Formula Student Alpe Adria

&

IPG Automotive

# IPG Driverless Competition

# Competition Handbook v0.7

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**Changelog**

| Version | Section | Change description |
|---|---|---|
| 0.5 | 1-6 | Section Creation |
| 0.7 | 3-6 | Changes for release of the Handbook |

## 1. Introduction

### 1.1 IPG Automotive

Founded in Germany, IPG Automotive is a globally-recognized leader in virtual test-driving technology and simulation solutions. Their flagship software, the CarMaker family, allows vehicle developers to perform virtual driving, sensor- and vehicle-dynamics testing, and full system validation — from MIL/SIL all the way to HIL/VIL.

With a strong emphasis on enabling autonomous-driving and advanced driver-assistance systems (ADAS) workflows, IPG Automotive's platform supports realistic scenarios, flexible scenario generation and reproducible tests — key ingredients in the mobility transformation.

Their mission is to accelerate vehicle development by reducing physical prototype costs and increasing testing efficiency and coverage in the virtual domain.

In line with this vision, IPG Automotive is proud to partner with the Formula Student Alpe Adria series to bring simulation and driver-model technology into the student racing domain.

### 1.2 Formula Student Alpe Adria (FSAA)

Founded in 2017, Formula Student Alpe Adria (FSAA) has emerged as one of the fastest-growing Formula Student events in Europe.

The 2025 edition took place from 11 to 16 August 2025 at the Bugatti Rimac test track in Mičevec, Croatia, featuring 58 competing teams and more than 1,600 students, mentors, volunteers, judges and scrutineers from over 20 countries.

The event further distinguished itself by a high-quality livestream that connected the FS paddock to the general public, reinforcing the FSAA brand as not only technically innovative but also community- and media-oriented. It marked another milestone in the journey toward building one of the leading Formula Student competitions globally.

### 1.3 Virtual Formula Student Alpe Adria (vFSAA)

As the world's first virtual Formula Student competition, Virtual Formula Student Alpe Adria was launched in 2024.

In its most recent edition, vFSAA II drew 96 teams from 31 countries, across five disciplines, and attracted over 16,000 viewers via YouTube. (Exact viewer figure to be confirmed.)

The event pursues five core goals:

- Simulation – Showcase the potential and power of virtual testing for car and driver development
- Driver – Inspire students to embrace driving (the essence of race cars) and allow them to compete on equal virtual machinery
- Social – Connect teams worldwide throughout the year, beyond a singular event
- Motorsport – Foster a passion for motorsport among students globally
- Alpe Adria – Support the growth of STEM and engineering in South-East Europe via the FS ecosystem

By combining simulation, competition and community, vFSAA offers a novel platform for student engineers to test their ideas virtually, while competing on a level playing-field across geographic boundaries.

### 1.4 IPG Driverless Competition

Building on the long-term collaboration between IPG Automotive and FSAA, the IPG Driverless Competition takes simulation participation to the next level. In May 2025, the partners jointly organised a special virtual event — the "Night of Champions" (vFSAA:NoC) — and later in Summer 2025 the IPG Virtual Autocross competition was held within FSAA 2025.

The next milestone is the IPG Driverless Competition (IPG-DV), to be held within Virtual Formula Student Alpe Adria III from 25–27 November 2025. In this event, student teams from around the world will design and optimize a

driver-model capable of controlling a given virtual vehicle and posting the fastest time on specified tracks. The core aim is to enable students to generate knowledge in the field of autonomous driving — an area increasingly important in Formula Student and the automotive industry at large.

Participants will gain a deep insight into driver-model behaviour, vehicle physics and system performance, enabling them not only to understand how a car “drives itself” but also to precisely compare different versions of their virtual cars and algorithms.

## 2. General Information

### 2.1 vFSAA Rules

The IPG Driverless Competition is an integral part of Virtual Formula Student Alpe Adria (vFSAA).

Unless a specific exception is stated in this document, all rules and conventions defined in the official Virtual Formula Student Alpe Adria Competition Handbook apply.

