mounted radiators with thermostatic controlled electric fans
BRAKE SYSTEM Floating, Cast Iron, hub mounted, 200mm outer diam., adjustable brake balance
ELECTRONICS sealed wiring harness, Multifunctional Steering Wheel, Electropneumatic Shifting System

KONSTANZ

University of Applied Sciences Konstanz

Car 343 | **Pit 44-B** | **WRL 82** | Germany

Founded at the UAS Konstanz in 2006, the Bodensee Racing Team proudly presents its 14th racecar, the ILTIS19. At the beginning of the season our team welcomed many motivated rookies and now consists out of 30 students from different faculties. The ILTIS19 represents the end of an era - it will be our last combustion car.For the next year we are looking forward to open a new chapter of our team history with the ILTIS20E.#farewellcombustion

FRAME CONSTRUCTION Tubular steel space frame
MATERIAL SAE 4130
OVERALL L / W / H 2880mm / 1474mm / 1175mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1222mm / 1172mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 117kg / 143kg
SUSPENSION Double unequal length CFK A-Arm. Pull rod actuated horizontally oriented spring and damper
TYRES (Fr / Rr) 205/470 R13 (34M), Continental C19 / 205/470 R13, Continental C19 (34M)
WHEELS (Fr / Rr) 7.0x13, 30mm offset, Mg Rim, OZ S.p.A. / 7.0x13, 30mm offset, Mg Rim, OZ S.p.A.
ENGINE Modified Suzuki GSX R600 (k8-10)
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 12.5:1
FUEL SYSTEM multipoint injection
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 12000 rpm/ 8200rpm
DRIVE TYPE Suzuki original gear, 3 gears, 520 chain
DIFFERENTIAL Drexler LSD - Formula Student, 0-100Nm preload, TBR: drive 3.08 brake 2
COOLING water radiator, 594cfm fan on sidepod; oil radiator, 413cfm fan on sidepod
BRAKE SYSTEM self devel. floating rotors with 225mm OD, adj. brake bias, 4- and 2-piston ISR calipers
ELECTRONICS Steering Wheel with integrated Display, selfdesigned PDM, Electropneumatic Shifting System

LEGANÉS

University Carlos III of Madrid

Car 373 | **Pit T-81** | **WRL 409** | Spain

Formula UC3M started back in 2016 with its first prototype C3-R16. Each year the team tries to achieve its maximum. The first prototype includes a complete aero package, our second car was a completely new concept. Our goal is simple: get good results putting together all the resources, experience and passion. In order to achieve our goals the team is always trying to improve the designs, manufacturing process, statics events and performance. This C3-R19 put all these goals together in a car.

FRAME CONSTRUCTION Hybrid chassis: Carbon fiber + foam monocoque and rear tubular steel frame.
MATERIAL Carbon fibre-Foam sandwich structure
OVERALL L / W / H 2884mm / 1447mm / 1179mm
WHEELBASE / TRACK (Fr / Rr) 1580mm / 1230mm / 1170mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 131kg / 181kg
SUSPENSION Double unequal wishbone arms, pull-rod actuated in front and push activated in rear.
TYRES (Fr / Rr) AVON 7.0/16.0-10
WHEELS (Fr / Rr) Braid Sturace 10
ENGINE Honda CBR 600 F4i
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 12:1
FUEL SYSTEM Inline fuel pump, 300lph and injectors
FUEL RON 98
MAX POWER/TORQUE DESIGN 11500 rpm/ 6800rpm
DRIVE TYPE Chain
DIFFERENTIAL Mechanical limited slip differential - Drexler 2010
COOLING Rear mounted 600cc radiator with a self developed fan
BRAKE SYSTEM 4-Disk system, self developed steel rotors (4mm front, 3mm rear)
ELECTRONICS Custom desinged telemetry, radiator fans and flatshifter with servo motor for clutch.

LIUZHOU

Guangxi University of Science and Technology

Car 268 | **Pit T-68** | China

Data acquisition system, dry lubrication and traction control system, composite suspension system;The FSC formula racing team of guangxi university of science and technology was established on April 18, 2013. It is composed of students of different grades and majors from different colleges of guangxi university of science and technology, as well as a number of instructors with rich experience in automobile research. Currently, the team has more than 60 members.

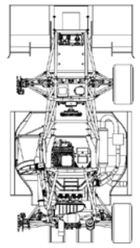
FRAME CONSTRUCTION Steel tube truss structure
MATERIAL 30CrMo
OVERALL L / W / H 2830mm / 1500mm / 1180mm
WHEELBASE / TRACK (Fr / Rr) 1565mm / 1200mm / 1180mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 126kg / 154kg
SUSPENSION Double unequal length A-Arm. Push rod actuated horizontally oriented spring and damper (co
TYRES (Fr / Rr) 228x55 R10, Hoosier R25B
WHEELS (Fr / Rr) 7.5x10, 50mm offset, 3 pc Al Rim
ENGINE Modified Honda CBR600F (PC35)
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 12,2:1
FUEL SYSTEM Open-source MegaSquirt system with semi-sequential injection and wasted-spark ignition
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 11000 rpm/ 9000rpm
DRIVE TYPE International sequence gear
DIFFERENTIAL Torque sensitive limited slip bevel gear differential with internal preload adjustment
COOLING Rear mounted 900cc Mini radiator and 254mm electric fan
BRAKE SYSTEM 4-Disk system, self developed rotors with180mm diameter, adjustable brake balance, RIT de
ELECTRONICS wiring harness sealed to IP67, Multifunctional Steering Wheel, Electropneumatic Shifting S

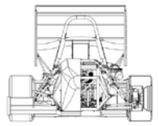
LUND

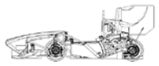
Lund University

Car 317 **Pit 34-C** **WRL 182** Sweden

Lund Formula Student is returning to FSG for the third year in a row. 40 students from 10 different programs have been working hard since September to produce our latest car, LFS19. The biggest changes from last year are a more advanced aerodynamics package, front anti-roll bar, electro-pneumatic shifting system, and a 10% overall reduction in weight. We are determined to continue the trend of positive results we have achieved in the past couple of years, and are aiming for a top ten finish.







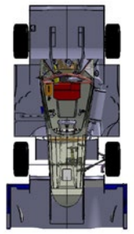
FRAME CONSTRUCTION Tubular steel space frame with CFRP sandwich panel reinforcement
MATERIAL Cold drawn seamless steel tubes. Foam core CFRP sandwich panels
OVERALL L / W / H 2951mm / 1435mm / 1150mm
WHEELBASE / TRACK (Fr / Rr) 1590mm / 1190mm / 1160mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 134kg / 144kg
SUSPENSION Double A-arm. Direct actuated spring and damper (air spring). Anti-roll bar front and rear
TYRES (Fr / Rr) 18.0x6.0 R10 Hoosier R25B. Front and rear
WHEELS (Fr / Rr) 7x10 split aluminium rim, milled aluminium center. Front and rear
ENGINE Modified Honda CB600F
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 14:1
FUEL SYSTEM Port injection at intake runners. 3D printed fuel tank with fuel mat.
FUEL E85
MAX POWER/TORQUE DESIGN 10500 rpm/ 8500rpm
DRIVE TYPE Chain drive
DIFFERENTIAL Limited slip differential with preload adjustment
COOLING Side mounted custom water and oil radiator with xxxmm electric fan.
BRAKE SYSTEM 4-Disk steel rotor system with adjustable brake balance.
ELECTRONICS Electronic throttle, electro-pneumatic clutchless shifting, live-telemetry, launch control

MARIBOR

University of Maribor

Car 235 **Pit T-76** **WRL 211** Slovenia

Driving upside down in a tunnel is a goal we want to achieve. Having done an extensive job on aerodynamic package and weight reduction, we are now confident we have come there! Now we just have to test it. Chassis integrated diffusor, blown undertray, refined front wing design are some of the features we used to achieve the downforce, while carbon fibre monocoque and systematic lightweight construction is making our car one of the lightest there is!



FRAME CONSTRUCTION Carbon fibre sandwich monocoque with integrated aluminium front hoop
MATERIAL Plain carbon fibre and kevlar skin(1.22 mm), nomex and aluminium honeycomb core (20 mm and 40 mm)
OVERALL L / W / H 2945mm / 1570mm / 1195mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 110kg / 128kg
SUSPENSION Double unequal length A-arm. Pull and pushrod actuated dampers. Adjustable
TYRES (Fr / Rr) 155x65 R10, Hoosier LC0 (front and rear)
WHEELS (Fr / Rr) 7.0x10, 59 mm offset, Carbon fibre, aluminium centre (front and rear)
ENGINE Modiffied KTM 450 SX-F
BORE / STROKE / CYLINDERS / DISPLACEMENT 95mm / 63,4mm / 1 cylinder / 499cc
COMPRESSION RATIO 14.0:1
FUEL SYSTEM Multi point port injection, REF-SYNC sensor
FUEL E85
MAX POWER/TORQUE DESIGN 8500 rpm/ 6000rpm
DRIVE TYPE 4-speed sequential, robotized
DIFFERENTIAL Torque sensitive limited slip differential with internal preload adjustment
COOLING Side mounted ATV radiator with fan and electric water pump
BRAKE SYSTEM 4-Disk system, self developed rotors with 200mm diameter, adjustable brake balance
ELECTRONICS Weight optimized, Multifunctional Steering Wheel, Electropneumatic Shifter, Telemetry

MILANO

Polytechnic University of Milan

Car 208 **Pit 43-A** **WRL 17** Italy

Dynamis PRC was born 15 years ago and is now ready more than ever to compete against the best team from all over the world.We are looking forward to show you our wonderful, light and fast prototype: the DP11.#KeepPushing#WeAreDynamisPRC#WeAreMilanoPolitecnico

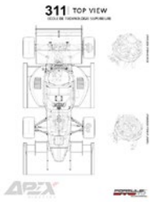
FRAME CONSTRUCTION CFRP monocoque
MATERIAL High strenght and high modulus pre-preg CFiber, epoxy resin, Nomex®, Rohacell foam, Al honeycomb
OVERALL L / W / H 2983mm / 1405mm / 1186mm
WHEELBASE / TRACK (Fr / Rr) 1600mm / 1200mm / 1160mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 108kg / 119kg
SUSPENSION Adjustable double carbon fiber wishbone, Pull-Rod, Double horizontal Shock Absorber, Adjus
TYRES (Fr / Rr) 185/40/R13/185/40/R13
WHEELS (Fr / Rr) 7.0x13, 10mm offset, CFRP Rims /7.0x13, 10mm offset, CFRP Rims
ENGINE Modified Aprilia RXV550, V-Twin (77°) design
BORE / STROKE / CYLINDERS / DISPLACEMENT 80mm / 55mm / 2 cylinders / 552cc
COMPRESSION RATIO 12,5
FUEL SYSTEM EFI euro4, full sequential fuel injection
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 9500 rpm/ 8000rpm
DRIVE TYPE Chain drive, pitch: 15.875mm, plate th:1
DIFFERENTIAL Drexler Formula Student LSD. Lock-up 88% power, 51% coast, 25 Nm preload
COOLING Two custom double pass core side mounted radiators with ECU controlled fans
BRAKE SYSTEM 4-Disk system, self developed rotors with 250mm diameter, adjustable brake balance
ELECTRONICS Multifunctional Steering Wheel, Electroactuated Shifting S

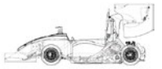
MONTRÉAL

University of Québec - ETS

Car 311 **Pit T-70** **WRL 9** Canada

Formule ETS is composed of 15 dedicated engineering students who thrive for success. The APEX-19 is the 26th and last combustion car of ETS. It integrates an in-house manufactured and designed supercharged engine, inverted spindles, custom brake calipers, heave and roll decoupled suspension system, a high specific stiffness full CFRP-monocoque as well as a light and high downforce focused aerodynamic package. This concept is validated with the help of extensive data acquisition and testing.





FRAME CONSTRUCTION Full composite monocoque
MATERIAL CFRP, Aluminum, Titanium, Steel, Inconel, Tungsten and Smoked Meat Poutine
OVERALL L / W / H 2861mm / 1370mm / 1180mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1143mm / 1143mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 101kg / 121kg
SUSPENSION Front and rear decoupled heave and roll suspension
TYRES (Fr / Rr) Hoosier 16.0 x 7.5-10 LCO
WHEELS (Fr / Rr) Hoosier 16.0 x 7.5-10 LCO
ENGINE Supercharged custom single cylinder engine
BORE / STROKE / CYLINDERS / DISPLACEMENT 95mm / 63,4mm / 1 cylinder / 450cc
COMPRESSION RATIO 12,5:1
FUEL SYSTEM Single piece CFRP fuel tank, twin port injected
FUEL E85
MAX POWER/TORQUE DESIGN 9500 rpm/ 6500rpm
DRIVE TYPE Single gear chain drive
DIFFERENTIAL Drexler
COOLING Sidewing mounted cross stream radiator
BRAKE SYSTEM Custom quad pistons inverted calipers, floating stainless steel drilled discs
ELECTRONICS Full data acquisition telemetry

MUMBAI

Dwarkadas. J. Sanghvi College of Engineering

Car 347 **Pit T-82** **WRL 207** India

DJS Racing is the Formula Student team of Dwarkadas J Sanghvi College of Engineering, Mumbai, India. The team consists of 120 engineering undergrads, united by an common objective- to seek constant improvement in terms of technology and professionalism for the team as well as for every individual member. Throughout our 7 year history, the team has always strived for innovation. At FSG 2019, we will be participating with our combustion prototype DJSR 05.

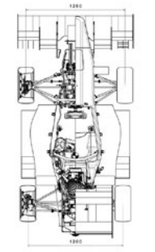
FRAME CONSTRUCTION Front and Rear Tubular Space Frame
MATERIAL Mild steel - AISI grade 1018
OVERALL L / W / H 3046mm / 1353mm / 1170mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1200mm / 1150mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 129kg / 119kg
SUSPENSION Double unequal length A-Arm. Push rod actuated horizontally oriented spring and damper.
TYRES (Fr / Rr) 152.4x67 V16, Hoosier R25B / 152.4x67 V16, Hoosier R25B
WHEELS (Fr / Rr) 6x10, 25 mm offset, 2 pc Al Rim / 6x10, 25 mm offset, 2 pc Al Rim
ENGINE 2018 KTM RC 390
BORE / STROKE / CYLINDERS / DISPLACEMENT 89mmmm / 60mmmm / 1 cylinder / 373cc
COMPRESSION RATIO 12.88:1
FUEL SYSTEM Bosch Fuel Injection System with EV-14 (Compact) Injector, Manifold Injection
FUEL 98 Octane Unleaded Gasoline
MAX POWER/TORQUE DESIGN 9500 rpm/ 7000rpm
DRIVE TYPE Chain Drive
DIFFERENTIAL Drexler V2 Limited Slip Differential with 45 N-m pre load
COOLING Right Side mounted Single Core radiator, 2400 CFM fan mounted to radiator using a Carbonfibre shroud
BRAKE SYSTEM 4- Disk,Custom made Calipers, Adjustable Pedal Position,Adjustable Balance Bar
ELECTRONICS Optimized wiring harness using twisting and heat shrink,electro pneumatic shifting system,

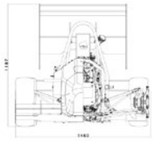
MÜNCHEN

University of Applied Sciences München

Car 231 **Pit T-66** **WRL 151** Germany

Passionworks – not only the name of our cars but also our guiding principle! We are proud to present the PW12.19 and hope to unleash its whole potential at the Hockenheimring this August. With a focus on aerodynamics and lightweight we intend to improve our dynamic performance, while the Team has been hard at work to master the static disciplines.





FRAME CONSTRUCTION Monocoque/Tubular Space Frame (TSF)
MATERIAL CFRP, Rohacell Foam Core/ 15CrMoV6
OVERALL L / W / H 2918mm / 1460mm / 1187mm
WHEELBASE / TRACK (Fr / Rr) 1540mm / 1250mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 116kg / 116kg
SUSPENSION Double unequal lenght A-Arm. F:Pull-, R:Pushrod actuated 3-damper-system
TYRES (Fr / Rr) 205/470 R13 - Continental C19
WHEELS (Fr / Rr) 7x13, 30mm CFRP Rim with tolology optimized aluminium rim star
ENGINE KTM 450 SX-F
BORE / STROKE / CYLINDERS / DISPLACEMENT 95mm / 63,4mm / 1 cylinder / 449cc
COMPRESSION RATIO 13,95:1
FUEL SYSTEM dead end system, self-developed fuel rails, two Bosch EV14 injectors
FUEL E85
MAX POWER/TORQUE DESIGN 9000 rpm/ 7000rpm
DRIVE TYPE chaindrive 428# chain, 4 speed gearbox
DIFFERENTIAL Drexler, clutch pack limited slip, adjustable bias ratio and pre load
COOLING custom radiator at the rear,
BRAKE SYSTEM 4-Disk system, rotors with F:254/R:211mm diam. Adjustable brake-balance, AP 2-piston cal.
ELECTRONICS MoTec M150 , self developed BMS/ Mainpower/ TC/ LC/AU

PADERBORN

University of Paderborn

Car 258 **Pit 41-A** **WRL 123** Germany

After 12 years of steady evolution of our combustion race car, we as the UPBracing Team have decided to go all out this season. 46 kilograms saved, an entirely new chassis and aerodynamics package, a decoupled suspension system and our first telemetry system - this is an extraordinary progress.We want to make a statement and create a base for seasons to come. 48 students, sleepless nights and a common goal have created a potential to accelerate „small Paderborn" to the top ranks.

FRAME CONSTRUCTION Front monocoque, rear steel frame
MATERIAL CFRP and 1.7734
OVERALL L / W / H 2992mm / 1397mm / 1146mm
WHEELBASE / TRACK (Fr / Rr) 1600mm / 1052mm / 1032mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 121kg / 128kg
SUSPENSION double unequal wishbone, decoupled pull-rod/pushrod suspension
TYRES (Fr / Rr) Hoosier 16.0x7.5 R10
WHEELS (Fr / Rr) 10x7, cast magnesium rim, 22mm offset
ENGINE Modified Suzuki GSX-R 600
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 13:1
FUEL SYSTEM Bosch EV12 injectors with student-made fuel rail
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 9500 rpm/ 7000rpm
DRIVE TYPE chain drive 22.5mm
DIFFERENTIAL Drexler Formula Student limited slip differential
COOLING left, right-side mounted 290x181x34mm core with electric fans
BRAKE SYSTEM Self developed rotors with 189mm diameter, adjustable brake balance, Brembo P4-24 & P2-24
ELECTRONICS One central control unit, two-part loom, Steering wheel with display and signal lights

PADOVA

University of Padova

Car 285 **Pit 46-C** **WRL 140** Italy

Race UP Team started participating in Formula SAE ruled competitions since 2003. This year the team is coming back to Formula Student Germany with its 14th car, starting from the experience of the good project of last year. All the components are designed to give the best performance on track and to reach the best integration. The goals of the year are to reduce the COG in order to improve vehicle dynamics and to extract the maximum performance out of the new car, with an intense testing phase

FRAME CONSTRUCTION Tubolar spaceframe
MATERIAL Steel AISI4130 (25CrMo4)
OVERALL L / W / H 2958mm / 1478mm / 1174mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1220mm / 1190mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 136kg / 147kg
SUSPENSION Double unequal length A-Arm. Pull-rod actuated
TYRES (Fr / Rr) 185x40 R13 Pirelli / 185x40 R13 Pirelli
WHEELS (Fr / Rr) 7.0 x 13" / 7.0 x 13" OZ Racing magnesium
ENGINE Honda CBR 600 RR PC40 2007/2008
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO
FUEL SYSTEM Single injector per cylinder, low pressure
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN rpm/ rpm
DRIVE TYPE gearbox (student developed), 520 chain
DIFFERENTIAL Limited slip, 0/75 Nm Preload, 60% drive - 45% decel interlock value
COOLING both sides mounted 30 core radiator, 800 cfm fan mounted to radiator
BRAKE SYSTEM ISR calipers, 4 self developed rotors with 250mm / 220mm diameter, adjustable brake bias
ELECTRONICS Self-developed dashboard, custom ETC, electropneumatic clutch and shifting system

PFORZHEIM

Pforzheim University

Car 379 **Pit 43-C** **WRL 239** Germany

Rennschmiede Pforzheim proudly presents „RSP19 - Emerald". The goal was to improve our last year car by redesigning our chassis to fit our whole aero-package and improve lateral acceleration. Additionally we succesfully manufactured carbon rims for the first time on our own. We did some major changes on our standard KTM SX-F 450 engine as well by installing a 510ccm big bore kit and attaching it to a selfmade carbon fuel tank. Emerald is the lightest and innovative car we have ever built!