In case of any ambiguity or inconsistency between the rules, participants must contact the organizers directly using the contact information provided in Chapter 6 of this handbook.

### 2.2 Official Language and Communication

The official language of the competition is English. All official documents, announcements, and communications will be provided exclusively in English.

Before the registration deadline, the primary communication channel between teams and organizers will be email.

After registration closes, all official communication will take place via Discord, which all participating teams are required to join for updates, coordination, and event-related discussions.

The official Discord server is publicly accessible, but specific sections are restricted to designated roles. Roles will be assigned to registered team members after verification.

Teams can join the official server using the following link: https://discord.gg/JQhHe6vKh2

### 2.3 Official Event Time Zone and Date/Time Format

The official time zone for Virtual Formula Student Alpe Adria (vFSAA) is Central European Time (CET) during the winter period and Central European Summer Time (CEST) during the summer period, in accordance with European daylight-saving changes.

All event-related timings follow the format: YYYY-MM-DD hh:mm (24-hour clock).

This format applies to all deadlines, schedules, and time-sensitive communications.

Teams are responsible for ensuring that their local systems and schedules align with the official time zone and format to avoid misunderstandings regarding deadlines or session start times.

### 2.4 Software and Versions

- Vehicle model: Developed in CarMaker 14.1 (IPG Automotive).
- Driver model: Implemented in Simulink R2024b (MathWorks MATLAB).
- Operating system: It is recommended to run the model under Windows 11.

Each team must hold valid licenses for all required software.

Teams may prepare their models using other operating systems; however, they are fully responsible for ensuring compatibility and successful execution under Windows 11 for official evaluation.

## 3. Eligibility and Registration

### 3.1 Eligibility

To be eligible for the IPG Driverless Competition (IPG-DV), teams must:

- Be correctly registered for the corresponding Virtual Formula Student Alpe Adria (vFSAA) event.
- Be enrolled in the Formula CarMaker Program via the official IPG Automotive website, using the following link:

https://www.ipg-automotive.com/en/support/licenses/formula-carmaker/

Teams that do not meet both criteria will not be considered eligible to participate in the IPG-DV event.

### 3.2 Registration

No additional registration procedure is required specifically for the IPG-DV.

Registration is considered formally complete once all required files have been correctly uploaded to the official Google Drive folder of the competition, as provided by the organizers.

Teams are advised to verify successful upload and accessibility of their files before the submission deadline to ensure valid participation.

## 4. Schedule and Deadlines

### 4.1 Official Schedule

- **2025-10-27 12:00 – Official Announcement and Handbook Release**
  The competition is officially announced, and the present Handbook is published on all official channels.
- **2025-11-10 12:00 – Track and Driver Model Release**
  The official track and driver model are finalized (“frozen”) and made available for download by all registered teams. A Tutorial containing all necessary information will also be provided.

- **2025-11-23 23:59 – Submission Deadline**
  Deadline for all teams to upload their optimized data and required files to the official competition Google Drive folder. Late submissions will not be accepted.
- **2025-11-27 22:00 – Results Announcement**
  The official results of the IPG Driverless Competition will be published during the **YouTube livestream of the Formula Student Alpe Adria Finals**.

### 4.2 Amendments to Schedule and Deadlines

Any changes or amendments to the official schedule or deadlines will be communicated exclusively via the official Discord channel of the competition.

Teams are responsible for monitoring the Discord server regularly to remain informed of potential updates or organizational notices.