FRAME CONSTRUCTION tubular steel space frame
MATERIAL E235+C
OVERALL L / W / H 2915mm / 1400mm / 1212mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1180mm / 1140mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 111kg / 121kg
SUSPENSION Double A-Arm, Pullrod actuated spring/ damper with rocker, adjustable Anti Roll Bar U-Type
TYRES (Fr / Rr) 16.0 x 6.0-10, Hoosier R25B / 16.0 x 6.0-10, Hoosier R25B
WHEELS (Fr / Rr) selfmade 10" carbon wheels with aluminium-rimstar
ENGINE Modified KTM SX-F 450 with 510cc big bore kit
BORE / STROKE / CYLINDERS / DISPLACEMENT 95mm / 72mm / 1 cylinder / 510cc
COMPRESSION RATIO 14.9:1
FUEL SYSTEM carbon fuel tank and PFI fuel injection
FUEL E85
MAX POWER/TORQUE DESIGN 9400 rpm/ 7500rpm
DRIVE TYPE chain drive
DIFFERENTIAL Drexler limited slip differential
COOLING one radiator on each frame side with attached fans fans
BRAKE SYSTEM Selfdesgined, drilled and floating rotors with 182mm diameter , ISR brake calipers
ELECTRONICS Multifunctional steering wheel, electropneumatic shifting

PISA

University of Pisa

Car 243 **Pit 46-A** **WRL 240** Italy

E-Team Squadra Corse presents KeruBlast. The team is composed by 80 members, who work hard to obtain the best. The development of a new 4-speed gear box was based on a brilliant idea of our team. ETC finally landed on our car. Titanium alloy and carbon fiber tubes are used to lighten it. And for the first time aerodynamic grooves have been implemented on the vehicle. To discover the other cool features of our car you are all invited to come and talk with us, the most orange guys.

FRAME CONSTRUCTION Tubular steel space frame
MATERIAL BS4 T45 round tubing
OVERALL L / W / H 3070mm / 1450mm / 1180mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1265mm / 1135mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 140kg / 152kg
SUSPENSION Double unequal length A-Arm. Push rod (front) and pull rod (rear)
TYRES (Fr / Rr) 13" - 180mm/530mm, DSS, Pirelli
WHEELS (Fr / Rr) 7"x13", 43mm offset, 1 pc Magnesium Rims
ENGINE Modified Honda CBR 600RR, 2003
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 13:1
FUEL SYSTEM Student des/built, external pump by bosch, custom Al rail, injectors by bosch
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 11000 rpm/ 8000rpm
DRIVE TYPE 520 chain, 15.875mm pitch
DIFFERENTIAL LSD, 30-35Nm preload after initial run in, ramp angle setup 40deg/50deg
COOLING Twin side pod mounted radiators with electric fans
BRAKE SYSTEM Self developed, inox, floating 230mm (front), fixed 210mm (rear), driver adj. balance bar
ELECTRONICS Self developed PDU, Electric shift, GSM based Telemetry, multifuntional dashboard with LCD

PUNE

Smt. Kashibai Navale College of Engineering

Car 215 **Pit 35-C** **WRL 244** India

We at STES's Stallion Motorsport are committed to enhance the level of engineering by nurturing passionate, dedicated and bright engineers, but, more importantly good human beings. With one collective dream, „To be the best", the team was established in 2014 by a few passionate engineers and has been growing and progressing ever since.We pride ourselves over our dedication, work ethic and a bond that the team infuses between our teammates which inspires us to strive for glory.

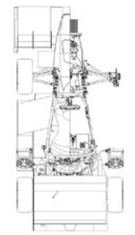
FRAME CONSTRUCTION Tubular space frame
MATERIAL AISI-1018
OVERALL L / W / H 3152mm / 1360mm / 1226mm
WHEELBASE / TRACK (Fr / Rr) 1545mm / 1150mm / 1100mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 108kg / 162kg
SUSPENSION Double unequal length A-arm. Pull rod actuated adjustable in compression and rebound.
TYRES (Fr / Rr) 152x46 R10, Hoosier R25B/ 152x46 R10, Hoosier R25B
WHEELS (Fr / Rr) 6.25x10, 50.14mm offset, 2pc Al rim /7x10, 12.7mm offset, 2pc Al rim
ENGINE Triumph Daytona 675R
BORE / STROKE / CYLINDERS / DISPLACEMENT 76mmmm / 49,6mm / 3 cylinders / 675cc
COMPRESSION RATIO 13.1:1
FUEL SYSTEM Multi-point sequential electronic fuel system
FUEL RON 98
MAX POWER/TORQUE DESIGN 14000 rpm/ 8500rpm
DRIVE TYPE Chain Drive
DIFFERENTIAL Gear type limited slip differential with self manufactured Aluminium casing
COOLING Side pod mounted Aluminium radiator with switch operated fan
BRAKE SYSTEM 4 Disk System, self designed rotors with adjustable brake balance
ELECTRONICS Gear indicator display, electronic shifting, data logging with embedded live-telemetry

REGENSBURG

Ostbayerische Technische Hochschule Regensburg

Car 262 **Pit 41-B** **WRL 24** Germany

It is the first time, the Dynamics e.V. is building two cars since our founding in 2006. About 70 dedicated members are designing, manufacturing and testing the two new cars. The RP19c and the RP19e. For the combustion competition this will be our 12th car. A lightweight design, the focus on aerodynamics and high reliability are the key facts for this season.



FRAME CONSTRUCTION Full CFRP monocoque
MATERIAL CFRP: twill and UD prepreg, aluminium honeycomb and rohacell cores
OVERALL L / W / H 2990mm / 1460mm / 1155mm
WHEELBASE / TRACK (Fr / Rr) 1575mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 124kg / 134kg
SUSPENSION Double unequal length A-Arm. Push rod actuated horizontally oriented spring and damper
TYRES (Fr / Rr) Double unequal length A-Arm. Push rod actuated horizontally oriented spring and damper
WHEELS (Fr / Rr) 7.0x13.0 self-developed CFRP rims
ENGINE Modified Honda CBR600RR (PC40)
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 14.0:1
FUEL SYSTEM Aluminium fuel tank with pressure controlled electric pump; intake-manifold fuel injection
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 10500 rpm/ 9000rpm
DRIVE TYPE AFAM 3D chain 520 MX
DIFFERENTIAL self-developed semiactive limited slip differential; quickly adjustable
COOLING two sidepod mounted radiators with PWM controlled waterpump and fan
BRAKE SYSTEM floating; hub mounted; 233mm outer diameter, 179mm inner diameter, t=4mm
ELECTRONICS self-developed Main Controll Unit, Data Logger, Live Telemetry, ETC

ROCHESTER

Oakland University

Car 212 **Pit T-67** **WRL 286** United States

Grizzlies Racing is proud to present GRX9, which continues to build off of previous successful standards of innovation. This is the first year Grizzlies Racing is participating in Formula Student Germany, this endeavor would not be possible with out the full support of our sponsors, faculty and all supporters for helping us continuously push our innovation to the next level.

FRAME CONSTRUCTION Tubular Steel Frame
MATERIAL 25CrMo4
OVERALL L / W / H 3070mm / 1490mm / 1100mm
WHEELBASE / TRACK (Fr / Rr) 1549mm / 1300mm / 1250mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 123kg / 157kg
SUSPENSION Double unequal length converging A-Arm. Front pull rod and anti-roll bar. Rear push rod.
TYRES (Fr / Rr) Continental C18, 205/470 R13
WHEELS (Fr / Rr) Continental C18, 205/470 R13
ENGINE Honda CBR600RR
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 12.2:1
FUEL SYSTEM Student built sequential port injection
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 10000 rpm/ 11500rpm
DRIVE TYPE Chain Drive
DIFFERENTIAL Drexler limited slip differential
COOLING Dual side mounted radiator
BRAKE SYSTEM Tilton Master Cylinder, Precision Ground Steel Rotors, Brembo Calipers
ELECTRONICS Self developed CAN system with custom digital dashboard, Electro-pneumatic shifting system

ROMA

University of Rome Tor Vergata

Car 227 **Pit T-85** **WRL 102** Italy

STV is the official Formula Student team of the University of Rome Tor Vergata. After having designed a new car in 2014, we reached our best results in the 2017 season.Starting from the experience gained in these years, we decided to inizialize a two years based project, in order to design a new car completely different from the previous ones. We are presenting our new project during the 2019 FS events.

FRAME CONSTRUCTION Steel Spaceframe
MATERIAL BS4 T45 steel round tubing
OVERALL L / W / H 3017mm / 1400mm / 1235mm
WHEELBASE / TRACK (Fr / Rr) 1630mm / 1258mm / 1258mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) kg / kg
SUSPENSION Double unequal length A-Arm. Pull and push rod. actuated spring / damper. Adj. Roll bar
TYRES (Fr / Rr) Hoosier 6.0x18 - 10 LCO
WHEELS (Fr / Rr) OZ 7x10, 48mm offset, Magnesium
ENGINE 2012 KTM 690 Duke R
BORE / STROKE / CYLINDERS / DISPLACEMENT 102mm / 84,5mm / 1 cylinder / 690cc
COMPRESSION RATIO 12.6:1
FUEL SYSTEM student design fuel rail, 1 Bosh injector, external Bosh fuel pump
FUEL E85
MAX POWER/TORQUE DESIGN 7000 rpm/ 6000rpm
DRIVE TYPE 520 Chain
DIFFERENTIAL Drexler LSD Sailsbury type,preload 30Nm, 88% acc. 51% decel.
COOLING Right sidepod mounted 30mm core radiator , xxxx cfm fan mounted to radiator out
BRAKE SYSTEM 4-Disk system, rotors with 190mm diameter, adjustable brake balance, APRacing calipers
ELECTRONICS Multifunctional Steering Wheel, Electropneumatic Shifting System, Live-Telemetry, IP67

SEVILLA

University of Seville

Car 291 **Pit T-77** **WRL 268** Spain

We are back again! ARUS Andalucía Racing is the first Andalusian team competing in Formula Student, and has developed a strong presence in the competition since its foundation. A lot has happened since we came to FSG for the last time. The ART-19c is the sixth combustion car in our history, and we aim to show the world how reliable our car has become. We are not here only for taking part, we are here to break our limits.

FRAME CONSTRUCTION Steel space frame
MATERIAL E355 Steel equivalent to St52
OVERALL L / W / H 2977mm / 1506mm / 1177mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1250mm / 1175mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 146kg / 146kg
SUSPENSION Double unequal length A-Arm. Pull (F)/ Push(R) rod actuated springs and dampers.
TYRES (Fr / Rr) Hoosier 18x7.5-10 R25b
WHEELS (Fr / Rr) 10x7.5 3pc Al Rim, custom aluminium center
ENGINE Honda CBR600 RR
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 13:1
FUEL SYSTEM Direct injection (DENSO 6 AT) 180 mm before intake valve. 3.43 bar fuel pressure.
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 9100 rpm/ 8700rpm
DRIVE TYPE Chain-sprocket
DIFFERENTIAL Drexler
COOLING Side mounted 386x273mm core aluminium radiator 55º inclined, 0.59 cfru fan mounted radiator
BRAKE SYSTEM 4-disk system, self ddeveloped rotors with 200mm(F)/162mm(R). Adjustable brake balance.
ELECTRONICS IP67, multifunctional dashboard, electric shifting system, selfdesigned live-telemetry

SOUTHAMPTON

University of Southampton

Car 226 **Pit T-74** **WRL 280** United Kingdom

Southampton University Formula Student Team (SUFST) are entering this year's competition with their 7th car, STAG VI.Their main aim is to build on the success of last year, a first endurance finish at FS EAST. Finishing in the top 20 is one of the team's goals for their first appearance at FSG. They're competing at 3 events this year for the first time, FSUK, FSG and FS Czech Republic.The team would like to thank all of their sponsors for their support helping the team realising their goals.

FRAME CONSTRUCTION Aluminium monocoque with tubular steel rear subframe
MATERIAL Aluminium Honeycomb Sandwich Panel / T45 Steel tube
OVERALL L / W / H 2913mm / 1504mm / 1195mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1200mm / 1150mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 123kg / 150kg
SUSPENSION Pushrod activated double wishbone - Gas Roll Springs/Dampers
TYRES (Fr / Rr) 6.0/18/0-10 Hoosier LC0 / 6.0/18/0-10 Hoosier LC0
WHEELS (Fr / Rr) 10x7" Centre Locking, Forged Magnesium, OZ
ENGINE Honda CBR600RR
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 12.2:1
FUEL SYSTEM DTAFast S60 ECU, Denso Returnless Common Rail
FUEL 99 Octane Unleaded Gasoline
MAX POWER/TORQUE DESIGN 11500 rpm/ 10500rpm
DRIVE TYPE Chain Driven
DIFFERENTIAL Drexler FSAE Viscous Differential
COOLING Rear Mounted Custom single core radiator, 5.2 cfm fan.
BRAKE SYSTEM Floating, 5mm x 184mm front, 4mm x 184mm rear. ISR 22-038B Front, AP Racing CP226 Rear
ELECTRONICS Launch control, electric paddle shifter, 16 stream wireless telemetry system.

ST. PETERSBURG

Peter the Great St. Petersburg Polytechnic University

Car 278 **Pit T-59** Russia

2019 is the third year of our team Polytech NCM performing at the Formula Student competitions. No doubts, new car we developed is better than the last one. We designed and used modular layout in our car. The single cylinder engine Kawasaki KX450 makes 33% more power than the previous one. In addition, there were inevitable changes to the chassis, aerodynamics and ergonomics. Now we are ready for the competition. We want to say thank you to all the supporters, who make this experience possible!

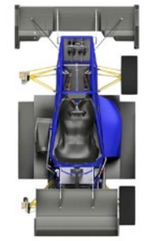
FRAME CONSTRUCTION Front and rear Tubular steel space frame
MATERIAL 1024 steel round tubing, 25x1,5mm, 25x2mm, 32x2mm, 14x1,5mm
OVERALL L / W / H 2727mm / 1394mm / 1153mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1180mm / 1150mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 130kg / 140kg
SUSPENSION Double unequal length A-Arm. Through bell cranks push rod actuated spring and damper
TYRES (Fr / Rr) 150x75 - R10, Hoosier #41100, front and rear
WHEELS (Fr / Rr) 6.0x10, 25mm offset, 3 pc Al Rim, front and rear
ENGINE 2019 Kawasaki KX™450, 1 cylinder
BORE / STROKE / CYLINDERS / DISPLACEMENT 96mm / 62,1mm / 1 cylinder / 449cc
COMPRESSION RATIO 12,5:1
FUEL SYSTEM Port fuel injection, Bosch EV6ES injector
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 10000 rpm/ 2500rpm
DRIVE TYPE Chain DID 520
DIFFERENTIAL Drexler Mechanical limited slip differential, 45Nm preload
COOLING Left side pod munted radiator with electric fan
BRAKE SYSTEM Floating, steel, hub mounted discs, 185mm outer diam., 109mm inner diam, vented
ELECTRONICS

STRALSUND

University of Applied Sciences Stralsund

Car 319 **Pit 35-A** **WRL 252** Germany

As the first German Formula Student team Baltic Racing has brought this competition to Germany and ever since then has participated in FSG. Thanks to our long history we can look back to many achievements in the past and are looking forward to a great season with our new car – the TY19. Again we have been working hard to exceed last year's performance, including our team's very first aero package! We are more than happy to have the privilege of being part of this splendid competition.



FRAME CONSTRUCTION tubular space frame
MATERIAL 25CrMo4
OVERALL L / W / H 2807mm / 1515mm / 1130mm
WHEELBASE / TRACK (Fr / Rr) 1560mm / 1250mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 131kg / 142kg
SUSPENSION double unequal length A-arms, pull rod actuated dampers on both axles, KW Competition 3A
TYRES (Fr / Rr) 205/470 R13, Continental C19
WHEELS (Fr / Rr) 7.0x13, ET 30, OZ Racing magnesium rims with Center Lock
ENGINE 2013 Triumph Street Triple 675
BORE / STROKE / CYLINDERS / DISPLACEMENT 74mm / 52,3mm / 3 cylinders / 675cc
COMPRESSION RATIO 12.65:1
FUEL SYSTEM original fuel injection and ignition system using EcuMaster ECU, fully sequential
FUEL RON 98 unleaded gasoline
MAX POWER/TORQUE DESIGN 9000 rpm/ 8500rpm
DRIVE TYPE chain #520 MAD6
DIFFERENTIAL torque biasing Torsen B (by Quaife), self made Al 7075 T6 hard-anodized housing
COOLING twin radiator, mounted on each side, parallel connected flow, self made cooling fans
BRAKE SYSTEM 4-disk system, self developed rotors with d=200, t=3, X46Cr13; adjustable balance bar
ELECTRONICS self developed electromechanical clutch, shifting and ETC systems, communication via CAN

STUTTGART

University of Stuttgart

Car 229 **Pit 37-C** **WRL 1** Germany

We - the Rennteam Uni Stuttgart - are very proud to be part of the Formula Student Germany for the fourteenth time now. After our long-awaited success in 2018 we are highly motivated to win again. To prevail against the strong competition we focused on our new monocoque with attention on manufacturing quality, new lightweight concepts and a well rounded and extensively tested vehicle setup. Complete - Finish - Win!

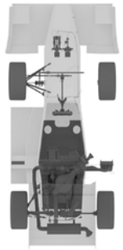
FRAME CONSTRUCTION Singlepiece monocoque with tubular rearframe
MATERIAL CFRP Sandwich Monocoque, steel rearframe
OVERALL L / W / H 3030mm / 1435mm / 1195mm
WHEELBASE / TRACK (Fr / Rr) 1630mm / 1212mm / 1192mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 119kg / 129kg
SUSPENSION Double unequal length A-Arms, pushroad actuated KW damper, adj. U-ARB
TYRES (Fr / Rr) 16.0 x 7.5 - 10 LC0 Hoosier
WHEELS (Fr / Rr) 16.0 x 7.5 - 10 LC0 Hoosier
ENGINE Modified Yamaha YZF-R6
BORE / STROKE / CYLINDERS / DISPLACEMENT 65,5mm / 44,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 14.87:1
FUEL SYSTEM Student build fuel injection system using MiTeC, fully sequential
FUEL E85
MAX POWER/TORQUE DESIGN 9000 rpm/ 7500rpm
DRIVE TYPE Sequential 4-speed gearbox
DIFFERENTIAL Drexler limited slip
COOLING Side mounted core dual radiator, fan mounted to back of each radiator
BRAKE SYSTEM 4-disk system, adjustable brake balance, self-designed rotors
ELECTRONICS Digital multifunctional steering wheel, self-developed display system

ULM

University of Applied Sciences Ulm

Car 244 **Pit T-80** **WRL 66** Germany

Building cars since 2006, Einstein Motorsport participates at FSG for the twelfth time. This year Einstein will compete with the AL19. Car and team are named after ALbert Einstein who was born in Ulm. AL19, the thirteenth car developed by Einstein Motorsport features a new manufacturing process for the aerodynamic package and an ethanol conversion.



FRAME CONSTRUCTION Two-piece monocoque
MATERIAL CFRP with ROHACELL foam core with variable thickness and density
OVERALL L / W / H 2927mm / 1505mm / 1153mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1197mm / 1157mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 121kg / 125kg
SUSPENSION Double A-Arm. Push rod actuated rear dampers, pull rod actuated front dampers
TYRES (Fr / Rr) 18 x 6.0 R10, Hoosier LC0/ 18 x 6.0 R10, Hoosier LC0
WHEELS (Fr / Rr) OZ FSAE 7x10, 22mm offset, 1 pc Mg cast rim
ENGINE Modified 2018 KTM 450 SX-F
BORE / STROKE / CYLINDERS / DISPLACEMENT 95mm / 72mm / 1 cylinder / 510cc
COMPRESSION RATIO 15,1:1
FUEL SYSTEM student built
FUEL E85
MAX POWER/TORQUE DESIGN 8200 rpm/ 6000rpm
DRIVE TYPE chain drive (520 pitch)
DIFFERENTIAL Drexler limited slip differential
COOLING one radiator with single electric fan
BRAKE SYSTEM 4-Disk System, floating water cutted iron rotors, adjustable balance, AP Racing calipers
ELECTRONICS Electropneumatic shifting system, live-telemetry system, multifunctional steering wheel

VALÉNCIA

Universitat Politécnica de Valéncia

Car 395 **Pit 38-B** **WRL 12** Spain

After a successful 2018, becoming the 12th in the FS world ranking, the FSUPV Team faces with the FSUPV-06, a challenging 2019 year. With the aim of improving the astonishing last year performance, a brand new full monocoque structure has been designed, carrying our traditional CBR 600 rr engine which have been intensely modified to increase its performance and efficiency. Aerodynamics and Dynamics were also improved, working the whole team together to fit all in the new monocoque.

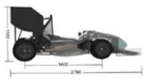
FRAME CONSTRUCTION Full monocoque
MATERIAL Carbon Fiber prepreg, aluminum honeycomb core
OVERALL L / W / H 2973mm / 1405mm / 1190mm
WHEELBASE / TRACK (Fr / Rr) 1585mm / 1200mm / 1170mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 113kg / 150kg
SUSPENSION Double unequal length A-arm. Pushrod actuated horizontally spring and damper
TYRES (Fr / Rr) 18 x 7.5 - 10 R25B, Hoosier
WHEELS (Fr / Rr) 8.0x10, 25.2mm offset, 3 pc Al Rim
ENGINE Modified 2006 Honda CBR 600 RR
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 13.5:1
FUEL SYSTEM Student des/built, fuel injection
FUEL E85
MAX POWER/TORQUE DESIGN 10100 rpm/ 8000rpm
DRIVE TYPE 520 x-ring chain
DIFFERENTIAL Limited slip, 30-35 Nm preload, torque bias 1.4
COOLING One radiator with single electric fan
BRAKE SYSTEM 4-Disk system, self developed rotors with adjustable brake balance
ELECTRONICS Self developed DAQ, traction, launch and full throtle systems. Steering wheel display.

VELLORE

VIT University - Vellore

Car 254 **Pit T-78** **WRL 318** India

Pravega is the Sanskrit word for acceleration. The team was conceived in the year 2009, everything that followed has been an amalgamation of hard work, perseverance and eventually - glory. Year after year, the team has maintained a consistent growth rate which led to it being crowned the best team in India in the year 2017. PRV-19 is the 10th edition of our Formula Style Race-car which was designed and manufactured with an objective to achieve improved reliability and enhanced drivability.



FRAME CONSTRUCTION Tubular spaceframe
MATERIAL AISI 4130 (heat treated)
OVERALL L / W / H 2790mm / 1427mm / 1180mm
WHEELBASE / TRACK (Fr / Rr) 1600mm / 1200mm / 1150mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 140kg / 158kg
SUSPENSION Short long arm, pushrod actuated with horizontally oriented spring and damper , U bar ARB
TYRES (Fr / Rr) 205/470 R13 Continental 34M / 205/470 R13 Continental 34M
WHEELS (Fr / Rr) 7x13in, Aluminium rim with CFRP wheel centre, Fr: 52.91mm offset/ Rr: 39.33mm offset
ENGINE Honda CBR600RR (2008)
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 12.2:1
FUEL SYSTEM Denso , Type - Electronic common rail fuel injection system
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 10000 rpm/ 8000rpm
DRIVE TYPE Chain (DID 520 ERV 3) , Pitch - 15.875mm
DIFFERENTIAL Clutch pack Limited Slip Differential
COOLING Side mounted 2508cc radiator and 254mm diameter electric fan
BRAKE SYSTEM 4-Disk System with Slotted Floating Disc, Custom design Front and Rear brake caliper
ELECTRONICS Electropneumatic Shifting System; Self-designed Live Telemetry System, Self designed PDU

VIGO

University of Vigo

Car 314 **Pit T-53** **WRL 387** Spain

UVigo Motorsport is the first Formula Student team in the Spanish region of Galicia, which faces the fifth season since our formation. After having completed all the dynamic tests of the FS with the UM18 for the first time, we want to continue improving our prototype in order to gain a foothold in the competition and be able to compete with the best teams in the Formula Student.

FRAME CONSTRUCTION Hibrid frame composed by a monocoque and a rear subframe
MATERIAL Carbon fiber monocoque and steel subframe
OVERALL L / W / H 2960mm / 1402mm / 1174mm
WHEELBASE / TRACK (Fr / Rr) 1533mm / 1214mm / 1260mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 120kg / 157kg
SUSPENSION Double unequal length A-Arm. Pull rod actuated horizontally oriented spring and adjustable
TYRES (Fr / Rr) 200x72 R13, AVON
WHEELS (Fr / Rr) Mg CAST 7x13, 4-Stud (4x100), ET = 30 mm
ENGINE 2016 Kawasaki er6 two inline cylinders
BORE / STROKE / CYLINDERS / DISPLACEMENT 83mm / 60mm / 2 cylinders / 649cc
COMPRESSION RATIO 11.3:1
FUEL SYSTEM self with electronic sequential injection
FUEL Gasoline
MAX POWER/TORQUE DESIGN 10000 rpm/ 7000rpm
DRIVE TYPE metallic chain
DIFFERENTIAL clutch pack Drexler LSD
COOLING one radiator back mounted with thermostatic controlled electric fan
BRAKE SYSTEM
ELECTRONICS

VOLOS

University of Thessaly

Car 377 **Pit T-69** **WRL 165** Greece

Centaurus Racing Team was founded in 2009 from a group of 6 students with on goal in mind, to achieve the best of their capabilities. Since then 5 race-cars came to life and the last of them Amphion is the result of two years of research, validation, manufacturing and track testing.

FRAME CONSTRUCTION Tubular steel frame
MATERIAL 4130 Chromoly, 304L Stainless Steel
OVERALL L / W / H 2959mm / 1361mm / 1190mm
WHEELBASE / TRACK (Fr / Rr) 1540mm / 1180mm / 1150mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 135kg / 153kg
SUSPENSION Unequal and non-parallel double A-Arm, pull-rod actuated spring and damber, ARB, Fr & Rr
TYRES (Fr / Rr) 7x20.5 R13, Hoosier R25B/7x20.5 R13, Hoosier R25B & Hoosier Wet Compound (Fr&Rr)
WHEELS (Fr / Rr) 7x13 Magnesium OZ, 30mm offset/7x13 Magnesium OZ, 30mm offset, 4 bolt
ENGINE Honda CBR 600RR (PC40)
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42,5mm / 4 cylinders / 599cc
COMPRESSION RATIO 12.2:1
FUEL SYSTEM DTA S80, fully sequential inj.-ign., separate inj-ign mapping per 2cyl, 2 lambda sensors
FUEL 98 octane unleade gasoline
MAX POWER/TORQUE DESIGN 10000 rpm/ 9000rpm
DRIVE TYPE Chain drive though 2 sprockets
DIFFERENTIAL Clutch type LSD, internal preload adjustment
COOLING Side mounted 2 radiators, 140mm ID electric fans, enclosed in sidepods
BRAKE SYSTEM 4 floating disk system, 240mmFr-220mmRr OD, 4-piston Fr-2-pistonRr, adjustable balance
ELECTRONICS Electropneumatic Shifting System - BSPD self developed, wiring harness sealed to IP64

WIESBADEN

University of Applied Sciences RheinMain

Car 265 **Pit T-52** **WRL 328** Germany

The Scuderia Mensa Racing Team is proud to present their twelfth Formula Student car, SPR19, also running under the name Holly. The Team counts 45 students from various courses of studies. The SPR19 is an improvement of the SPR18. Our main goal is a low and central point of gravity. To reach this goal we improved the position of several components and also saved some weight if possible. We also paid a lot of attention to our manufacturing quality and improved our Aerodynamics.

FRAME CONSTRUCTION Singlepiece Monocoque with tubular rear space frame
MATERIAL CFRP Monocoque with Aluminum Honeycomb, steel rear frame
OVERALL L / W / H 2898mm / 1220mm / 1152mm
WHEELBASE / TRACK (Fr / Rr) 1575mm / 1220mm / 1180mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 100kg / 148kg
SUSPENSION FA: Double A-Arm with direct pushrod sytem; RA: Double A-Arm with indirect pushrod sytem
TYRES (Fr / Rr) Hoosier 16x6x10 R25B / LCO / Hoosier 16x6x10 R25B / LCO
WHEELS (Fr / Rr) OZ 10
ENGINE KTM LC4 690
BORE / STROKE / CYLINDERS / DISPLACEMENT 102mm / 84,5mm / 1 cylinder / 690cc
COMPRESSION RATIO 12.4:1
FUEL SYSTEM Fuel injection and transparent 3D-printed fuel tank
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 8200 rpm/ 6800rpm
DRIVE TYPE Chain drive (D.I.D. 520 ert2)
DIFFERENTIAL Drexler Formula Student Differential limited slip
COOLING Electrical and mechanical pump, radiator placed in side pod with electrical fan
BRAKE SYSTEM 4-Disk system, floating rotors, 185mm/125mm dia., adjustable brake balance
ELECTRONICS Anti stall assistance, traction control, data logging, live telemetry system

WROCŁAW

Wrocław University of Technology

Car 325 **Pit T-62** **WRL 23** Poland

PWR Racing Team, founded in 2009, is proud to participate for 8th time in Formula Student Germany. Our latest race car - RTX - is designed and built by 50 team members, on the basis of 10 years of experience. Powered by Honda CBR600 engine, RTX comes up with autoclave-made CFRP monocoque, pushrod actuated suspension and ultralight military grade wiring harness. Thanks to redesigned aerodynamics package, new Hoosier tires and CFRP rims we've reached significant increase in performance.

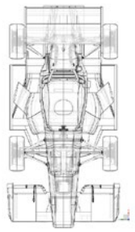
FRAME CONSTRUCTION Monocoque and tubular engine cage
MATERIAL Gurit SE84LV prepreg, aluminum honeycomb and Rohacell foam monocoque and DOCOL R8 steel spaceframe
OVERALL L / W / H 2925mm / 1488mm / 1198mm
WHEELBASE / TRACK (Fr / Rr) 1525mm / 1200mm / 1180mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 130kg / 136kg
SUSPENSION Double A-Arm, pushrod actuated, T-bar stabilizer (Fr), U-bar stabilizer (Rr)
TYRES (Fr / Rr) 16.0/7.5-10, R25B, Hoosier
WHEELS (Fr / Rr) 8.2x10, 50mm offset, 2pc CFRP Rim
ENGINE Modified Honda CBR600RR
BORE / STROKE / CYLINDERS / DISPLACEMENT 67mm / 42mm / 4 cylinders / 599cc
COMPRESSION RATIO 12,2:1
FUEL SYSTEM Denso 1060, multi point injection
FUEL 98 octane unleaded gasoline
MAX POWER/TORQUE DESIGN 10000 rpm/ 8000rpm
DRIVE TYPE 520 non-oring chain, 4 gear gearbox
DIFFERENTIAL Drexler LSD variable preload 0-75Nm,
COOLING two side radiators two fans on each radiator mounted on core
BRAKE SYSTEM 4-disk system with self developed 4-piston calipers
ELECTRONICS Ultralightweight military grade wiring harness; team-developed measuring modules; steering

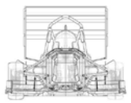
AACHEN

RWTH Aachen University

Car 99 **Pit 16-B** **WRL 47** Germany

Ecurie Aix is one of the oldest Formula Student Teams in Germany, founded in the year 2000. The team name is derived from the French words ecurie meaning racing team and aix standing for Aachen. Since last season some people might think our name is spoken like „EuciRoix" but it isn't actually. This season is our fourth season with an 4WD car. Our primary goal for the season is to design an easy-to-drive, lightweight car with a focus on aerodynamic performance.





FRAME CONSTRUCTION one piece composite monocoque, prepreg manufacturing integrated Al front hoop
MATERIAL woven & unidirectional CFRP prepreg fibres, aramid prepreg, CFRP Inserts, Al honeycomb & milled RHC
OVERALL L / W / H 3016mm / 1465mm / 1186mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1275mm / 1275mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 124kg / 131kg
SUSPENSION Double unequal length A-Arm. Longitudinal mounted dampers & springs with pushrod actuation
TYRES (Fr / Rr) 205/47 R13, Continental C18
WHEELS (Fr / Rr) 7J x 13, 30mm offset, CFRP-Al & Mg Rims
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / wheel hub mounted / 32 kW
MOTOR TYPE PMSM
MAX MOTOR RPM 20000
MOTOR CONTROLLER KW26-S5-FSE-4Q
MAX SYSTEM VOLTAGE 600V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 7.02 kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 14,556 / n/a
DRIVE TYPE coupled, two-staged planetary gearbox
DIFFERENTIAL n/a
COOLING SLM printed, CFD optimized cooling sleeves sidepod mounted radiators with chimneys
BRAKE SYSTEM grinded 42CrMov4 disks attached via 4 floaters to hub; ISR Calipers & Tilton cylinders
ELECTRONICS self developed VCU & toolchain, telemetry system & radio; aero sensor array rake, HV-BMS

AMBERG

Ostbayerische Technische Hochschule Amberg-Weiden (OTH)

Car 23 **Pit 12-C** **WRL 2** Germany

The Running Snail Racing Team was established in August 2004 at the OTH Amberg-Weiden in eastern Bavaria. After building eight combustion cars, the „RS19" is our seventh generation electric powered racecar. With further weight reduction, optimized motors and a new aerodynamics package, we hope to be able to surpass last year's results. For further information please visit us on Facebook or our website www.runningsnail.oth-aw.de.

FRAME CONSTRUCTION CFRP/aluminium Honeycomb Monocoque
MATERIAL Aluminium Honeycomb core, CFRP sandwich panel
OVERALL L / W / H 2921mm / 1678mm / 1194mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1200mm / 1180mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 126kg / 137kg
SUSPENSION Double unequal length A-Arm. Direct acting spring and damper
TYRES (Fr / Rr) 16.0 x 7.5-10, Hoosier / 16.0 x 7.5-10, Hoosier
WHEELS (Fr / Rr) 16x7.5-10, 1 pc Carbon Rim / 16x7.5-10, 1 pc Carbon Rim
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / At each wheel / 35.3kW
MOTOR TYPE Fischer Elektromotoren TI085-052-070
MAX MOTOR RPM 20000
MOTOR CONTROLLER LENZE Schmidhauser MOBILE DCU 60
MAX SYSTEM VOLTAGE 600V
ELECTRODE MATERIALS LiPo - graphite
COMBINED ACCUMULATOR CAPACITY 7,98kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:12.67 / N/A
DRIVE TYPE planetary gear
DIFFERENTIAL N/A
COOLING twin side pod mounted radiators
BRAKE SYSTEM semi-floating, hub mounted, 175 mm outer diameter, 3 mm thick, X5CrNi18-10
ELECTRONICS Torque vectoring, traction control, endurance (power) limiter

BARCELONA

PT University of Catalonia - Engineering School of Barcelona

Car 54 **Pit 14-B** **WRL 36** Spain

ETSEIB Motorsport is a FSE team established in 2007 at Barcelona. First, we started with combustion cars in 2007 but since 2010 we have been designing, constructing and competing with an electric car. The CAT12e is completely different to all the other CATs, for the first time we are competing with an electric 4WD car. Until now we have fought against the best teams and with our new concept we expect to bring the fight to the overall top teams too.

FRAME CONSTRUCTION Single-piece CFRP monocoque + fully laminated FH + steel roll over protection
MATERIAL HS & IM CF plies + Aluminium core + Aluminium FH + Steel MH
OVERALL L / W / H 2953mm / 1454mm / 1185mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1200mm / 1150mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 132kg / 141kg
SUSPENSION Double unequal length A-Arm. Direct acting spring and damper on upper A-Arm
TYRES (Fr / Rr) 18.0 x 7.5 - 10, Hoosier R25B / 18.0 x 7.5 - 10, Hossier R25B
WHEELS (Fr / Rr) 7x10, 35mm offset, Laminated CF Rim / 7x10, 35mm offset, Laminated CF Rim
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / 2 Front & 2 Rear / 35,366 kW
MOTOR TYPE FL,FR,RR,RL: Fischer TI085 PMSM
MAX MOTOR RPM FL,FR: 20.000; RR, RL: 20.000
MOTOR CONTROLLER Lenze Schmidhauser - MOBILE DCU 6
MAX SYSTEM VOLTAGE 600V
ELECTRODE MATERIALS Li-on - LiCoO2
COMBINED ACCUMULATOR CAPACITY 7,14kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:11,96 / --
DRIVE TYPE Self developed in-wheel planetary gearbo
DIFFERENTIAL --
COOLING Twin side pod mounted radiators with thermostatic controlled electric fans
BRAKE SYSTEM 4-Disk system, self developed steel rotors with 182.5mm diameter, adjustable brake balance
ELECTRONICS Wiring harness sealed to IP67, TFT colour dashboard, multiple race modes

BAYREUTH

University of Bayreuth

Car 21 **Pit 14-A** **WRL 72** Germany

This year might just seem like one more of a decade of participating at the FSG. But right after our change to electric, it is one of the most exciting ones. This year we're going big – we're happy to present the FR19 Loki, our first four-wheel-driven racecar. Therefore, many concepts had to be improved and we found new ways to take it to a whole new level. With the great support of our sponsors and the University of Bayreuth, we're glad to exceed all hopes and coming back stronger...

FRAME CONSTRUCTION Full CFRP monocoque with aluminum Front and Steel Main Hoop
MATERIAL CFRP prepreg, Al-honeycomb, balsa and abachi wood , EP adhesive film prepreg
OVERALL L / W / H 2921mm / 1440mm / 1199mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 137kg / 148kg
SUSPENSION Double unequal length A-Arm. Push rod actuated horizontally oriented spring and damper
TYRES (Fr / Rr) 18.0x7.5 R10, Hoosier R25B
WHEELS (Fr / Rr) 7x10, 35mm offset, 1 pc Carbon Rim
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / each wheel one / 35kW per Motor
MOTOR TYPE self developed: MaToMo
MAX MOTOR RPM 16
MOTOR CONTROLLER Lenze S. - MOBILE DCU 60/60 2
MAX SYSTEM VOLTAGE 588
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 6,84 kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:11,49 /
DRIVE TYPE Planetary Gear with stepped planets
DIFFERENTIAL software
COOLING Twin side pod mounted radiators with thermostatic controlled electric fans
BRAKE SYSTEM 4-Disk system, self developed 42CrMo4 rotors, adjustable brake balance
ELECTRONICS Self developed, reduandant VCU, Live-Telemetry via LTE, self developed BMS

BERLIN

Technische Universität Berlin

Car 13 **Pit 23-B** **WRL 167** Germany

The FT19e will be the second electric vehicle built by FaSTTUBe to date. After the solid baseline of the FT18e it is the aim of this season to improve the system in order to achieve more reliability. Following our philosophy of FaSTTUBe to fully understand and validate a concept of a car and adhere to our three years plan from 2017, we want to overcome early iteration obstacles and laying an improved foundation for coming seasons as an even stronger competitor.

FRAME CONSTRUCTION Steel space frame
MATERIAL 25CrMo4
OVERALL L / W / H 2653mm / 1441mm / 1114mm
WHEELBASE / TRACK (Fr / Rr) 1575mm / 1200mm / 1150mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 109kg / 135kg
SUSPENSION Double unequal lenth A-Arm. Push rod actuated spring & damper. Adjustable anti roll bar
TYRES (Fr / Rr) 205x470-R13, Continental R25B / 205x470-R13, Continental R25B
WHEELS (Fr / Rr) 7x13, 25 mm offset, 3 pc Al Rim / 7x13, 25 mm offset, 3 pc Al Rim
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear Right, Rear Left / 36
MOTOR TYPE AMK / DD5-14-10-POW
MAX MOTOR RPM 20000
MOTOR CONTROLLER AMK / KW26-S5-FSE-4Q
MAX SYSTEM VOLTAGE 588
ELECTRODE MATERIALS LiNiCoMnO2 - graphite
COMBINED ACCUMULATOR CAPACITY 6,526
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:12 / n/a
DRIVE TYPE planetary gearbox with staged planets
DIFFERENTIAL n/a
COOLING Single serial cooling circuit with two radiators passively cooled, mounted on the back
BRAKE SYSTEM 4-Disk system, self developed and optimized rotors, ISR Calipers, cockpit adjustable brake
ELECTRONICS self developed BMS and multifunctional self designed steering wheel

BRAUNSCHWEIG

Technische Universität Braunschweig

Car 91 **Pit 09-B** **WRL 116** Germany

Founded in 2000, the Lions Racing Team from the TU Braunschweig is the 2nd oldest Formula Student Team in Germany. In 2012 we changed from combustion to electric driven vehicles – and we are proud to present the LR19 as our latest. Our team worked passionately throughout the season to set up a reliable and structurally optimized vehicle and now we are looking forward to meet you at FSG 2019!