## 5. IPG Driverless Competition (IPG-DV)

### 5.1 Competition Process

The IPG Driverless Competition will be conducted in the following steps:

#### 5.1.1 Step 1 – Model Preparation

IPG Automotive will prepare the following files:

- **Vehicle File [IPG_Challenge_Car]** – Contains a model representative of a high-performance Formula Student car of the Electric Vehicle category with multiple sensors attached. The model is designed to interface with and be controlled by a driver model in MATLAB Simulink.
- **3D Object of the Formula Student car [IPG_Challenge_Car.gltf] –** Includes an example livery
- **Livery [Livery.png] –** Livery of the car
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- **AutocrossTrack [FSAA-AutoX.rd5]** – Represents the Autocross track of Formula Student Alpe Adria 2024. Contains a changeable example centerline trajectory.
- **VirtualAlpeAdriaTrack [FSAAII.rd5]** – Represents the Mičevec track as used during Virtual Formula Student Alpe Adria II. Contains a changeable example centerline trajectory.
- **Driver Model [DriverModel.slx]** – Contains a MATLAB/Simulink model capable of driving the provided car on both tracks.
- **Driver Model Parameters [DriverModelParameters.m]** – Contains a set of parameters to adjust the behavior of the driver model.
- **Testruns [Autocross_challenge, Endurance_challenge]** – Contains the Scenarios of the Challenge including lap time measurements
- **Simulation Parameters [SimParameters]** – Defines the Environment Parameters of the Challenge

#### 5.1.2 Step 2 – Download

From the date specified in Section 4.1, teams will be allowed to download all files and run them on their own computers.

Download link will be provide through the official discord channel.

#### 5.1.3 Step 3 – Optimization

Each team will be allowed to modify and optimize the following files:

- Livery.png
- FSAA-AutoX.rd5
- FSAAII.rd5
- DriverModel.slx
- DriverModelParameters.m

Teams are permitted to:

- FSAA-AutoX.rd5 → The only change allowed in this file is the change of the target Trajectory. Tutorial will be delivered to explain the changing procedure in detail.
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- FSAAII.rd5 → The only change allowed in this file is the change of the target Trajectory. Tutorial will be delivered to explain the changing procedure in detail.
- DriverModel.slx → Changes are only allowed in Vehicle Control subsystem block. CarMaker inputs and outputs are not changeable.
- DriverModelParameters.m → No rule
- Manually optimize the target trajectory (racing line) on each individual track to minimize lap time.
- Optimize the parameters of the driver model.
- Modify the Driver Model or even replace the Driver Model with a different one, provided it uses the same inputs and outputs as the original DriverModel.slx file.

To ensure that all teams use the same tools and all models are executable on the IPG server, the Simulink model is restricted to using blocks from the following Toolboxes.

- Simulink
- CarMaker4SL (only predefined ones in given DriverModel)
- HDL Coder
- Simulink Extras
- Stateflow

(Note: This list is provisional definitive list will be provided at Track and Driver Model Release)

Furthermore, teams are encouraged to prepare and upload a livery texture file for the 3D Object of the car as a .png [Livery.png] file.

The Livery file must not contain any inappropriate, offensive, or copyrighted content. The event organizers reserve the right to reject or remove any submission that violates this rule.

The Texture dimensions should be the same as the original example livery, and the total compressed file size must not exceed 30 MB.

### 5.1.4 Step 4 – Upload

Teams are required to upload, via the Google Form provided by the organizers, all files listed in Section 5.1.3 before the deadlines specified in Section 4.1.

The following files must be uploaded:

- Livery.png
- Track-FSAA-AutoX.rd5
- Track-vFSAAII.rd5
- DriverModel.slx
- DriverModelParameters.m

There will be a Tutorial.pdf for the challenge specifying how to setup the CarMaker Project, how to modify the desired files and how to upload them.

### 5.1.5 Step 5 – Driverless Autocross (DV-AX)

All models will be executed by IPG Automotive on their servers for five laps of the FSAA Autocross Track (Track-FSAA-AutoX.rd5).

Prior to the run, IPG Automotive will define the following weather conditions stochastically:

- Wind speed for each lap
- Wind direction for each lap
- Friction coefficient for each lap virtually represents a change in track temperature

Restrictions:

- Wind speed may vary from 0 to 40 knots.
- Wind speed may change linearly from Lap 1 to Lap 3 with a maximum gradient of 5 knots per lap.
- Wind speed may change linearly from Lap 4 to Lap 5 with a maximum gradient of 8 knots per lap.