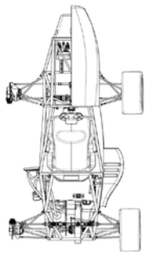
FRAME CONSTRUCTION CFRP singlepiece sandwich monocoque
MATERIAL Prepreg impregnated CFRP, aluminium honeycomb core
OVERALL L / W / H 2935mm / 1363mm / 1180mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1164mm / 1138mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 135kg / 135kg
SUSPENSION Double unequal length A-Arm, pushrod actuated spring/damper
TYRES (Fr / Rr) Continental 205 / 470 R13
WHEELS (Fr / Rr) 7x13, 22 mm Offset, 1 Pc Al Rim
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Wheel Hubs Rear / 35 kW
MOTOR TYPE AMK - DD5-14-10-POW
MAX MOTOR RPM 20000
MOTOR CONTROLLER AMK - KW26-S5-FSE-4Q
MAX SYSTEM VOLTAGE 600V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 7 kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 15,88 /
DRIVE TYPE Planetary gear drive and step planets
DIFFERENTIAL n/a
COOLING Watercooled motors & inverters; Aircooled Accumulator
BRAKE SYSTEM 4-Disk system, steel rotors
ELECTRONICS Self-designed ECU, DC-DC converter instead of LV-battery

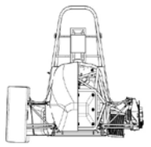
CHEMNITZ

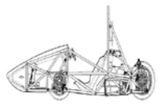
Technische Universität Chemnitz

Car 36 **Pit 04-B** **WRL 132** Germany

T.U.C. Racing from the TU Chemnitz was founded in 2015. Since then we are electrified and unstoppable! After our premiere last year, over 50 team members spent hard and endless hours in the workshop to bring our second car - Mkx.II - to the race tracks of Europe. The experiences of 2018 gave us a lot of motivation and now we are heading to the finish line with the throttle full open! Feel free to meet our awesome and incredibly devoted engineers in the pit! #madeinsaxony







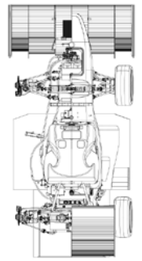
FRAME CONSTRUCTION Tubular space frame
MATERIAL S235 & S355 steel tubes
OVERALL L / W / H 2615mm / 1090mm / 1103mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1250mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 122kg / 148kg
SUSPENSION double unequal length A-Arms. Fr: Pull rod actuated Rr:Push rod actuated spring/damper
TYRES (Fr / Rr) Continental 205/470 R13 /Continental 205/470 R13
WHEELS (Fr / Rr) 7x13, 30 mm offset, OZ Magnesium 4H / 7x13, 30 mm offset, OZ Magnesium 4H
NUMBER OF MOTORS / LOCATION / MAX POWER 1 / Rear / 75 kW
MOTOR TYPE EMRAX 208 HV
MAX MOTOR RPM 7000
MOTOR CONTROLLER Unitek Bamocar D3 700/400
MAX SYSTEM VOLTAGE 452V
ELECTRODE MATERIALS LiNiCoAlO2
COMBINED ACCUMULATOR CAPACITY 7,24kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:5 / n/a
DRIVE TYPE chain drive
DIFFERENTIAL Drexler limited slip differential with adjustable preload
COOLING Motor and inverter water cooled. Single side mounted radiator
BRAKE SYSTEM 4 self designed floating discs, adjustable brake balance, Wilwood GP200 calipers
ELECTRONICS self-designed ECU, TSAL and Telemetrie-System, Dashboard with E-Paper Display&status LED'S

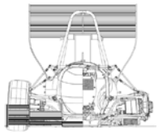
DARMSTADT

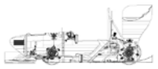
Technische Universität Darmstadt

Car 42 **Pit 23-C** **WRL 53** Germany

DART Racing is the Formula Student Team of the Technical University of Darmstadt. The team was founded in 2005 as an IC Team. Since 2011 we build electric race cars and since 2017 all-wheel-driven ones. With the ny2019 we continue this development. This year's goal was to optimize the last year's concept and to build a great and reliable race car. Therefore we focused on our packaging-optimized monocoque, on high-performance vehicle dynamics for our 4WD and on our tractive system accumulator.







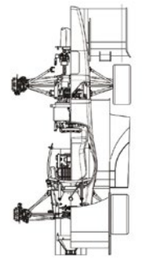
FRAME CONSTRUCTION Monocoque
MATERIAL Single peace CFRP with aluminium honeycombs
OVERALL L / W / H 2942mm / 1462mm / 1190mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1235mm / 1230mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 139kg / 139kg
SUSPENSION Double unequal length A-Arm. Push rod actuated horizontally oriented spring and damper
TYRES (Fr / Rr) 205/470 R13, Continental
WHEELS (Fr / Rr) 7x13, 12.3 mm offset, 2 pc CFRP/alu Rim
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Wheel hub / 52 kW
MOTOR TYPE Brusa IPM 1-10.09.04
MAX MOTOR RPM 24000
MOTOR CONTROLLER Brusa DMC 514
MAX SYSTEM VOLTAGE 443V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 5,8
TRANSMISSION RATIO (PRIMARY / SECONDARY) 18 /
DRIVE TYPE planetary gearbox
DIFFERENTIAL no differential
COOLING two Radiators mounted in sidepods, seperated front and rear cooling
BRAKE SYSTEM 4-Disk System, self developed roots with 220mm diameter (front) and 200mm diameter (rear)
ELECTRONICS selfdesigned Live-Telemetry System, BMS, decentralized sensor nodes, dashboard w/ LEDpanel

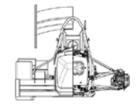
DRESDEN

Technische Universität Dresden

Car 59 **Pit 04-A** **WRL 34** Germany

Elbflorace Electric consists of 60 students from Dresden. In the last year we have been working on our 12th race car named LilIE. The appeal of our new lady lies in a decoupled spring-damper system, a new drive concept, featuring a 3D printed upright as well as a carbon rim and air-cooled inverters. Building this race car wasn't always easy. We had to take up several challenges like a forklift truck crashing into our production hall. We are very happy and grateful to participate at FSG 2019.





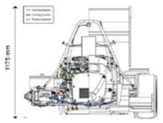
FRAME CONSTRUCTION full size CFRP Monocoque
MATERIAL CFRP with aramid core 15-20mm thick
OVERALL L / W / H 2940mm / 1405mm / 1165mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1200mm / 1150mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 114kg / 122kg
SUSPENSION double unequal lenght triangular A-Arm Suspension, pitch/roll decoupled spring/damper sys
TYRES (Fr / Rr) 205x470 R13 Continental C19
WHEELS (Fr / Rr) 7x13 CFRP rim, 65 mm offset
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Wheel Hubs FL FR RR RL / 35kW
MOTOR TYPE AMK / DD5-14-POW-19000
MAX MOTOR RPM 20
MOTOR CONTROLLER AMK
MAX SYSTEM VOLTAGE 588V
ELECTRODE MATERIALS Lithium-ion Polymer
COMBINED ACCUMULATOR CAPACITY 6,8kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:16,51 / n/a
DRIVE TYPE 1.5 stage planetary hollow gear output
DIFFERENTIAL electrical torque vectoring
COOLING air cooled inverters and accumulator, double looped closed circuit motor cooling system
BRAKE SYSTEM 4 wheel recuperation, mechanically adjustable brake balance, motorcycle & bicycle calipers
ELECTRONICS driver accessible vehicle settings via cockpit buttons, torque vectoring, traction control

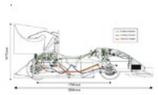
EINDHOVEN

Eindhoven University of Technology

Car 40 **Pit 16-A** **WRL 13** Netherlands

University Racing Eindhoven's (URE) latest car, the URE14D/E, is special for Formula Student. It can compete in the EV class, with its custom URE/AE in-wheel electric motors controlled by the custom URE/Prodrive motor controller with torque vectoring, a full aerodynamic package and custom Vredestein tires. However, it also can also compete in the DV class, driving fully autonomously and switching between DV and EV mode in less than three hours. A convertible Formula Student car!





FRAME CONSTRUCTION CRFP sandwich full monocoque
MATERIAL Textreme M30SC/CPV4 prepreg. Gurit EP137 UD, Bi- & Triaxial prepregCore: Al 5056
OVERALL L / W / H 2928mm / 1413mm / 1175mm
WHEELBASE / TRACK (Fr / Rr) 1536mm / 1207mm / 1162mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 123kg / 145kg
SUSPENSION Unequal length double wishbones, pushrod actuated horizontal oriented dampers
TYRES (Fr / Rr) 205x50 R10 Vredestein
WHEELS (Fr / Rr) 7x10 inch, 22 mm offset, Magnesium OZ centerlock
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Wheelhub mounted / 4x30kW
MOTOR TYPE URE&AE / Custom-developed PMSM
MAX MOTOR RPM 18
MOTOR CONTROLLER Custom quad motorcontroller
MAX SYSTEM VOLTAGE 400V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 7,0 kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:11,61 / N/A
DRIVE TYPE In-wheel compounded planetary gearbox
DIFFERENTIAL Electronic torque vectoring differential
COOLING Side mounted double radiator, water cooled, accumulator airducts and rear mounted electric fans
BRAKE SYSTEM Floating, steel hub mounted, 182x3 mm, vented student designed rotors
ELECTRONICS IO Nodes, 14 way fusebox settable via CAN, Live telemetry, 300W DC/DC converter

FREIBERG

TU Bergakademie Freiberg

Car 85 **Pit 14-C** **WRL 10** Germany

Racetech Racing Team was founded in 2005. This year we built our 13th car and eighth electric vehicle. With the RT13 we refined our sheet metal monocoque and casted rear end and focused on a continuing weight reduction e.g with the help of a CFRP accumulator container. We also worked intensively to improve our performance with a further development of our aerodynamic devices. The RT13 we will take on the competition in Hungary, Austria and Germany. We are looking forward to meeting you!

FRAME CONSTRUCTION Hybrid: Al Monocoque with casted rear frame
MATERIAL aluminium sheets, aluminium honeycomb core, magnesium inlays / Casted Al rear frame
OVERALL L / W / H 2973mm / 1437mm / 1170mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 130kg / 135kg
SUSPENSION Double A-Arm, Pushrod actuated spring/ damper, u-shaped anti-roll bar
TYRES (Fr / Rr) Continental C19
WHEELS (Fr / Rr) 7 inch, 34mm offset, CFRP shell, Al center
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear Left, Rear Right / 50.7kW ,50,7kW
MOTOR TYPE RL,RR: Bosch SMG138-FSE
MAX MOTOR RPM RL,RR: 16000
MOTOR CONTROLLER Bosch INV2.2
MAX SYSTEM VOLTAGE 395V
ELECTRODE MATERIALS LiCoO2, pouch cells
COMBINED ACCUMULATOR CAPACITY 6.88kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:2.9 / 1:3.0
DRIVE TYPE stage spur gearbox
DIFFERENTIAL n/a
COOLING 2 independent,rear mounted radiators and electric fans
BRAKE SYSTEM 4-Disk system, self developed calipers, adj. brake balance
ELECTRONICS self developed vehicle dynamics control module, Live Telemetry system

GÖTTINGEN

Hochschule für angewandte Wissenschaft und Kunst Hildesheim/ Holzminden/Göttingen

Car 161 **Pit 19-B** **WRL 44** Germany

Blue Flash is known to be the pioneer in low voltage technology within the formula student competition. An interesting fact is that all cars of the team history weight below 200kg. The Team goal is to build an especially safe but also competitive vehicle. For the 2019 competition the team designed the E_HAWK19 with the focus on lightweight solutions. In addition, the vehicle is as simple as possible to be as reliable as possible. We are looking forward to exciting days at FSG 2019.

FRAME CONSTRUCTION Tubular space frame
MATERIAL S235 +C , S355 +N ; 27x1.5, 26x1.2, 30x2
OVERALL L / W / H 3000mm / 1420mm / 1200mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 128kg / 130kg
SUSPENSION Double A-Arm, unequal length, Push rod, Spring and Damper horrizontally
TYRES (Fr / Rr) 205/470 R13 Conti FSAE 2019
WHEELS (Fr / Rr) Mg CAST 7x13 WHEEL 4-STUD STANDARD, 30mm offset
NUMBER OF MOTORS / LOCATION / MAX POWER 1 / Rear center / 80kW
MOTOR TYPE EMRAX 228 Medium Voltage liquid cooled
MAX MOTOR RPM 6500
MOTOR CONTROLLER emDrive H300
MAX SYSTEM VOLTAGE 454V
ELECTRODE MATERIALS LiPo - Cobalt Oxide
COMBINED ACCUMULATOR CAPACITY 7,62kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:3,81 /
DRIVE TYPE Chain drive
DIFFERENTIAL Limited slip differential (Drexler)
COOLING Two separate cooling circuits for inverter and motor
BRAKE SYSTEM 4-Disk system, self dev. rotors with 207/207mm (f/r) diameter, adj. brake balance
ELECTRONICS self design main control unit, self designed battery management system

HELSINKI

Helsinki Metropolia University of Applied Sciences

Car 98 **Pit 10-B** **WRL 52** Finland

Metropolia Motorsport is the oldest Finnish Formula Student team, competing since 2002. The team consists of over 30 members, from Metropolia UAS and Aalto University. Main improvements compared to the previous car was the introduction of aerodynamic side-wings, development of self-designed ECU, redesigning of inverter package, and installing more sensors for data collection. This new car is at least 6 kg lighter, with more down-force. Vast majority of parts are made using university facilities.

FRAME CONSTRUCTION Tubular steel frame with composite stress panels
MATERIAL SSAB Form 370 and docol 800 High strength steel, carbon fiber and structural foam composites
OVERALL L / W / H 2970mm / 1394mm / 1180mm
WHEELBASE / TRACK (Fr / Rr) 1590mm / 1200mm / 1160mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 122kg / 147kg
SUSPENSION Double unequal length A-Arm. Pullrod and rocker (Fr). Pushrod and rocker (Rr)
TYRES (Fr / Rr) 6.0/16.0-10, Hoosier R25B / 7.5/16.0-10, Hoosier R25B
WHEELS (Fr / Rr) Fr / Rr 7.0x10 3pc Al rim with bespoke center
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear Right, Rear Left / 37kW, 37kW
MOTOR TYPE Siemens 1FE1082-6WP10-1BA2
MAX MOTOR RPM 8500
MOTOR CONTROLLER 6SL3120-1TE23-0AD0
MAX SYSTEM VOLTAGE 598V
ELECTRODE MATERIALS Lithium Polymer
COMBINED ACCUMULATOR CAPACITY 7.03kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:4.56 /
DRIVE TYPE One stage reduction gear
DIFFERENTIAL Two separately driven motors
COOLING Water cooling for electric motors and inverters. Radiator is attached to the inverterbox rear wall.
BRAKE SYSTEM 4-Disk system, self developed rotors 185mm, ISR calipers
ELECTRONICS Selfdesigned Central Control Unit, Adjustable Torque Request

JINZHOU

Liaoning University of Technology

Car 76 **Pit 09-C** **WRL 21** China

The Wonder Racing Team of Electricity was established in Liaoning University of Technology in November 2014. It consists of undergraduate and postgraduate students from the automotive, mechanical, electrical, telecommunications, art, literature, management departments and so on. The team trains more than 50 students every season. Jinzhou Wonder Group is the title sponsor of the team. „Gratefulness, respect, innovation, creation" is the concept of the team.

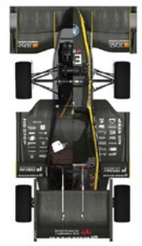
FRAME CONSTRUCTION Frt and rear Tubular space frame
MATERIAL 4130 steel round tubing (10mm to 25.4mm dia)
OVERALL L / W / H 2970mm / 1420mm / 1200mm
WHEELBASE / TRACK (Fr / Rr) 1570mm / 1200mm / 1180mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 152kg / 186kg
SUSPENSION Doubule unequal length A-Arm. Push rod actuated orizonally oriented spring and damper
TYRES (Fr / Rr) 18.0x7.5 R10,Hoosier R25B/18.0x7.5 R10,Hoosier R25B
WHEELS (Fr / Rr) 8.0-10 2.5 offset 3pc al Rim/8.0-10 2.5 offset 3pc al Rim
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear Right, Rear Left / 80kW, 80kW
MOTOR TYPE RR,RL: AC permanent magnet synchronous motor
MAX MOTOR RPM RR,RL: 6000
MOTOR CONTROLLER BAMOCAR PG-D3
MAX SYSTEM VOLTAGE 504V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 7.28kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:4 / n/a
DRIVE TYPE shaft drive transission
DIFFERENTIAL The electric control differential
COOLING Two rear 427.2cc radiators and two Mini fans of 120mm*120mm*38mm
BRAKE SYSTEM 4-Disk system, adjustable brake balance, martensitic stainless steel outsidedimeter 190
ELECTRONICS wiring harness sealed to IP67 and Rotate gear adjustment

KARLSRUHE

Karlsruhe Institute of Technology

Car 19 **Pit 12-A** **WRL 22** Germany

„One Team - Three Cars!" KA-RaceIng is designing manufacturing and competing with a FSC, FSE and FSD car every year. After a season full of problems with our KIT18e, we focused on trouble shooting and weight reduction. The biggest change was a newly designed rotor with a sintered cooling system and cooling housing, our carbon fibers and the gender of our CTO. To solve our problems with the self-developed power electronics, we decided to do something completely crazy: we listened to our alumni.



FRAME CONSTRUCTION CFRP monocoque
MATERIAL UHM UD, HM twill, IM UD, aluminium and nomex honeycomb
OVERALL L / W / H 2930mm / 1560mm / 1195mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1220mm / 1220mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 119kg / 118kg
SUSPENSION Double unequal length A-Arm, push rod actuated horizontally oriented spring and damper
TYRES (Fr / Rr) Continental 205/470 R13 (Fr and Rr)
WHEELS (Fr / Rr) Student made CFRP rim 7x13", 22mm offset (Fr and Rr)
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / mounted on chassis / 26,7
MOTOR TYPE permanent exited synchronous machine
MAX MOTOR RPM 20000
MOTOR CONTROLLER ETI SIC01-600V-65A, self designed
MAX SYSTEM VOLTAGE 600V
ELECTRODE MATERIALS LiPo
COMBINED ACCUMULATOR CAPACITY 7,34
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:14,3 / n/a
DRIVE TYPE 4-wheeldrive with 4 seperate motors with
DIFFERENTIAL N/A
COOLING 2 radiators, watercooling, separated cooling circuits for motors and inverter
BRAKE SYSTEM 4-Disk system
ELECTRONICS Live-Telemetry, Traction Control, Active Yaw Control, Torque Vectoring, Interface Unit

KASSEL

University of Kassel

Car 28 **Pit 22-C** **WRL 158** Germany

After 8 petrol-driven years, the Herkules Racing Team switches to electric drive this season. Under the watchful eye of Herkules and with our hardworking 25-strong team, we have put a completely new concept on the road. Our 2019 race car is called ‚Aiolos'; the god of winds. On the track, we will show you more than just hot air, can't wait to meet you at our pit and look forward to an exciting competition. Special thanks are directed to all our supporters for their outstanding help!

FRAME CONSTRUCTION CFRP Monocoque
MATERIAL Aluminum Honeycomb snadwich panel
OVERALL L / W / H 2961mm / 1397mm / 1199mm
WHEELBASE / TRACK (Fr / Rr) 1540mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 130kg / 153kg
SUSPENSION
TYRES (Fr / Rr) Continental C18 470/225 R13
WHEELS (Fr / Rr) OZ Racing Magnesium Rim
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / FR, FL, RR, RL / 41kW,41kW,41kW,41kW
MOTOR TYPE All: AMK Dynasin DD5-14-10-POW-18600-B5
MAX MOTOR RPM FL,FR,RR,RL: 20.000
MOTOR CONTROLLER AMK KW26-S5-FSE-4Q
MAX SYSTEM VOLTAGE 600
ELECTRODE MATERIALS Li(NiCoMn)O2 - graphite
COMBINED ACCUMULATOR CAPACITY 12,096
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:13,7 /
DRIVE TYPE
DIFFERENTIAL
COOLING
BRAKE SYSTEM
ELECTRONICS

KIEL

University of Applied Sciences Kiel

Car 153 **Pit 07-A** **WRL 79** Germany

This year Raceyard comes to Hockenheim with their lightest and fastes car ever. With its base on the last years car we improved all the properties on our now 14th car. We focused on lightweight construction aswell as equipping our T-Kiel A19 E with more effecient aerodynamics. All this was made possible with a team made both of experienced and new teammembers, eager to meet this years competition.

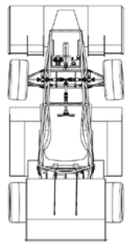
FRAME CONSTRUCTION CFRP sandwich monocoque with tubular steel roll bars
MATERIAL Prepreg Carbon Fiber layup with aluminium honeycomb sandwich panels
OVERALL L / W / H 3035mm / 1405mm / 1190mm
WHEELBASE / TRACK (Fr / Rr) 1565mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 127kg / 127kg
SUSPENSION Double unequal length wishbone; Push rod; seperated heave and roll spring and damper
TYRES (Fr / Rr) 205/470 R13, Continental C19 / 205/470 R13, Continental C19
WHEELS (Fr / Rr) 7x13, 30mm offset, 1 Pc Mg Rim (OZ) / 7x13, 30mm offset, 1 Pc Mg Rim (OZ)
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Each Wheelhub / 4x 35,4kW
MOTOR TYPE TI085-052-070-04B7S-07S04BE2
MAX MOTOR RPM 20
MOTOR CONTROLLER Lenze-Schmidhauser Mobile DCU
MAX SYSTEM VOLTAGE 600V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 6,5kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 14,2:1 / n/a
DRIVE TYPE 1.5-stage planetary gearbox
DIFFERENTIAL n/a
COOLING Water cooled motors and motor controller, air cooled accumulator
BRAKE SYSTEM topology optimized brake system designed for SLM manufacturing process
ELECTRONICS Selfdesigned Live-Telemetry Design, ASR, Torque Vectoring, Multifuncional Steering wheel

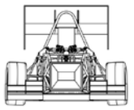
LAUSANNE

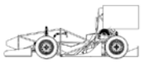
École Polytechnique Fédérale de Lausanne

Car 127 **Pit 06-B** Switzerland

The Lausanne Racing Team is a rookie Formula student team. From EPFL Lausanne, It gathers 50 people around this electric race car project. For its first apparition on track, the team is presenting Orion, whose focuses on reliability in order to build a solid basis for the years to come. It is also a more environmental friendly EV thanks to the use of flax fiber for most of the composites. Come and hang out with our team in the pits to discover more on the project.