- Wind direction may change linearly from Lap 1 to Lap 3 with a maximum gradient of 5 degrees per lap.
- Wind direction may change linearly from Lap 4 to Lap 5 with a maximum gradient of 10 degrees per lap.
- Friction coefficient may vary from 0.8 to 1.2.
- Friction coefficient may change linearly from Lap 1 to Lap 3 with a maximum gradient of 0.05 per lap.
- Friction coefficient may change linearly from Lap 4 to Lap 5 with a maximum gradient of 0.1 per lap.
- Wind and Friction conditions will be identical for all teams.

All cars will be run independently on the IPG server.

Results will be announced during the livestream of the Finals of Virtual Formula Student Alpe Adria III on 2025-11-27 and subsequently published on the official Discord server.

Each team will have the possibility to download the result files containing both its own run and the run of the fastest car in the DV-AX event.

The ten fastest cars, based on total time including penalties, will qualify for the Driverless Endurance (DV-ED) event. If any team is unable to finish the run due to OC it will be placed based on the distance until OC after the teams that finished (See Section 5.2.2).

### 5.1.6 Step 6 – Driverless Endurance (DV-ED)

The ten fastest cars from the DV-AX competition will be run by IPG Automotive on their servers for ten laps of the FSAA Virtual Alpe Adria Track (Track-vFSAAII.rd5).

Prior to the run, IPG Automotive will define the following weather conditions stochastically:

- Wind speed for each lap
- Wind direction for each lap
- Friction coefficient for each lap
- Restrictions:

- Wind speed may vary from 0 to 40 knots.
- Wind speed may change linearly from Lap 1 to Lap 6 with a maximum gradient of 5 knots per lap.
- Wind speed may change linearly from Lap 7 to Lap 10 with a maximum gradient of 8 knots per lap.
- Wind direction may change linearly from Lap 1 to Lap 6 with a maximum gradient of 5 degrees per lap.
- Wind direction may change linearly from Lap 7 to Lap 10 with a maximum gradient of 10 degrees per lap.
- Friction coefficient may vary from 0.8 to 1.2.
- Friction coefficient may change linearly from Lap 1 to Lap 6 with a maximum gradient of 0.05 per lap.
- Friction coefficient may change linearly from Lap 7 to Lap 10 with a maximum gradient of 0.1 per lap.
- Wind and Friction conditions will be identical for all teams.

All cars will be run independently on the IPG server.

Results will be announced during the livestream of the Finals of Virtual Formula Student Alpe Adria III on 2025-11-27 and subsequently published on the official Discord server.

Each team will have the possibility to download the result files containing both its own run and the run of the fastest car in the DV-ED event.

### 5.1.7 Step 7 – Stream

The main results of the DV-AX and DV-ED events will be announced during the Final Day of Virtual Formula Student Alpe Adria III.

The following will be presented:

- Names and total times of the ten fastest teams in the DV-AX event.
- Names and total times of each individual team participating in the DV-ED event.

The DV-ED broadcast will feature all ten cars starting in reverse order, six seconds apart.

The entire ten-lap competition will be shown live and commented on by experts from IPG Automotive and Formula Student Alpe Adria.

### 5.2 Penalties

The driver model must be developed with the intent to follow the trajectory within the track boundaries and to avoid cones.

#### 5.2.1 Cone Down or Out (DOO)

A cone is considered Down or Out (DOO) if it has been touched by the car.

If a DOO occurs a time penalty of 2 seconds is added per each occurrence to the total time. Missing one or more gates in a slalom section of the Autocross Track is will be penalized according to the number of cones DOO.

#### 5.2.2 Off Course (OC)

An Off Course (OC) occurs when the vehicle leaves the defined racetrack with at least one wheel.

In this case the simulation is stopped and the distance run until the OC is recorded. The run will be considered a Did not finished (DNF). All runs that DNF will be sorted according to the distance of the OC

#### 5.2.3 Unsporting behavior (UB)

A driver model that is not developed to follow, in a spirit of sportsmanship, the intended purpose of the competition will be considered as engaging in Unsporting behavior (UB) and will be immediately disqualified from the event.