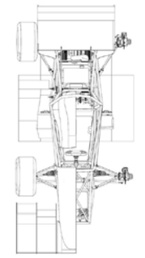
FRAME CONSTRUCTION Tubular space frame
MATERIAL E235 steel Tubing (round 25mm diameter and square 25x25mm)
OVERALL L / W / H 3002mm / 1432mm / 1200mm
WHEELBASE / TRACK (Fr / Rr) 1570mm / 1250mm / 1250mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 150kg / 196kg
SUSPENSION Double unequal length A-Arm. Push rod actuated horizontally oriented spring and damper
TYRES (Fr / Rr) Avon 7.2/20.0-13 / Avon 7.2/20.0-13
WHEELS (Fr / Rr) 7x13, 22mm offset, Al Rim, 4 stud bolt / 7x13, 22mm offset, Al Rim, 4 stud bolt
NUMBER OF MOTORS / LOCATION / MAX POWER 1 / Rear / 100
MOTOR TYPE Emrax 228
MAX MOTOR RPM 6000
MOTOR CONTROLLER Unitek Bamocar D3 700
MAX SYSTEM VOLTAGE 600V
ELECTRODE MATERIALS LiPo
COMBINED ACCUMULATOR CAPACITY 8.65 kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1 / 4,03
DRIVE TYPE 520 & 530 X-ring chain
DIFFERENTIAL Ajustable clutch pack limited slip differential
COOLING Single radiator, with fan on main-hoop bracing
BRAKE SYSTEM 4-Disk system, self made 220mm rotors, adjustable brake balance, AP racing calipers
ELECTRONICS Traction control, launch control, self developped BMS

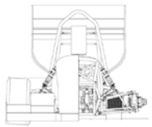
LEMGO

University of Applied Sciences Ostwestfalen-Lippe

Car 53 **Pit 06-A** Germany

The team was founded in Ostwestfalen-Lippe (OWL) in 2008 and took part in an event for the first time in 2009. Since then, nine combustion vehicles have been built. After the most successfull year 2018 in team history the team starts with the 10th car as the first electric race car with only two electricans. Actually the team has a huge generation change with 70% first year students. Overall 25 students work together and manufacture the racecar.





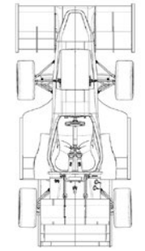
FRAME CONSTRUCTION Steeltubeframe
MATERIAL E355 steel
OVERALL L / W / H 2975mm / 1400mm / 1180mm
WHEELBASE / TRACK (Fr / Rr) 1610mm / 1200mm / 1170mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 136kg / 167kg
SUSPENSION Double Wishbone, Pushrod-Bellcrank-Shock actuation U-Type ARB attached to Bellcrank
TYRES (Fr / Rr) 18.0x7.5 R10, Hosier
WHEELS (Fr / Rr) 7.0x10, 22mm offset, OZ magnesium
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear Right, Rear Left / 60kw
MOTOR TYPE RR, RL: Emrax 188 HV
MAX MOTOR RPM 7000
MOTOR CONTROLLER Lenze Schmidhauser 60/60 DCU
MAX SYSTEM VOLTAGE 600
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 6,4kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:4,26 / -
DRIVE TYPE spur gearboxes
DIFFERENTIAL electric differential with torque control and limited rpm difference
COOLING two 100cc watercooler with 136mm electric fans in the sideboxes
BRAKE SYSTEM 4 Disk system, selfdeveloped rotors 180mm, adjustable brake balance
ELECTRONICS Battery Management with fiber optic communication, Drive Controller, Power PCB

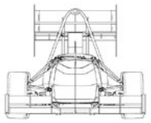
LEUVEN

KU Leuven - Group T Campus

Car 122 **Pit 19-A** **WRL 62** Belgium

Formula Electric Belgium is a team of 40 engineering students from KU Leuven and Thomas More from different backgrounds, making it a multi-regional and interdisciplinary team. The newest car the Umicore Eclipse is their third 4WD car.It features a self-build ECU, telemetry, dashboard and integrated push-to-talk. The suspension features a decoupled pitch and roll control utilizing only two dampers per axle. The single-piece monocoque is constructed with unidirectional carbon fibre.





FRAME CONSTRUCTION Single piece monocoque structure
MATERIAL woven prepreg carbon fiber with aluminium honeycomb core
OVERALL L / W / H 2930mm / 1425mm / 1160mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1200mm / 1150mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 123kg / 145kg
SUSPENSION Unequal Double wishbone, Push-rod, decoupled vehicle modes
TYRES (Fr / Rr) 205/470 R13 - Continental
WHEELS (Fr / Rr) 7x13 - 1 inch offset - 2-piece construction - milled aluminium - Keizer Wheels
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / In-Wheel / 37kW
MOTOR TYPE Permanent magnet synchronous motors
MAX MOTOR RPM 20
MOTOR CONTROLLER AMK-KW26-S5-FSE-4Q 2
MAX SYSTEM VOLTAGE 600
ELECTRODE MATERIALS Lithium-Ion / LiCoO2
COMBINED ACCUMULATOR CAPACITY 5,5kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 15,12 /
DRIVE TYPE Compound epicyclic gearbox
DIFFERENTIAL Electronic differential (torque vectoring)
COOLING Side panel mounted radiators. Cooling jacket for motors and cooling plate for drives.
BRAKE SYSTEM 4-Disk system, self developed rotors with 190 mm diameter, adjustable brake balance, AP ca
ELECTRONICS Self developed ECU, Torque vectoring, push-to-talk, self designed telemetry with zigbee

LISBOA

Instituto Superior de Engenharia de Lisboa

Car 20 **Pit 10-C** **WRL 130** Portugal

We are ISEL Formula Student team, IFS. We've started this journey back in 2014 with our first car, IFS01 and now we are competing with our second car, IFS02e, the first fully electric car of this team. We've been hard at work debugging and improving this prototype for the last year, making sure it meets our main values of affordability, reliability and most importantly of driving performance and enjoyability. We would like to thank our sponsors for believing in our team and making this possible!

FRAME CONSTRUCTION Steel spaceframe with tubular steel roll bars
MATERIAL AISI 4130 normalised
OVERALL L / W / H 2900mm / 1340mm / 1195mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1150mm / 1050mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 140kg / 170kg
SUSPENSION Push Rod with Double Unequal lenght A-Arm
TYRES (Fr / Rr) Hoosier 18 x 7.5 - 10 R25B Dry/Hoosier 18 x 7.5 - 10 R25B Dry
WHEELS (Fr / Rr) 178mm, OZ Racing Center Lock Magnesium,18 X 7.5 - R10 (dry) / 18 X 7.5 - R10 (rain)
NUMBER OF MOTORS / LOCATION / MAX POWER 1 / Center Rear / 100 kW
MOTOR TYPE Emrax 228 MVLC - Permanent Magnet Brushless
MAX MOTOR RPM 6500
MOTOR CONTROLLER Sevcon Gen4 Size8
MAX SYSTEM VOLTAGE 400V
ELECTRODE MATERIALS Energus Lithium-ion NMC cells
COMBINED ACCUMULATOR CAPACITY 7.9kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 3,27 / -
DRIVE TYPE Pinion-Sprocket
DIFFERENTIAL Drexler LSD V1
COOLING Dual side mounted 260cc radiators; single Pierburg CWA50 pump
BRAKE SYSTEM 4 Disk system, self developed rotors with 163mm diameter, adjustable brake balance, Wilwoo
ELECTRONICS Self designed AMS, Live Telemetry and Dashboard, Wiring harness sealed to IP67.

LISBOA

Universidade de Lisboa - Instituto Superior Técnico

Car 50 **Pit 17-B** **WRL 64** Portugal

FST Lisboa is the oldest active Formula Student team in Portugal. Established in Lisbon since 2001, the team started to compete in the IC category, changing to EV in 2010. More recently, a new car has been developed every year, being the FST 09e the most recent and competitive prototype. For 2019, all 40 team members are focused on keeping reliable electronics, increased mechanical integration, adjustable aerodynamics, and faster data analysis. All due to a strict project management plan.

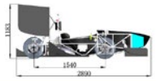
FRAME CONSTRUCTION Composite single-piece monocoque built with 2 negative carbon fiber moulds
MATERIAL Carbon fiber sandwich structure with Honeycomb, Rohacell and 3D core as the core
OVERALL L / W / H 2987mm / 1442mm / 1185mm
WHEELBASE / TRACK (Fr / Rr) 1540mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 146kg / 162kg
SUSPENSION Double unequal A-Arm. Push rod actuated spring/damper and torsional ARB
TYRES (Fr / Rr) 18x7.5-10 Hoosier R25B dry / 18x6-10 Hoosier 7CY9 wet
WHEELS (Fr / Rr) OZ 7x10 CL Magnesium wheel
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Outboard wheel motors / 35kW, 35kW, 35kW, 35kW.
MOTOR TYPE AMK / DD5-14-10-POW
MAX MOTOR RPM 20
MOTOR CONTROLLER AMK - KW26-S5-FSE-4Q
MAX SYSTEM VOLTAGE 600
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 7.98kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 16.25:1 / N/A
DRIVE TYPE Epicyclic gear train, 3 planets
DIFFERENTIAL N/A
COOLING Twin side pod mounted radiators for motor and inverter water cooling. Air cooled accumulator
BRAKE SYSTEM 4 - floating disk system, self developed rotors with 178mm OD, adjustable brake balance
ELECTRONICS Self-developed PCBs, pilot interface in dash, 2xCAN comm, WiFi telemetry

LIUZHOU

Lushan College of Guangxi University of Science and Technology

Car 18 **Pit 19-C** China

LSR-2019E is our 7th generation of formula student electric car. We focus on delivering a lightweight, simlified, handling-focus and compact design in the most cost effective way.



FRAME CONSTRUCTION Frt and rear Tubular space frame
MATERIAL 4130 steel round tubing 14mm to 25.4mm dia
OVERALL L / W / H 2890mm / 1140mm / 1183mm
WHEELBASE / TRACK (Fr / Rr) 1540mm / 1190mm / 1160mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 143kg / 155kg
SUSPENSION Double unequal length A-Arm. Push rod actuated horizontally oriented spring and damper
TYRES (Fr / Rr) 190.5x52 R10, Hoosier R25B / 190.5x52 R10, Hoosier R25B
WHEELS (Fr / Rr) 7×10,30mm offset, 2 pc AL Rim/7×10,30mm offset, 2 pc AL Rim
NUMBER OF MOTORS / LOCATION / MAX POWER 1 / Rear / 75kW
MOTOR TYPE permanent magnet synchronous motor
MAX MOTOR RPM 5000
MOTOR CONTROLLER Unitek-Bamocar D3 700/400
MAX SYSTEM VOLTAGE 436V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 7kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 3,545 / n/a
DRIVE TYPE Chain drive
DIFFERENTIAL Torque sensitive limited slip bevel gear differential with internal preload adjustment
COOLING Rear mounted 1200cc Mini radiator
BRAKE SYSTEM 4-Disk system, brake disc F188mm R180mm diameter, adjustable brake balance,
ELECTRONICS Rapid Prototype developed VCU,CAN communication, self developed dashboard, data acqusition

LJUBLJANA

University of Ljubljana

Car 169 **Pit 22-B** **WRL 87** Slovenia

Superior Engineering was formed in late 2015 from a group of colleagues attending mainly mechanical and electrical courses in the University of Ljubljana. In the first two years we built two combustion cars before switching to an electric drivetrain for the next two cars as our main focus. The latter one, named Svarog features a monocoque chassis, revised powertrain, improved ergonomics and driver assists while being robust and reliable with an emphasis on extensive testing before the season.

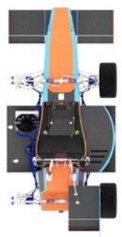
FRAME CONSTRUCTION Carbon fibre monocoque with an aramid honeycomb
MATERIAL Carbon fiber and aramid honeycomb, thickness 5-20mm HEX
OVERALL L / W / H 2929mm / 1438mm / 1169mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1208mm / 1208mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 119kg / 144kg
SUSPENSION Double unequal length A-Arm. Push rod actuated, adjustable ARB through flappy
TYRES (Fr / Rr) 18.0x7.5 R10, Hoosier R25B all around
WHEELS (Fr / Rr) 6.5x10, 20mm offset, single piece CF, self made all around
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear Right, Rear Left / 70
MOTOR TYPE RL, RR: Emrax 188 HV, CC
MAX MOTOR RPM RL, RR: 7800
MOTOR CONTROLLER Emsiso emDrive H150
MAX SYSTEM VOLTAGE 450
ELECTRODE MATERIALS Li-Ion
COMBINED ACCUMULATOR CAPACITY 8,8
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:5.45 / n/a
DRIVE TYPE Planetary gearbox
DIFFERENTIAL n/a
COOLING Symmetrically mounted radiators under sidepods with two 110mm fans
BRAKE SYSTEM 4-Disk system, self developed rotors with 180mm diameter, adjustable brake balance
ELECTRONICS Selfdesigned Telemetry via LoRa communication, custom dashboard and ECU pcb's, custom BMS

MADRID

Technical University of Madrid (UPM)

Car 15 **Pit 17-C** Spain

UPM Racing is the FS team of Universidad Politécnica de Madrid. Founded in 2003, it is the first Spanish team that participated in the competition. The team is formed by 50 students from different disciplines. After many years competing with combustion cars, we changed our philosophy and moved into our first monocoque chassis, that combined with a new 4 in-wheel-drive system, makes UPM03e the most revolutionary car of our history. We are back at FSG to do our best and enjoy the competition!



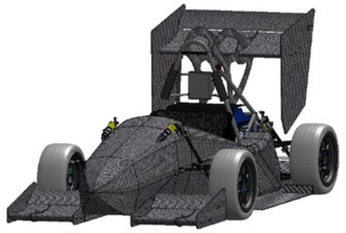
FRAME CONSTRUCTION Composite sandwich monocoque chassis with roll hoops attached
MATERIAL CFRP and aramid epoxy prepeg + aluminium hexagonal and aramid flexcore honeycomb
OVERALL L / W / H 2954mm / 1430mm / 1185mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 132kg / 176kg
SUSPENSION Double unequal lenght A-Arm. Push rod actuated with bellcrank. Springs and Öhlins TTX25.
TYRES (Fr / Rr) Hoosier 6.0/18.0-10 LCO / Hoosier 6.0/18.0-10 LCO
WHEELS (Fr / Rr) 6.0x10, -5 mm offset, Aluminium alloy / 6.0x10, -5 mm offset, Aluminium alloy
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / In wheels' hub / 27.3 kW x4
MOTOR TYPE Permanent magnets synchron machine
MAX MOTOR RPM 20000
MOTOR CONTROLLER Speed / Torque
MAX SYSTEM VOLTAGE 580V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 7.15kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 13,176 / n/a
DRIVE TYPE Compound planetary gear with locked rim
DIFFERENTIAL n/a
COOLING Two independent cooling systems. Heat exchangers on each sidepod.
BRAKE SYSTEM 4-disc system, self developed 188mm rotors. Proportional valve and bias bar. ISR calipers.
ELECTRONICS Self-developed PCBs: CAN transducer, cooling control system.

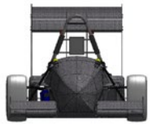
MANNHEIM

University of Applied Sciences Mannheim

Car 68 **Pit 06-C** **WRL 80** Germany

We are Delta Racing from UAS Mannheim, founded in 2008. Our headquaters is located just 20km away from the famous Hockenheimring where FSG will take place. As a home team we want to participate the first time with an electric racecar. We want to thank all our sponsors and supporters in the region and around the world.





FRAME CONSTRUCTION Trianguleted Tubular Space frame , TIG welded
MATERIAL Steel round and quare S235 JR
OVERALL L / W / H 3080mm / 1400mm / 1180mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 136kg / 166kg
SUSPENSION KW Spring Damping System connected to double A-Arms by push rods.
TYRES (Fr / Rr) Continental 205 / 470 R13
WHEELS (Fr / Rr) OZ 13-7 inch Magnesium rim
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear Middle / 80kW
MOTOR TYPE Emrax 208
MAX MOTOR RPM RR/RL: 6000
MOTOR CONTROLLER Bamocar D3
MAX SYSTEM VOLTAGE 504V
ELECTRODE MATERIALS
COMBINED ACCUMULATOR CAPACITY 6,39kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:3,33 / /
DRIVE TYPE
DIFFERENTIAL /
COOLING Water cooled system with radiator in the left sidebox
BRAKE SYSTEM 4 Disk system
ELECTRONICS completly self designed curcuit boards

MUMBAI

K. J. Somaiya College of Engineering

Car 27 **Pit 12-B** India

Orion Racing India, a team of dedicated engineers, traces its inception to 2006. After a successful run of developing 12 combustion vehicles, this year we took up our biggest challenge yet- making our first ever electric vehicle-Artemis. Artemis enters FSG with a reliable powertrain, balanced aerodynamic package and agile vehicle dynamics. Through a self-designed AMS, Z-type anti-rollbar and tuned prime mover on a self-built dynamometer, Artemis is ready to take the world of FS by storm.

FRAME CONSTRUCTION Full tubular space frame
MATERIAL DIN 2391 ST52
OVERALL L / W / H 2974mm / 1488mm / 1224mm
WHEELBASE / TRACK (Fr / Rr) 1580mm / 1200mm / 1150mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 152kg / 146kg
SUSPENSION Double unequal length A-Arm. Pull-Push rod actuated horizontally oriented spring & damper
TYRES (Fr / Rr) 18x6-10, Hoosier R25B / 18x6-10, Hoosier R25B
WHEELS (Fr / Rr) 7x10, 20mm offset, 3 piece Al rim / 7x10, 20mm offset, 3 piece Al rim
NUMBER OF MOTORS / LOCATION / MAX POWER 1 / Rear, / 80 kW
MOTOR TYPE Permanent Magnet Synchronous Motor
MAX MOTOR RPM 4600
MOTOR CONTROLLER Unitek Bamocar-PG-D3 700/400
MAX SYSTEM VOLTAGE 470V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 9,87
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1: 3.3 / n/a
DRIVE TYPE Chain drive
DIFFERENTIAL Clutch pack limited slip differential
COOLING Rear mounted self-designed radiator
BRAKE SYSTEM 4-disk system, self developed and tested rotors with 180 mm dia,adjustable brake balance
ELECTRONICS Wiring harness sealed to IP67, Self-developed AMS, ECU and Data acquisition system

MÜNCHEN

Technical University of Munich

Car 31 **Pit 23-A** **WRL 11** Germany

The TUfast Racing Team from the TU Munich consists of 80 team members who in one team designed and build two race cars this season (electric + driverless). One Team – Two cars – TUfast. The main goals designing the TUfast eb019 are lightweight design and aerodynamic performance. This is achieved with 31 airfoils, 5 diffusors and a topology optimized wheel package. On top comes our self developed ECU, SiC Inverter and Accumulator. Feel free to come to our pit and talk to us!

FRAME CONSTRUCTION Full CFRP Monocoque with aluminium honeycomb
MATERIAL Carbon Fiber Reinforced Plastic
OVERALL L / W / H 2895mm / 1443mm / 1176mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1225mm / 1225mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 110kg / 110kg
SUSPENSION Double unequal length A-Arm, Push rod actuated at upper A-Arm, Direct acting spring and da
TYRES (Fr / Rr) 16x7.5 - 10 Hoosier LC0
WHEELS (Fr / Rr) 8x10, 1 pc CFRP Rim
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Wheehubdrive / 35
MOTOR TYPE permanent excitated watercooled synchronous
MAX MOTOR RPM 20000
MOTOR CONTROLLER TUfast MCJK019, self-made SiC-inv
MAX SYSTEM VOLTAGE 600
ELECTRODE MATERIALS LiPo
COMBINED ACCUMULATOR CAPACITY 7kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 12 / n/a
DRIVE TYPE 2 stage planetary gearing system
DIFFERENTIAL Torque Vectoring
COOLING water radiator with cooling duct integrated in rear diffusor
BRAKE SYSTEM Floating, steel S355, drilled
ELECTRONICS self-developed ecu, DRS

NEW DELHI

Indian Institute of Technology Delhi

Car 67 **Pit 25-A** **WRL 135** India

We innovate, We perform, We excel! Axlr8r Formula Racing is a team of 20 young undergraduate innovators from Indian Institute of Technology Delhi, India. Till now, we have engineered 5 combustion, 3 electric cars and participated in events like FS UK, FS California, FSG and Formula Bharat. Our aspirations have ascended and to make our stand, we present our third electric car this season, ‚XLR-18'. Focus on accumulator safety and self-customised BMS are key features of this year's design.

FRAME CONSTRUCTION Tubular Steel Spaceframe Chassis
MATERIAL AISI 1015 Mild Steel
OVERALL L / W / H 2525mm / 1465mm / 1190mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1260mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 142kg / 174kg
SUSPENSION Double unequal length A-Arm, Push(rear) / pull(front) rod actuated geometry
TYRES (Fr / Rr) 205/470 R13, Continental
WHEELS (Fr / Rr) 7x13, 22mm offset Al Rim
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear right, Rear left / 36kW, 36kW
MOTOR TYPE Permanent Magnet Brushed DC axial flux
MAX MOTOR RPM 4400
MOTOR CONTROLLER Kelly KDH14601E (Opto-isolated)
MAX SYSTEM VOLTAGE 100V
ELECTRODE MATERIALS LiCoO2-graphite
COMBINED ACCUMULATOR CAPACITY 8,87
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:4,67 / n/a
DRIVE TYPE Single stage planetary gear assembly
DIFFERENTIAL n/a
COOLING Air convection-motors and forced convection using 3 electric fans-accumulator
BRAKE SYSTEM 4-Disk system, self developed rotors by laser cut, adjustable brake balance, floating disk
ELECTRONICS IP67 sealed wiring, customized BMS

PADOVA

University of Padova

Car 185 **Pit 09-A** **WRL 77** Italy

SG-e 03: this is the third electric car of the University of Padova. The frame is a carbon fiber monocoque with laminated front hoop, full aeropack, push rod suspension geometry, AMK motors hub mounted connected to wheel by a self developed planetary gearbox with drive reduction ration of 14:1, self-developed electronic circuitry. Battery pack is composed of 284 prismatic Lithium cell and aramidic composite battery case

FRAME CONSTRUCTION One-piece CFRP monocoque
MATERIAL GG205T,IMS65, HS T1000, Aluminum honeycomb 4.5pcf, Aluminum honeycomb 6.1pcf
OVERALL L / W / H 2850mm / 1430mm / 1170mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1230mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 130kg / 135kg
SUSPENSION Double unequal lenght A-Arms, push-rod, rocker and longitudinal spring+damper
TYRES (Fr / Rr) 18.0x7.5-10, Hoosier R25B/ 18.0x7.5-10, Hoosier R25B
WHEELS (Fr / Rr) 7.0x10, OZ magnesium rim/7.0x10, OZ magnesium rim
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / FR,FL,RR,RL / 35kW
MOTOR TYPE AMK Brushless motors
MAX MOTOR RPM 20
MOTOR CONTROLLER KW26-S5-FSE-4Q
MAX SYSTEM VOLTAGE 596
ELECTRODE MATERIALS LiCo02
COMBINED ACCUMULATOR CAPACITY 6,7 kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 14,4:1 / 14,4:1
DRIVE TYPE Planetary Gearbox
DIFFERENTIAL Software
COOLING Twin side pod mounted water radiators
BRAKE SYSTEM 4-Disk system, self developed Floating rotors, 173mm outer diam., 115mm inner diam
ELECTRONICS wiring harness sealed to IP67, Multifunctional Steering Wheel, Live-Telemetry System

RAVENSBURG

Baden-Württemberg Cooperative State University Ravensburg

Car 32 **Pit 16-C** **WRL 4** Germany

Global Formula Racing is an international collaborative Formula Student team from Oregon State University and DHBW Ravensburg. Each year we build two cars, one combustion, and one electric, sharing chassis, aerodynamics and suspension packages. 2019 marks the first year GFR is also working on a driverless car in addition For the Season 2019 we changed our Drivetrain Concept from a 2WD concept to a 4WD hubmotor concept.

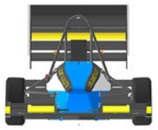
FRAME CONSTRUCTION CFRP/aluminum honeycomb monocoque with bolted steel main and front hoops
MATERIAL TORAY T700, aluminum and nomex core, varying thickness
OVERALL L / W / H 2788mm / 1350mm / 1190mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1145mm / 1145mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 136kg / 136kg
SUSPENSION Unequal length non-parallel a-arms, push rod shock, air spring, adjustable camber
TYRES (Fr / Rr) Hooziers LC0
WHEELS (Fr / Rr) 7075 Al 10"x7.25"
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / FR, FL, RR, RL / 41kW
MOTOR TYPE MSP1066
MAX MOTOR RPM 20000
MOTOR CONTROLLER Lenze Schmidhauser - MOBILE DCU 6
MAX SYSTEM VOLTAGE 403V
ELECTRODE MATERIALS Lithium Cobalt - graphite
COMBINED ACCUMULATOR CAPACITY 7,62kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 11,87 / -
DRIVE TYPE staged compound Planetary Gearbox
DIFFERENTIAL not necessary due to independent geartrains for each wheel with four motor concept
COOLING Air cooled Battery. Water Cooled Inverter and Motor with two radiator
BRAKE SYSTEM 4-Disk system, ductile iron rotor 196mm outer diameter, adjustable brake balance
ELECTRONICS self designed AMS, Dash-Display, Sensor Interfaces; sealed wiring harness

SANKT AUGUSTIN

University of Applied Sciences Bonn-Rhein-Sieg

Car 45 **Pit 22-A** **WRL 56** Germany

BRS Motorsport is the Formula Student team of UAS Bonn-Rhine-Sieg with about 50 students of all faculties, who share their love for designing, developing and manufacturing their third all-wheel driven electric car. It sticks out with its CFRP monocoque with 10" aluminium wheels, heave-spring system, a powertrain package by AMK combined with a compound planetary gearbox in the uprights and an aerodynamic package.



FRAME CONSTRUCTION Composite monocoque
MATERIAL CFK prepreg with aluminium honeycomb core
OVERALL L / W / H 2908mm / 1416mm / 1156mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1240mm / 1220mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 135kg / 146kg
SUSPENSION Double whishbone pushrod actuated heave-spring
TYRES (Fr / Rr) 18.0x6.0-R10, Hoosier R25B
WHEELS (Fr / Rr) 10x6.5 aluminium machined
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / at all wheelhubs / 36.75kW
MOTOR TYPE AMK DD5
MAX MOTOR RPM 20000
MOTOR CONTROLLER AMK - KW26-S5-FSE-4Q 2
MAX SYSTEM VOLTAGE 600V
ELECTRODE MATERIALS LiNiCoAl
COMBINED ACCUMULATOR CAPACITY 7.78kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 13,6 / n/a
DRIVE TYPE 4 gearboxes in the uprights
DIFFERENTIAL electrical differential (software)
COOLING two self developped mounded radiators
BRAKE SYSTEM four self developped disks with 4 piston calipers in the front and 2 in the rear
ELECTRONICS 3D wiring harness, self developped ECU's, multifuntional steering wheel and dashboard

SCHWEINFURT

University of Applied Sciences Würzburg-Schweinfurt

Car 97 **Pit 20-B** Germany

Mainfranken Racing e.V. was founded in 2006 out of the idea of some motor sport enthusiastic students from the University of Applied Sciences Schweinfurt. The team consist of 45 motivated students building the 12th racecar. Our goal for our first electric vehicle is to finish every endurance we attend. This season we are happy to participate at FSCz and FSG.

FRAME CONSTRUCTION Tubular space frame
MATERIAL E235+C
OVERALL L / W / H 3069mm / 1462mm / 1135mm
WHEELBASE / TRACK (Fr / Rr) 1575mm / 1200mm / 1175mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 154kg / 166kg
SUSPENSION Double Wishbone
TYRES (Fr / Rr) 18.0x7.5-10, Hoosier R25B
WHEELS (Fr / Rr) 7.0x10, 22mm offset, 1 pc Mg Rim
NUMBER OF MOTORS / LOCATION / MAX POWER 1 / Rear / 100 kW
MOTOR TYPE Enstroj - EMRAX 228 HV LC
MAX MOTOR RPM 5000
MOTOR CONTROLLER TTZ-EMO FENG
MAX SYSTEM VOLTAGE 587
ELECTRODE MATERIALS Li-Ion (LiNiMnCoO2)
COMBINED ACCUMULATOR CAPACITY 7,75
TRANSMISSION RATIO (PRIMARY / SECONDARY) 3,5 / 1
DRIVE TYPE Optibelt DELTA CHAIN Carbon 896 8MDC
DIFFERENTIAL limited slip differential (Drexler) 50Nm
COOLING Twin side pod mounted radiators with controlled electric fans
BRAKE SYSTEM 4-Disk system, floating self developed brake rotors, front: 4pistons, rear: 2pistons
ELECTRONICS multifunctional steering wheel, datalogger, self design life telemetry

SEVILLA

University of Seville

Car 51 **Pit 20-C** **WRL 82** Spain

ARUS-e joins the Formula Student Germany for the first time. As a counterpart to ARUS Andalucía Racing, the ART19-e is our second electric car, following the basis of the first prototype, made in 2018. Regarding all the mechanical knowledge and experience earned thanks to his combustion brother, this single seated car is ready to make a memorable first appearance in Formula Student Germany. We are not here only for taking part, we are here to break our limits.

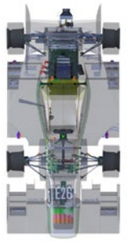
FRAME CONSTRUCTION Steel Spaceframe
MATERIAL E355 equivalence to St 52
OVERALL L / W / H 2993mm / 1506mm / 1185mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1250mm / 1175mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 149kg / 139kg
SUSPENSION Double unequal leght A-Arm. Front pull rod and rear push rod actuated spring.
TYRES (Fr / Rr) 18x7.5 R10, Hoosier R25B
WHEELS (Fr / Rr) 7.5, 3pc aluminium Rim, custom aluminium center
NUMBER OF MOTORS / LOCATION / MAX POWER 1 / Rear / 100kW
MOTOR TYPE EMRAX 228 MV LC
MAX MOTOR RPM 6500
MOTOR CONTROLLER Bamocar-PG-D3
MAX SYSTEM VOLTAGE 450V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 6.750kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY) 1:3 / N/A
DRIVE TYPE Chain drive, 520 pitch, no gearbox
DIFFERENTIAL Drexler limited slip differential
COOLING Two radiators situated on the sides, 595cc with 228.6 mm electric fan and 325 cc with 152.4 mm fan
BRAKE SYSTEM 4 Disk system, self designed rotors with 200 mm(F)/162 mm(R). Driver adjustable balance.
ELECTRONICS IP67, multifuncional dashboard, selfdesigned BMS, selfdesigned Telemetry

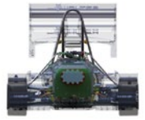
STUTTGART

University of Stuttgart

Car 26 **Pit 20-A** **WRL 5** Germany

2019 marks the 10th anniversary of the GreenTeam and therefore also the 10th time we participate at Hockenheim. As in previous years, the team of 50 students aimed to build a highly competitive vehicle. Our new car, the E7011-10, is a controlled revolution: Improving the strengths of its predecessor while introducing innovative concepts. For the first time we run our self-developed motors which in conjunction with our proven oil cooled accumulator enable us to extract a new level of performance.





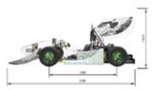
FRAME CONSTRUCTION Carbon fiber sandwich structure monocoque
MATERIAL Aluminum honeycomb sandwich panel
OVERALL L / W / H 3000mm / 1440mm / 1200mm
WHEELBASE / TRACK (Fr / Rr)
1540mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 116kg / 120kg
SUSPENSION Decoupled Monospring System with coil over springs and air springs, push rod, A-Arms
TYRES (Fr / Rr) Hoosier LC0 16.0 x 7.5-10
WHEELS (Fr / Rr) 8.0x10, 2 pc Hybrid (Al, CFRP)
NUMBER OF MOTORS / LOCATION / MAX POWER
4 / One at each Wheel / 34.5kW per Motor
MOTOR TYPE Permanent Magnet Synchronous Machine
MAX MOTOR RPM 20000
MOTOR CONTROLLER AMK Inverter
MAX SYSTEM VOLTAGE 600V
ELECTRODE MATERIALS LiCO2
COMBINED ACCUMULATOR CAPACITY 7.55 kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY)
/
DRIVE TYPE Planetary gearbox
DIFFERENTIAL
COOLING Oil and water
BRAKE SYSTEM 4-Disk system, self developed steel brake disk
ELECTRONICS Self-designed system electronics, wireless CAN and live video feed

TERRASSA

Escola Superior d'Enginyeries Industrial, Aeroespacial i Audiovisual de Terrassa (UPC)

Car 11 **Pit 10-A** **WRL 43** Spain

UPC ecoRacing is a team formed by students of the UPC Terrassa, where the design of our car is not only focused in improving performance but also is to take into account environmental sustainability by using more renewable materials. This year's season we are going one step further in the design of electric cars in the team, presenting the ecoRX 2019, composed of a four wheel-drive system and a carbon fiber monocoque, a single seater that has the potential of making us dream this 2019 season.



FRAME CONSTRUCTION CFRP + Aluminum honeycomb monocoque sandwich structure
MATERIAL Twill and unidirectional CFRP + Aluminum honeycomb
OVERALL L / W / H 2938mm / 1406mm / 1169mm
WHEELBASE / TRACK (Fr / Rr)
1540mm / 1140mm / 1140mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 133kg / 140kg
SUSPENSION Short-long Arm, Push-rod actuated
TYRES (Fr / Rr) Hoosier 7.5/18-10 R25B
WHEELS (Fr / Rr) 7.5"x10 CFRP with aluminum disc
NUMBER OF MOTORS / LOCATION / MAX POWER
4 / Upright mount, each wheel / 35kW, 35kW, 35kW, 35kW
MOTOR TYPE AMK / DD5-14-10-POW-18600-B5
MAX MOTOR RPM 20000
MOTOR CONTROLLER KW 26-S5-FSE-4Q
MAX SYSTEM VOLTAGE 588V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 7,76kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY)
1:14,2 / N/A
DRIVE TYPE One and a half stage gear transmission
DIFFERENTIAL Torque vectoring
COOLING Two rear-mounted radiator with fan
BRAKE SYSTEM 4-Disk system, self developed rotors with 173mm diameter, adjustable brake balance
ELECTRONICS All selfdeveloped, wiring harness shielded against EMI. Telemetry System, Torque vectoring

THESSALONIKI

Aristotle University of Thessaloniki

Car 121 **Pit 07-B** **WRL 42** Greece

Aristurtle is glad to introduce its 4th racecar and return to Hockenheim! The overall design concept revolves around weight reduction, reliability improvement and performance optimization. Key features are its new aluminum monocoque and radically revised aerodynamic package. The team is proud to develop in-house most parts. Among main areas of focus was the upgrade of control systems. Significant specs are the Regenerative Braking System and DRS. AMS, Telemetry and Datalogger are all custom.

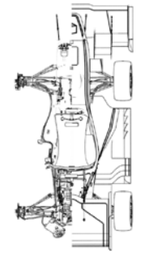
FRAME CONSTRUCTION Aluminum Monocoque
MATERIAL EN AW 2017 T4 0.8mm & 0.5mm aluminum skins, honeycomb core 3.2mmx20mm & 3.2x15mm
OVERALL L / W / H 2858mm / 1375mm / 1150mm
WHEELBASE / TRACK (Fr / Rr)
1535mm / 1180mm / 1150mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 192kg / 113kg
SUSPENSION Independent double wishbone pushrod suspension
TYRES (Fr / Rr) Hoosier 20.5x 7.0-13 R25B
WHEELS (Fr / Rr) 7 in. , 22 mm offset, Magnesium
NUMBER OF MOTORS / LOCATION / MAX POWER
2 / Rear Right, Rear Left / 55kW, 55kW
MOTOR TYPE Enstoij Emrax 228 Medium Voltage (PMSM)
MAX MOTOR RPM 6500
MOTOR CONTROLLER Unitek Bamocar D3 - 3phase servo
MAX SYSTEM VOLTAGE 357V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 7.46kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY)
1:3,2 / n/a
DRIVE TYPE Planetary Gearbox
DIFFERENTIAL Electronic Differential
COOLING Side mounted 800cc, custom designed laser melted aluminum heatsink
BRAKE SYSTEM ISR (25mm diam) floating brake rotors, 4-piston calipers front, 2-piston calipers rear
ELECTRONICS Custom designed passive AMS and telemetry system, wiring harness sealed to IP67

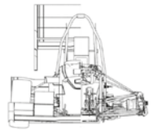
TRONDHEIM

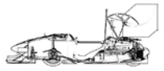
Norwegian University of Science and Technology

Car 63 **Pit 17-A** **WRL 8** Norway

Revolve NTNU was founded in 2010. Developed two combustion cars, before switching to electric in 2014 and had our first 4wd electric car in 2016. In 2018 we joined the new challenge of developing an autonomous racecar and still develop a new electric racecar, all in 8 months. Last year the team had the best competition result in the history both for the electric and driverless car.We are looking forward to showing you what we have made this year. See you at FSG.







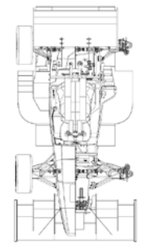
FRAME CONSTRUCTION CFRP two-piece monocoque
MATERIAL M46J(HM 6k) 2x2 twill DT120, UD 513 w/ HR40, Foam & ALUHC core, CRFP and Alu insert
OVERALL L / W / H 2890mm / 1445mm / 1192mm
WHEELBASE / TRACK (Fr / Rr)
1530mm / 1200mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 112kg / 119kg
SUSPENSION SLA, upper wishbone push rod actuated, T-bar ARB w/ progressive 3rd spring
TYRES (Fr / Rr) 205x34 R13, Continental C19 slick/wet
WHEELS (Fr / Rr) 7x13, 36 mm offset. Two piece CFRP/Al rims
NUMBER OF MOTORS / LOCATION / MAX POWER
4 / Hub mounted all wheels / 35.3 kW per motor
MOTOR TYPE Permanent magnet synchronous motor
MAX MOTOR RPM 20000
MOTOR CONTROLLER Self-developed, SiCMOS technology
MAX SYSTEM VOLTAGE 600
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 6.8 kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY)
14.41:1 / n/a
DRIVE TYPE Hub mounted compound planetary gearbox
DIFFERENTIAL n/a
COOLING Water cooled motors and inverters, dual cycle. Rear mounted radiators with outlet ducts.
BRAKE SYSTEM Self developed rotors and AM calipers, rear bike calipers. adjustable brake balance
ELECTRONICS All PCB's except IMD and telemetry and are self developed.

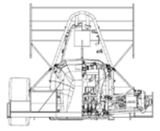
WOLFENBÜTTEL

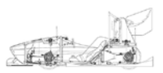
University of Applied Sciences Ostfalia

Car 35 **Pit 07-C** **WRL 73** Germany

The Team wob-racing from the UAS Ostfalia was founded in 2003. After 7 combustion cars the team focused on the construction of electric vehicles. This means that the Team wob-racing has been Wolfsburg's second largest automotive manufacturer for 16 years. With 35 team members our innovations from the past season were completely modified and expanded including a live telemetry and a full Aerodynamic package. A weight reduction of 10 kg was achieved despite all the innovations.







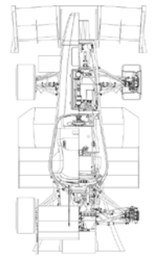
FRAME CONSTRUCTION Single Piece CFRP Monocoque
MATERIAL Aramid and EN AW 5056 Honeycomb sandwich panel
OVERALL L / W / H 2795mm / 1442mm / 1172mm
WHEELBASE / TRACK (Fr / Rr)
1530mm / 1220mm / 1200mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) kg / kg
SUSPENSION Double unequal length A-arm, pushrod actuated horizontal Spring and Damper
TYRES (Fr / Rr) 152x20 R10, Hoosier (Fr&Rr)
WHEELS (Fr / Rr) 6.0x10, 0mm offset 3 piece AL-Carbon rim (Fr&Rr)
NUMBER OF MOTORS / LOCATION / MAX POWER
4 / FL, FR, RL, RR / 4x 34 kW @ 16.000 rpm
MOTOR TYPE AMK DD5-14-10-POW
MAX MOTOR RPM 20.000 rpm
MOTOR CONTROLLER AMK KW26-S5-FSE-4Q
MAX SYSTEM VOLTAGE 600
ELECTRODE MATERIALS Lithium-Cobalt-Oxide & Graphit
COMBINED ACCUMULATOR CAPACITY 7.14 kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY)
1:13.19 / n/a
DRIVE TYPE 1.5 staged planetary gear mounted in eac
DIFFERENTIAL electronic differential using torque vectoring
COOLING Dual circuit, water cooled inverters and motors, radiator w/ fans mounted in sidepods
BRAKE SYSTEM 4x floating 190 mm rotors, separate systems Fr and Rr, adjustable balance
ELECTRONICS Multifunctional dashboard, online telemetry, selfdesigned BMS, diagnostics

ZÜRICH

Swiss Federal Institute of Technology Zurich

Car 33 **Pit 04-C** **WRL 1** Switzerland

The AMZ Racing Team was found in 2006 by students of the ETH Zurich.All cars in AMZ history are named after Swiss alpine passes or mountains such as flüela, gotthard, pilatus, eiger and the this year's car mythen. mythen features a completly self-developed drivetrain (SLM upright, motors in the 9th generation, gearbox, controller, electronics and accumulator), a warp and roll decoupled hydraulic suspension, a single piece CFRP monocoque, CFRP rims, RWS and wind tunnel validated aerodynamics.