In particular, the following behaviors will be treated as Unsporting behavior (UB):

- Voluntarily disregarding slalom gates to gain an unfair advantage.
- Accessing or attempting to access additional inputs other than those provided to the original driver model.

- Using additional not specified Simulink toolboxes in the Drive Model
- Actuating or attempting to actuate additional model parameters beyond those intended in the original driver model.
- Exploiting or attempting to exploit any clearly unrealistic behavior of the car or the track to gain an unfair advantage.
- The evaluation of the driver model's behavior will be carried out by IPG Automotive representatives, and their decision is final and not subject to appeal.
- The organization reserves the right to allow a team to modify its model if — at the sole and unappealable discretion of the organizers — sufficient time is available to update the model and rerun the simulation.

In any case, the final model must be submitted no later than the official deadline defined in Section 4.1.

## 6. Final Classification and Awards

All teams that were eligible and registered for the IPG Driverless Competition (IPG-DV) according to Section 3, and that have uploaded a valid driver model, will be listed in the official IPG-DV classification.

A model is considered valid if the parameter file Driver Model Parameters contains at least one parameter value different from the original file and the model is still able to run without major issues.

### 6.1 IPG-DV Final Classification

The IPG-DV Final Classification will be produced as follows:

- **Positions 1–10** will be assigned to the ten teams participating in the Driverless Endurance (DV-ED), based on their cumulative time in DV-ED, including all time penalties. If any team is unable to finish the run due to OC it will be placed based on the distance until OC after the teams that finished.
- **Positions 11 onward** will be assigned according to the cumulative times achieved in the Driverless Autocross (DV-AX), also including all applicable time penalties. If any team is unable to finish the run due

to OC it will be placed based on the distance until OC after the teams that finished.

- **Any team disqualified** according to Section 5.2.3 (Unsporting behavior) will be removed from the official IPG-DV classification.

### 6.2 Awards

The Top 3 teams in the IPG-DV Final Classification will be officially awarded during the Virtual Formula Student Alpe Adria (vFSAA) Closing Ceremony.

In addition, the 1st, 2nd, and 3rd-place teams will receive the following technical support packages from IPG Automotive:

- 1st place: 4 hours of CarMaker support
- 2nd place: 2 hours of CarMaker support
- 3rd place: 1 hour of CarMaker support

The support sessions will be delivered either through online meetings or during a visit to IPG Automotive facilities, depending on mutual availability.

### 6.3 vFSAA Semifinals

Each team listed in the official IPG-DV Final Classification will be awarded **75 points** toward the vFSAA Semifinals. The organization reserves the right to communicate possible disqualifications according to Section 5.2.3 until the start of the Finals.

### 6.4 vFSAA Finals

Each team that is listed in the IPG-DV Final Classification and qualifies for the vFSAA Finals will receive points according to its ranking in a reduced version of the IPG-DV Final Classification.

For this purpose, the IPG-DV Final Classification will be adjusted by removing all teams that did not qualify for the vFSAA III Finals.

The remaining teams will be rewarded as follows:

| Position | Points |
|---|---|

| | |
|---|---|
| 1st | 75 |
| 2nd | 60 |
| 3rd | 50 |
| 4th | 40 |
| 5th | 35 |
| 6th | 30 |
| 7th | 25 |
| 8th | 20 |
| 9th | 15 |
| 10th | 10 |
| 11th | and further 5 |

## 7. Contact Information

Teams should contact the organizers preferably through their Team Captain, as nominated in the vFSAA Registration Form.

Questions or topics of general interest should be discussed in the #IPG-Driverless chat on the official Discord channel, to ensure that all teams receive the same information.

For direct communication, please contact:

Event Ambassador

- Vincenzo Bevilacqua – vincenzo@fs-alpeadria.com

Technical Support

- Rohan Prajapati – rohan.prajapati@ipg-automotive.com
- Eric Assmann – eric.assmann@ipg-automotive.com
- Aditya Mahamuni – Aditya.Mahamuni@ipg-automotive.com