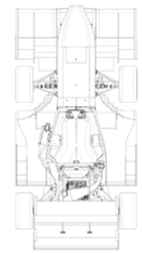
FRAME CONSTRUCTION CFRP single piece monocoque
MATERIAL CFRP pre-preg (Twill, UD), aluminum honeycomb and Rohacell core
OVERALL L / W / H 2851mm / 1538mm / 1189mm
WHEELBASE / TRACK (Fr / Rr)
1530mm / 1210mm / 1210mm
WEIGHT WITH 68kg DRIVER (Fr / Rr) 107kg / 119kg
SUSPENSION warp and roll decoupled hydraulic suspension
TYRES (Fr / Rr) Hoosier 16.0x7.5-10 R25B
WHEELS (Fr / Rr) 8x10.42 mm offset, CFRP hub, aluminum star
NUMBER OF MOTORS / LOCATION / MAX POWER
4 / FR, FL, RR, RL / 37 kW x4
MOTOR TYPE self-developed AMZ M9 PMSM in-runners
MAX MOTOR RPM 24000
MOTOR CONTROLLER self-developed AMZ I2 controller
MAX SYSTEM VOLTAGE 546V
ELECTRODE MATERIALS LiCoO2
COMBINED ACCUMULATOR CAPACITY 6.35 kWh
TRANSMISSION RATIO (PRIMARY / SECONDARY)
1:15.98 / N/A
DRIVE TYPE self-developed planetary gearset
DIFFERENTIAL N/A
COOLING passive CFD optimized radiatorcooling
BRAKE SYSTEM 4-Disk system, self developed SLM bracke calipers
ELECTRONICS optical AMS, live telemetry, Multifunctional Steering Wheel

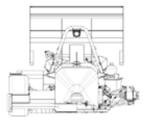
BERLIN

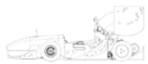
Hochschule für Technik und Wirtschaft Berlin

Car 538 **Pit 32-B** Germany

We are happy to present you the BRC19 with its revised adaptive autonomous system, aerodynamics, aggressive powertrain packaging and hydraulic system. We are totally committed to set new team records, but even more to celebrate the formula student atmosphere. Visit us at our pit and see more!







DRIVERLESS COMBUSTION

FRAME CONSTRUCTION Hybrid Monocoque: Front CFRP Monocoque / Rear Steel Tube Frame
MATERIAL CFRP Monocoque (HT Fibre & Rohacell core) and Steel Tube Frame 25,4mm diameter 25CrMo4
OVERALL L / W / H 2936mm / 1421mm / 1190mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1250mm / 1250mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 78kg / 117kg
ENGINE KTM SX-F 505 2008
BORE / STROKE / CYLINDERS / DISPLACEMENT 100mm / 60,8mm / 1 cylinder / 477cc
BRAKE SYSTEM 4-Disk system
PROCESSING UNITS Nvidia Jetson Xavier, dSPACE Embedded PC, self developed control unit with 6x ATSAMC21
PERFORMANCE OF PUs 2200 GFLOPS
POWER CONSUMPTION OF PUs 95 W
CAMERAS Matrix Vision mvBlueFOX3-2; Baumer VCXU-50C
RADAR n/a
LIDAR Velodyne VLP16-A
OTHER SENSORS Corrsys Datron SL (2 axis), Vectornav IMU VN300 with dual gps
HIGHLIGHTS OF THE DV SYSTEM adaptive design (60 min to install/remove all DV components) for CV and DV use, one hydraulic system for steering, clutch and brake, neural network object recognition, lightweight sensor setup, self-developed vehicle simulation

ERLANGEN

Friedrich-Alexander-Universität Erlangen-Nürnberg

Car 549 **Pit 32-A** Germany

For the first time in its history, High-Octane Motorsports e.V. participates at FSG with two cars. Besides the combustion vehicle FAUmax my, a second driverless combustion vehicle, the FAUmax athena was designed. It is based on the successful FAUmax lambda of 2018. Next to e-steering, e-throttle, e-clutch, and the emergency brake system, it was updated with new sensors and computing units tailored for autonomous driving. FAUmax athena is the beginning of an exciting FS Driverless journey.

DRIVERLESS COMBUSTION

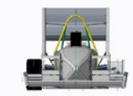
FRAME CONSTRUCTION CFRP full monocoque in sandwich structure
MATERIAL Plascore aluminium honeycomb core 20mm; carbon fibre skins 1,8mm
OVERALL L / W / H 2890mm / 1450mm / 1190mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1240mm / 1150mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 72kg / 92kg
ENGINE Modified KTM SX-F 450
BORE / STROKE / CYLINDERS / DISPLACEMENT 95mm / 72mm / 1 cylinder / 510cc
BRAKE SYSTEM Self designed master cylinders and stainless steel rotors, wilwood callipers
PROCESSING UNITS NVIDIA Drive PX AutoChaffeur
PERFORMANCE OF PUs 16000 GFLOPS
POWER CONSUMPTION OF PUs 80 W
CAMERAS One Stereolabs ZED Stereo Camera
RADAR
LIDAR One Sick MRS1104C-111011 LiDAR
OTHER SENSORS
HIGHLIGHTS OF THE DV SYSTEM Combination of multiple independent cone detection algorithms for better detection accuracy.

WEINGARTEN

University of Applied Sciences Ravensburg-Weingarten

Car 560 **Pit 34-A** Germany

The Driverless Team from Weingarten is now in their second season and build up again a driverless racecar with four cylinders! They decided to take the 2018 combustion car, the Stinger18C and equip it with the necessary hardware to make it drive autonomously. We would like to express our sincere thanks to our sponsors and everyone supporting the project!



DRIVERLESS COMBUSTION

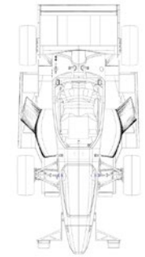
FRAME CONSTRUCTION tubular steel frame with CFRK inlays
MATERIAL steel
OVERALL L / W / H 2979mm / 1413mm / 119mm
WHEELBASE / TRACK (Fr / Rr) 1540mm / 1200mm / 1180mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 110kg / 117kg
ENGINE modified Honda CBR 600 rr / PC40
BORE / STROKE / CYLINDERS / DISPLACEMENT 69,0mm / 42,5mm / 4 cylinders / 636cc
BRAKE SYSTEM 4 disks system, self developed half floating rotors, self dev. balance bar, prop. valves
PROCESSING UNITS
PERFORMANCE OF PUs GFLOPS
POWER CONSUMPTION OF PUs W
CAMERAS
RADAR
LIDAR
OTHER SENSORS
HIGHLIGHTS OF THE DV SYSTEM

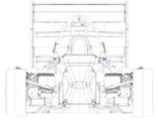
AACHEN

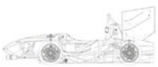
RWTH Aachen University

Car 499 **Pit 31-B** Germany

Ecurie Aix is one of the oldest Formula Student Teams in Germany, founded in the year 2000. The team name is derived from the French words ecurie meaning racing team and aix standing for Aachen. Since last season some people might think our name is spoken like „EuciRoix“ but it isn't actually.This season is our third season in the driverless class. The focus was to build a reliable and modular car based on our electric vehicle from last season.







DRIVERLESS ELECTRIC

FRAME CONSTRUCTION composite monocoque
MATERIAL HTA40 Prepreg, M40J UD Prepreg, Rohacell 51WF foam core, 72kg/m³ 5052 aluminium
OVERALL L / W / H 2932mm / 1526mm / 1126mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1250mm / 1200mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 102kg / 129kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Directly at the wheels / 33kW
COMBINED ACCUMULATOR CAPACITY
BRAKE SYSTEM 4-Disk system, self developed rotors with 240mm diameter
PROCESSING UNITS Modular selfdesigned main processing unit with Intel CPU and Nvidia GPU
PERFORMANCE OF PUs 3700 GFLOPS
POWER CONSUMPTION OF PUs 200 W
CAMERAS Stereolabs ZED 3D camera
RADAR none
LIDAR 2x SICK LD-MRS420201
OTHER SENSORS IMU and GPS
HIGHLIGHTS OF THE DV SYSTEM Redundant object detection via stereo cameras and LIDAR sensors with sensor fusion. Selfdesigned modular main processing unit. Full onboard localization with optional GPS.

BARCELONA

PT University of Catalonia - Engineering School of Barcelona

Car 454 **Pit 28-A** Spain

This year, the most beautiful and amazing car in the universe has been born. Indeed, we are talking about Xaloc, the first Driverless car created in Barcelona. This team, formed by mechanical and telecomunications engineers, has spent over 35.000 hours and consumed over 1.000 cookies to develop this self-driving car. Xaloc is the first generation of green happy cars. Although shy in the track, he is full of potential and looking forward to competing with other friends in FSG.

DRIVERLESS ELECTRIC

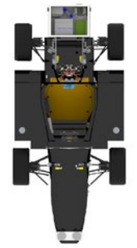
FRAME CONSTRUCTION One-piece CFRP & Al Honeycomb monocoque with integrated aluminium front hoop.
MATERIAL Prepreg CFRP and aluminium honeycomb. Al 6063 T6 Front hoop.
OVERALL L / W / H 2870mm / 1440mm / 1150mm
WHEELBASE / TRACK (Fr / Rr) 1540mm / 1200mm / 1150mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 101kg / 129kg
NUMBER OF MOTORS / LOCATION / MAX POWER 1 / Rear / 100kW
COMBINED ACCUMULATOR CAPACITY 7.1kWh
BRAKE SYSTEM
PROCESSING UNITS Nvidia Jetson TX2 and DX-1000 i7-6700TE (Skylake) 2.4GHz processor
PERFORMANCE OF PUs 1630 GFLOPS
POWER CONSUMPTION OF PUs 174 W
CAMERAS Two color DFK33ux252
RADAR n/a
LIDAR Velodyne VLP 32
OTHER SENSORS IMU+GPS - Vectornav VN-300
HIGHLIGHTS OF THE DV SYSTEM Sensor Fusion cone detection (Neural Network on camera image + LiDAR for distance determination), Graph SLAM for estimation and MPC control on vehicle actuation.

BUDAPEST

Budapest University of Technology and Economics

Car 414 **Pit 29-B** Hungary

BME Formula Racing Team was founded in 2007 by students of TU Budapest as the first Formula Student team of Hungary. Besides the EV car last year we made our first DV vehicle. In 2019 we are building only one car, which will be able to perform both in EV and DV category. We could accomplish this by designing a quickly mountable & dismountable driverless package. At FSG 2019 we are competing in driverless category, with a single goal: finishing every event with a learning algorithm.



DRIVERLESS ELECTRIC

FRAME CONSTRUCTION Single piece CFRP monocoque
MATERIAL Sandwich structure: prepreg layers (200g/m^2 twill, 120 g/m^2 UD)
OVERALL L / W / H 2968mm / 1405mm / 1016mm
WHEELBASE / TRACK (Fr / Rr) 1540mm / 1200mm / 1160mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 132kg / 132kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / In-hub motors at 4 wheels / 35kW, 35kW, 35kW, 35kW
COMBINED ACCUMULATOR CAPACITY 7.03kWh
BRAKE SYSTEM 4-Disk system, 191 mm diameter rotors, adjustable brake balance
PROCESSING UNITS 2xNvidia Jetson TX2, Microautobox, NI SOM
PERFORMANCE OF PUs 1500 GFLOPS
POWER CONSUMPTION OF PUs 300 W
CAMERAS Basler acA2040-120uc mono camera
RADAR
LIDAR 2xVelodyne VLP16
OTHER SENSORS Vectornav VN-300 INNS
HIGHLIGHTS OF THE DV SYSTEM Lidar sensor, and mono camera based perception running on Jetson TX2, Path Planning and contol algorithms running on Microautobox

DARMSTADT

Technische Universität Darmstadt

Car 442 **Pit 26-A** Germany

The TU Darstadt Racing Team was founded in 2005 and is attending FSG since its beginning. 2011 the Team switched to electric cars, and 2017 decided to go driverless. 35 students are currently working on the electric and the driverless project.This year, we built our third driverless vehicle. We used the chance to focus on further improving our autonomous system. An enhanced Sensor Fusion, a SLAM and a racing line generating trajectory planning are just some of this year's highlights.

DRIVERLESS ELECTRIC

FRAME CONSTRUCTION Single piece CFRP monocoque
MATERIAL CFRP-Prepreg, SGL SIGRAPREG C T24, Aluminium honeycomb
OVERALL L / W / H 2966mm / 1345mm / 1182mm
WHEELBASE / TRACK (Fr / Rr) 1525mm / 1183mm / 1162mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 107kg / 132kg
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear Right, Rear Left / 51kW
COMBINED ACCUMULATOR CAPACITY 6.35kWh
BRAKE SYSTEM self developed rotors 240mm dia. front / 200mm dia. rear, adj. brake balance
PROCESSING UNITS dSPACE MicroAutoBox II, custom PC
PERFORMANCE OF PUs 4285 GFLOPS
POWER CONSUMPTION OF PUs 302 W
CAMERAS Autonomos Smart Stereo Camera, 110° opening angle
RADAR n/a
LIDAR 2 Velodyne VLP-16 Hi-Res
OTHER SENSORS VectorNav VN-300, Kistler Correvit SFII
HIGHLIGHTS OF THE DV SYSTEM Neuronal network for computer visision, implementation of Google Cartographer for map generation, redundant kalmann-filter based sensor fusion of camera and lidar data

DELFT

Delft University of Technology

Car 485 **Pit 25-B** Netherlands

This year our association decided to take its first steps towards the new driverless challenge. The product is us. Delft Driverless in collaboration with MIT Driverless combined forces to make this endeavor a success. Modifying the high performing DUT18 and fixing its power issues, tsuhh, we are happy to present the DUT18D. A car, optimized for real time application at high speeds, our high update rates and low latencies will pave our way to victory! You don't believe it? Visit us on the podium!

DRIVERLESS ELECTRIC

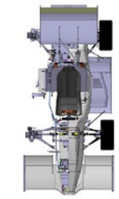
FRAME CONSTRUCTION Full monocoque
MATERIAL CFRP with aluminium honeycomb core
OVERALL L / W / H 2831mm / 1428mm / 1138mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1200mm / 1200mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 88kg / 92kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Front Right, Front Left, / 35kW
COMBINED ACCUMULATOR CAPACITY 7.3KwH
BRAKE SYSTEM Rotor floating in hub, 3 & 2 mm steel, 161/119mm, Integrated caliper half
PROCESSING UNITS Nvidia AGX Xavier, Advantech ARK-3520p
PERFORMANCE OF PUs 11358,616 GFLOPS
POWER CONSUMPTION OF PUs 130 W
CAMERAS FLIR Grasshopper 3, Nerian Karmin2, FLIR Blackfly S
RADAR -
LIDAR Velodyne VLP32C
OTHER SENSORS ADIS16497, Trimble BX992, Kistler Correvit SFII
HIGHLIGHTS OF THE DV SYSTEM 1. Fully redundant perception pipeline, robust against single sensor failure 2. Fully redundant globally consistent positioning using custom-designed Visual-Inertial Odometry (VIO) system and dual-antenna GPS

DRESDEN

Technische Universität Dresden

Car 411 **Pit 29-C** Germany

Elbflorace Driverless is the second team from Dresden. This year we're going to participate for the second time at FSG with our second ever built driverless car, called EmilE. Equipped with a second LiDAR and several cameras, she is supposed to easily recognize the cones and the track. Building a race car with only 15 people is a tough task. Luckily, we get great help of our friend, the cricket Jiminy. For almost one year he accompanies our work with his beautiful (and also annoying) sounds.



DRIVERLESS ELECTRIC

FRAME CONSTRUCTION full size CFRP Monocoque
MATERIAL Pre-impregnated CFRP with Aluminium honeycomb as core material
OVERALL L / W / H 2955mm / 1407mm / 1320mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1200mm / 1150mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 105kg / 105kg
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear / 35kw
COMBINED ACCUMULATOR CAPACITY 3,265
BRAKE SYSTEM 4-Disk system, self developed rotors and self developed front brake caliper
PROCESSING UNITS Teensy 3.2, Custom InVehicle PC (Intel i9-9900K and Nvidia RTX 2070), VCU (with a FPGA)
PERFORMANCE OF PUs 8078 GFLOPS
POWER CONSUMPTION OF PUs 600 W
CAMERAS 4 Ximea cameras, two black and white and two color. Range is about 18m, FOV is 43.6x33.4 Degrees
RADAR None
LIDAR 2 Velodyne Puck Hi-Res, with a 180 Degree FOV.
OTHER SENSORS None
HIGHLIGHTS OF THE DV SYSTEM The LiDAR system and the related algorithms are one of the highlights of our DV system, because they are very precise and reliable, but also fast to compute. Another highlight is our camera system, which is theoretically able to take up to 1400 images per second, though only 10 images per second per camera are evaluated in this season.

HAMBURG

Hamburg University of Technology

Car 478 **Pit 28-B** Germany

For the third time in a row the egn19-dv will enter the glowing asphalt of the Hockenheimring. After last year's extensive hardware and software conversion, the focus this season is on software optimizations. The two additional LIDARs, which increase the lateral field of vision of the racing car, also ensure better performance. For his last season, „Horst" has undergone another optical makeover and will not only look great on but also off the track.

DRIVERLESS ELECTRIC

FRAME CONSTRUCTION Monocoque structure with prep-reg and aluminium honeycomb core
MATERIAL IMS65 UD Fibres prepreg, aluminium honeycomb
OVERALL L / W / H 2920mm / 1385mm / 1140mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1200mm / 1150mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 114kg / 116kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / In the wheelhubs / 30kW
COMBINED ACCUMULATOR CAPACITY 6,7kWh
BRAKE SYSTEM 4-Disk system, self-developed rotors, adjustable breake balance
PROCESSING UNITS LPC 4337, Intel Core i7-6700K, Jetson TX2 module, Raspberry Pi
PERFORMANCE OF PUs 6573 GFLOPS
POWER CONSUMPTION OF PUs 300 W
CAMERAS 2 x Basler - daA1600-60ucArea Scan Camera with Global Shutter, USB 3.0, Res: 1600 x 1200 pixels
RADAR n/a
LIDAR 5x Ibeo Lux 2010, 85 deg. angle, 30m range, 4 Layer rotating mirror LIDAR scanner
OTHER SENSORS 1x Xsens - MTi-G-710-GNSS/INS (IMU), self-developed angle sensor at steering rack
HIGHLIGHTS OF THE DV SYSTEM In processing our LiDAR data we use Bundle Adjustment to retrieve both the car movement and a cone map, effectively using it for SLAM. We gather color information out of the camera data to simplify our path planning. We have also a smooth integration of the dv components in the ev car. To improve our lap times we optimized our torque vectoring.

KARLSRUHE

Karlsruhe Institute of Technology

Car 419 **Pit 26-C** Germany

„One team - three cars!" KA-RaceIng is designing, manufacturing and competing with a FSC, FSE and FSD car every year. With the increase in perfomance, we saw the need for aerodynamics to make further improvements in corner speed possible. The result is impressive: we threw out our sidewings. To increase our performance, we developed a model predictive control, decided to use the raw data of our LiDARs to improve the perception range by 22 meters and implemented a new, more realistic simulation.

DRIVERLESS ELECTRIC

FRAME CONSTRUCTION CFRP sandwich monocoque, manufacturing method:VARI
MATERIAL HT, IMS and HM carbon fibres, aramid twill, HM Zylon UD, Altropol Neukadur resin
OVERALL L / W / H 2710mm / 1455mm / 1180mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1220mm / 1150mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 120kg / 98kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / front and rear central / 23kW
COMBINED ACCUMULATOR CAPACITY 5,221kWh
BRAKE SYSTEM 4-Disk system
PROCESSING UNITS Mini itx Mainboard + Graphics Card
PERFORMANCE OF PUs n/a GFLOPS
POWER CONSUMPTION OF PUs 200 W
CAMERAS 2 Basler dart cameras looking forward/to the side and one Basler dart camera looking back
RADAR n/a
LIDAR Four ibeo LUX 2010 with an opening angle of 110°
OTHER SENSORS xsens IMU MTi G710
HIGHLIGHTS OF THE DV SYSTEM The Highlights of our DV system are a high ranged cone detection at 25Hz using LiDAR detections to determine interesting areas in the image planes. In addition, a self developed simulation is used to improve our modelbased trajectory planning and control algorithms.

MÜNCHEN

Technical University of Munich

Car 431 **Pit 31-C** Germany

TUfast Racing Team from the TU Munich consists of 80 team members who design and build two race cars this season as a single team (electric + driverless). One Team – Two cars – TUfast. We believe our state-of-the-art planning & control, the fast and light 2017 electric car we use as the platform, the self developed perception algorithms and our agile actuation systems will contribute to our success in this season. Feel free to pay us a visit in our pit!

DRIVERLESS ELECTRIC

FRAME CONSTRUCTION CFRP Monocoque with aluminium honeycomb
MATERIAL carbon fibre reinforced plastic
OVERALL L / W / H 2933mm / 1417mm / 1176mm
WHEELBASE / TRACK (Fr / Rr) 1550mm / 1200mm / 1200mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 98kg / 90kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / one in each wheel / 25,8
COMBINED ACCUMULATOR CAPACITY 7,4
BRAKE SYSTEM Integrated sintered upright calipers
PROCESSING UNITS NVIDIA Jetson AGX Xavier, Speedgoat Baseline OpenFrame, InCar PC CQ67G
PERFORMANCE OF PUs 3548 GFLOPS
POWER CONSUMPTION OF PUs 206 W
CAMERAS Basler ace GigE C-Mount v01 with Stemmer CVO GMTHR24514MCN 4.5mm, IDS UI-5244LE-C-HQ-MB with 8mm Tam
RADAR n/a
LIDAR Hesai Pandar 40, 360° FOV, 40 layers
OTHER SENSORS OXTS 3003 GPS, IB6 IMU, SBG GPS and IMU, Correvit SFII
HIGHLIGHTS OF THE DV SYSTEM Formula Student centered robust local trajectory planner,cascading non-linear feedforward controller, state-of-the-art deep learning techniques for independent cone detection on images and point clouds, robust probabilistic sensor fusion module, DSO Slam via Stereo Cameras, Extended Kalman Filter over four reliable and independent sources

RAVENSBURG

Baden-Württemberg Cooperative State University Ravensburg

Car 469 **Pit 32-C** Germany

GFR was formed in the 2009 season from the two FS teams of Oregon State University and DHBW Ravensburg. Students from both schools work collaboratively to design, build and test two vehicles each year. Since then we have built one combustion and one electric car with shared chassis, aerodynamics and suspension packages. For the first time this year, GFR is competing with a third car in the Driverless category.

DRIVERLESS ELECTRIC

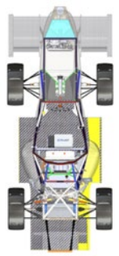
FRAME CONSTRUCTION CFRP/honeycomb monocoque
MATERIAL Toray
OVERALL L / W / H 2865mm / 1350mm / 1190mm
WHEELBASE / TRACK (Fr / Rr) 1535mm / 1145mm / 1145mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 79kg / 119kg
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Dual Inboard Motors / 2*55kW
COMBINED ACCUMULATOR CAPACITY
BRAKE SYSTEM Pneumatic actuator which pulls the brake pedal
PROCESSING UNITS Core i7-8559U, 512-core Volta GPU with Tensor Cores
PERFORMANCE OF PUs 8562 GFLOPS
POWER CONSUMPTION OF PUs 58 W
CAMERAS Basler dart
RADAR n/a
LIDAR Ouster OS1 64 Layer, 2048 samples
OTHER SENSORS n/a
HIGHLIGHTS OF THE DV SYSTEM

STOCKHOLM

KTH Royal Institute of Technology

Car 471 **Pit 29-A** Sweden

At KTH Formula Student, the main design philosophy revolves around being efficient and practical. At the same time, sustainability is something that is implemented in all ends of our project. To achieve this, the work is based on the core values of the team: Learning, Teamwork and Engineering. These are achieved by aiming to be working with a number of things: documentation, transparency and maintaining good relations with our partners to mention a few.



DRIVERLESS ELECTRIC

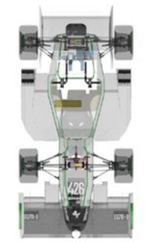
FRAME CONSTRUCTION Tubular steel spaceframe
MATERIAL Cold formed and welded high strength circular tubes, Docol R8, acc. EN 10304-3
OVERALL L / W / H 2982mm / 1304mm / 1150mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1100mm / 1080mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 110kg / 124kg
NUMBER OF MOTORS / LOCATION / MAX POWER 2 / Rear Right, Rear Left / 80 kW
COMBINED ACCUMULATOR CAPACITY 7,37
BRAKE SYSTEM 4-disk system. 4 piston front calliper, 2 piston rear with same size master cylinder.
PROCESSING UNITS dSpace MicroAuto Box
PERFORMANCE OF PUs 1410 GFLOPS
POWER CONSUMPTION OF PUs 30 W
CAMERAS StereoLabs ZED Camera (1)
RADAR N/A
LIDAR Velodyne VLP-16 (1)
OTHER SENSORS IMU: Xsens - MTi-G-710-GNSS/INS (1)
HIGHLIGHTS OF THE DV SYSTEM Focus put on system architecture and self-contained modules that interconnect via predefined interfaces. Pipeline using YOLOv3, fusion with LiDAR, FastSLAM2.0 and optimal tracking controller (MPC)

STUTTGART

University of Stuttgart

Car 426 **Pit 26-B** Germany

2019 marks the 10th anniversary of the GreenTeam and the 3rd time we partipate at Hockenheim with our driverless car. At the beginning of the season, the driverless project was – after two years of development - fully integrated into the team. Within the last eight months this team has transformed the previous year's vehicle, the E0711-9, to a fully autonomous vehicle, the D0711-3. Four cameras and one LiDAR, Visual-Graph SLAM and a pure pursuit control enable our car to excel on the track.



DRIVERLESS ELECTRIC

FRAME CONSTRUCTION Carbon fiber sandwich structure monocoque
MATERIAL Aluminium honeycomb sandwich panel
OVERALL L / W / H 3000mm / 1440mm / 1200mm
WHEELBASE / TRACK (Fr / Rr) 1540mm / 1200mm / 1200mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 80kg / 85kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / One at each Wheel / 32.5 kW per Motor
COMBINED ACCUMULATOR CAPACITY 3.2kWh
BRAKE SYSTEM 4-Disk system, self developed steel brake disk
PROCESSING UNITS Speegoat Baseline as Vehicle Dynamics ECU, Vecow EVS1100 as Autonomous System ECU
PERFORMANCE OF PUs 6000 GFLOPS
POWER CONSUMPTION OF PUs 610 W
CAMERAS Basler acA1920(2x), Basler acA1300(2x)
RADAR
LIDAR Velodyne VLP16 Hi-Res
OTHER SENSORS
HIGHLIGHTS OF THE DV SYSTEM Sensor concept consisting of four cameras (2x Mono, 1x Stereo Setup), FPGA accelerated image processing, Semi-Global-Matching, Visual-Graph SLAM, Model Predictive Control

TALLINN

Tallinn TU - University of Applied Sciences

Car 489 **Pit 28-C** Estonia

Formula Student Team Tallinn is based in Estonia and is the only team in our country. The team first came together in 2006 and since then has competed in all the major competitions in Europe and United States. 2019 is the first year the team took up the challenge to compete in the driverless class with the last season's car FEST18.

DRIVERLESS ELECTRIC

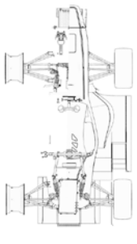
FRAME CONSTRUCTION CFRP single piece monocoque
MATERIAL Rohacell foam (5-20mm core)
OVERALL L / W / H 2896mm / 1460mm / 1163mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1206mm / 1180mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 108kg / 117kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / FR,FL,RR,RL / 35 kW per motor
COMBINED ACCUMULATOR CAPACITY 6.45 kWh
BRAKE SYSTEM 4 disc brakes, regenerative braking
PROCESSING UNITS NVIDIA Jetson AGX Xavier
PERFORMANCE OF PUs 11 000 GFLOPS
POWER CONSUMPTION OF PUs 30 W
CAMERAS 2 Basler Ace Classic acA780-75gc (780x580 px) & 1 SICK 2D vision picoCam I2D-301C (1280x1024 px)
RADAR N/A
LIDAR Ouster OS-1 with 64 lasers. Vertical FOV 33.2°, horizontal FOV 360°, range 0.8 - 120 m
OTHER SENSORS SBG Ellipse2-N INS. Accuracies: roll/pitch - 0.1°; heading - 0.5°; velocity - 0.1 m/s; position - 2 m
HIGHLIGHTS OF THE DV SYSTEM Self developed artificial intelligence path planner. Path generator produces random paths and evaluator grades the given trajectory based on car maximum accelerations and decelerations. Best out of 100 paths win. 64 layer LiDAR. Reduntant and calibrated cone detection for vehicle state estimation. Neural network based image recognition.

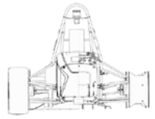
TRONDHEIM

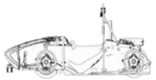
Norwegian University of Science and Technology

Car 463 **Pit 25-C** Norway

Revolve NTNU is a team from Norway, consisting of 67 students from all years of study. This year, over 15 members have worked hard to introduce Revolve's second autonomous vehicle. With a new base vehicle and a new autonomous pipeline, we will do our best in the competitions. Best of luck to everyone!







DRIVERLESS ELECTRIC

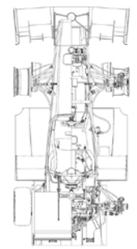
FRAME CONSTRUCTION CFRP Two-Piece Monocoque
MATERIAL IM 2x2 twill prepreg and HM UD prepreg with Foam & ALUHC core sandwich panel
OVERALL L / W / H 2870mm / 1400mm / 1185mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1200mm / 1180mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 96kg / 105kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / Hub mounted / 37 kW
COMBINED ACCUMULATOR CAPACITY 6.8 kWh
BRAKE SYSTEM 4-Disk system, self developed rotors, ISR 22-048/9 calipers, adjustable brake balance
PROCESSING UNITS Self developed processing unit with Intel i7-8700, NVIDIA GTX 1070
PERFORMANCE OF PUs 6825 GFLOPS
POWER CONSUMPTION OF PUs 250 W
CAMERAS Basler acA1300-200uc
RADAR N/A
LIDAR Ouster - OS-1, Velodyne - Puck VLP-16
OTHER SENSORS VectorNav VN-300
HIGHLIGHTS OF THE DV SYSTEM Autonomous systems written in C++ in ROS. Nonlinear observer for state estimation. Detection systems based on mono camera and 2xLiDARs using YOLOv3 and PCL, fused asynchronously with EKF in SLAM frontend. SLAM's backend is factor graph based (iSAM2). Particle Filter based path planning. Feedback Linearization Control. Tested on inhouse simulator.

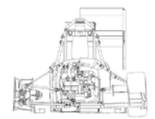
ZÜRICH

Swiss Federal Institute of Technology Zurich

Car 433 **Pit 31-A** Switzerland

AMZ Racing was founded in 2006 by students of ETH Zurich. Since 2010 AMZ focuses on electric vehicles and collaborates with the Lucerne University of Applied Science and Arts. AMZ took the opportunity to transform their electric vehicles into autonomous race cars, when Driverless was first introduced in 2017. The 2019 driverless team consists of an diverse and international team of Master's students from Robotics, Electrical Engineering, Mechanical Engineering, and Computer Science.





DRIVERLESS ELECTRIC

FRAME CONSTRUCTION Single piece CFRP monocoque
MATERIAL CFRP & AFRP pre-preg (Twill and UD), aluminum honeycomb sandwich
OVERALL L / W / H 2932mm / 1422mm / 1156mm
WHEELBASE / TRACK (Fr / Rr) 1530mm / 1220mm / 1220mm
WEIGHT WITHOUT DRIVER (Fr / Rr) 97kg / 100kg
NUMBER OF MOTORS / LOCATION / MAX POWER 4 / On all wheels / 38.44kW
COMBINED ACCUMULATOR CAPACITY 6.2kWh
BRAKE SYSTEM Self-developed aluminum calipers, adjustable brake balance, proportional valve in the rear
PROCESSING UNITS CPU: Intel Quad-Core Xeon E3-1505M V6, GPU: NVIDIA GeForce 1070
PERFORMANCE OF PUs 6660 GFLOPS
POWER CONSUMPTION OF PUs 210 W
CAMERAS Two Basler mono cameras with a combined opening angle of 135° enabling cone detections up to 20m
RADAR -
LIDAR Two Velodyne ULTRA Pucks with a horizontal field of view of 180° enabling cone detections up to 25m
OTHER SENSORS INS with dual antenna GNSS, non-contact optical speed sensor
HIGHLIGHTS OF THE DV SYSTEM Fully redundant sensor pipelines providing robustness against single sensor failure. Multi-level estimation methods leverage probabilistic cone observations. Different control algorithms are optimized to meet the requirements of the respective dynamic disciplines.

Formula Student Worldwide

958 teams – 58 nations – 5 continents – one passion

Every year students from various disciplines share their enthusiasm for the competition. The various venues are visited annually by hundreds of student teams. The Formula Student community is growing steadily and other countries are joining in with their own competition. This year at the Hockenheim Ring, Formula Student Germany is once again hosting a joint meeting for all Formula Student organisers, in order to share and develop the competition further.

958 Teams – 58 Länder – 5 Kontinente – eine Leidenschaft

Jedes Jahr teilen weltweit Studenten unterschiedlicher Fachrichtungen ihre Begeisterung für den Wettbewerb . Die verschiedenen Austragungsorte werden jährlich von hunderten studentischen Teams besucht. Die Formula Student-Gemeinschaft wächst stetig und weitere Länder schließen sich mit einem eigenen Wettbewerb an. Im Rahmen der Formula Student Germany 2019 auf dem Hockenheimring findet wieder ein Meeting aller weltweiten Formula Student Organisatoren statt, um den Wettbewerb gemeinsam weiterzuentwickeln.

Formula SAE
Lincoln & Electric
19.06.2019 – 22.06.2019
Lincoln Park, NE

Competition: C E

Reg. Teams: 110
Winners 2019:
C: CA Montréal PT
E: CA Montréal U McGill

Formula SAE
Michigan
08.05.2019 – 11.05.2019
Michigan International Speedway, MI

Competition: C

Reg. Teams: 120
Winners 2019:
C: DE Stuttgart U

Formula SAE
Canada
30.05.2019 – 02.06.2019
Barrie Molson Centre, Barrie ON

Competitions: C E

Reg. Teams: 45
Winners 2019:
C: CA Montréal ETS
E: US Pittsburgh CMU

FSAE
Brasil
28.11.2019 – 01.12.2019
ECPA – Esporte Clube Piracicabano de Automobilismo

Competitions: C E

Reg. Teams: 50
Winners 2018:
C: BR Belo Horizonte CEFET-MG
E: BR Campinas U

FS
UK
17.07.2019 – 21.07.2019
Silverstone Circuit

Competitions: C E D

Reg. Teams: 95
Winner 2019:
IT Modena UNIMORE
Best E: DE Zwickau UAS

FS
Austria
28.07.2019 – 01.08.2019
Red Bull Ring, part of Project Spielberg, in Spielberg, Styria

Competitions: C E

Reg. Teams: 58
Winners 2018:
C: AT Graz TU
E: DE Hamburg TU

FS
Spain
20.08.2019 – 25.08.2019
Circuit de Barcelona-Catalunya, Montmélo

Competitions: C E D

Reg. Teams: 85
Winners 2018:
C: DE Stuttgart U
E: DE Stuttgart U

FS
Netherlands
07.07.2019 – 11.07.2019
TT Circuit Assen

Competitions: C E

Reg. Teams: 60
Winners 2019:
C: IT Milano PT
E: NL Delft TU

FS
East
17.07.2019 – 21.07.2019
Zala ZONE Automotive Proving Ground, Zalaegerszeg

Competitions: C E D

Reg. Teams: 72
Winners 2019:
C: AT Graz UAS
E: CH Zürich ETH
D: DE München TU

Formula SAE
Italy
24.07.2019 – 28.07.2019
Riccardo Paletti Circuit, Varano 'de Melegari, Parma

Competitions: C E D

Reg. Teams: 100
Winners 2018:
C: AT Graz TU
E: EE Tallinn TU UAS
D: CH Zürich ETH

FS
Czech
12.08.2019 – 17.08.2019
Autodrom Most

Competitions: C E D

Reg. Teams: 55
Winners 2018:
C: CZ Brno TU
E: CZ Prague CTU

FS
China & FSCE
09.10.2019 – 15.10.2019 / 18.11.2019 – 23.11.2019
Xiangyang, Hubei province / Zhuhai, Guangdong province

Competitions: C E D

Reg. Teams: 140
Winners 2018:
C: CN Changchun JLU
E: CN Liuzhou UAS
D: CN Beijing IT

Formula
Bharat
22.01.2020 – 26.01.2020
Kari Motor Speedway, Coimbatore, Tamil Nadu

Competitions: C E

Reg. Teams: 75

Winners 2019:
C: IN Gandhinagar GTU
E: IN Pune PCCOE

Formula SAE
Korea
16.08.2019 – 18.08.2019
Gunsan-si, Jeollabuk-do

Competitions: C E

Reg. Teams: 38
Winners 2018:
C: KR Seoul U Kookmin
E: KR Gachon U

Formula SAE
Japan
27.08.2019 – 31.08.2019
Ogasayama Sports Park ECOPA

Competitions: C E

Reg. Teams: 98
Winners 2018:
JP Suita U Osaka
Best E: JP Nagoya U

Formula SAE
Australasia
05.12.2019 – 08.12-2019
Winton Motor Raceway, Rural City of Benalla, Victoria

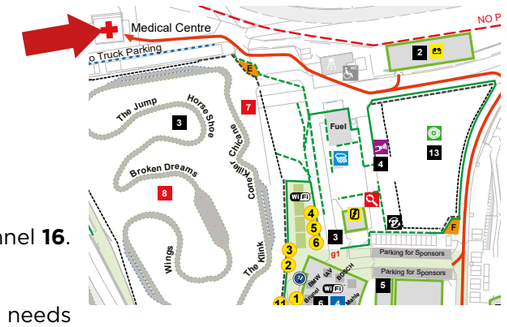
Competitions: C E

Reg. Teams: 35
Winners 2018:
C: AU Melbourne Monash
E: DE München TU

EMERGENCY INFORMATION

Minor Injury

Medical Centre:
Please accompany the injured person to the Medical Centre.
Emergency aid is provided there.
The Medical Centre is occupied whenever the Pits are open.



Severe Injury

Contact someone with a two-way radio:
Every Official and Security has two-way radio.
Ask them to call the Medical Centre or an ambulance on channel **16**.

Call an ambulance:
Call an ambulance yourself if someone is severely injured and needs urgent help. The Emergency Number for every phone and mobile phone is **112**.

During dynamics:
On the days that the dynamics are running, an ambulance is on site during the dynamic events.
They are located next to the Medical Centre and are marked on the Event Plan in blue.
To contact them, ask someone with a two-way radio (Official, Security) to call them.

Hospital:
Krankenhaus (Schwetzingen), Bodelschwinghstrasse 10,
68723 Schwetzingen, phone: +49 (0) 6202/84-30

https://fsg.one/hospital

Emergency Numbers

In case of an emergency call **112**.
This number works with each phone, also with mobile phone or coin-operated telephone as international GSM-standard. It is alway free of charge.

112

Officials

Event Control - Lea Pißareck	+49 (151) 560 747 02
Back Office - Sven Grundner	+49 (151) 560 747 03

(In case of an emergency please call 112 and afterwards Lea or Sven.)

Emergency Call Contents

The emergency control centre will ask you some questions to ensure proper help for you. To support you at your call, here are some standard questions and some hints for your answers in English and German.

Who is calling? (Wer ruft an?)
Say your name and your telephone number for callbacks. Digits in German: 0 (null), 1 (eins), 2 (zwei), 3 (drei), 4 (vier), 5 (fünf), 6 (sechs), 7 (sieben), 8 (acht), 9 (neun)

Where did it happen? (Wo ist es passiert?/Wo ist es geschehen?)
the event site has the adress "Hockenheimring, Sachshaus, Am Motodrom", make it more precise!:
pit lane (Boxengasse), dynamic area (Fahrerlager);
the adress for campsite C2 near the Motodrom Hotel " Hockenheimring, Zeltplatz C2 beim Motodrom Hotel"
and for campsite C3 on the other site of the highway "Hockenheimring, Zeltplatz C3 an der Continental Straße"

What happened? (Was ist passiert?/Was ist geschehen?)
accident (Unfall), traffic accident (Verkehrsunfall), fire (Feuer), fall (Sturz), explosion (Explosion)

How many people are affected? (Wie viele Personen sind betroffen?)
1 (eins), 2 (zwei), 3 (drei), 4 (vier), 5 (fünf), 6 (sechs), 7 (sieben), 8 (acht), 9 (neun), 10 (zehn)

What kind of injury has happened? (Welche Verletzung liegt vor?)
fracture (Knochenbruch), bleeding (Blutung), unconsciousness (Bewusstlosigkeit), burn (Verbrennung), electric shock (Stromschlag), suffocation (Ersticken), heart attack (Herzinfarkt), shock (Schock)

Don't hang up after answering these questions! Wait to hear if the control centre has further questions!

FORMULA STUDENT GERMANY 2019

Supporter: Accenture Technology Solutions | fishfarm netsolutions | Gross-Funk | Hockenheimring | Isabellenhütte Heusler | Kube Ingenieurbüro | Linde Material Handling | Maxim Integrated Products | RIEDEL Communications | SLV Mannheim