



Driving into the future

Student team's UGRacing 2025 gear train developed with KISSsoft assist.

UGRacing is the University of Glasgow's Formula Student team. Founded in 2005, the team has grown to more than 160 members, with many alumni using their experience gained in the team to work at various Formula 1 teams, including McLaren Formula 1 team, Mercedes-AMG Petronas Formula 1 team, and Oracle Red Bull Racing Formula 1 team.

The team designs, builds, and races a new single seat Formula Student car every year to compete at the FSUK competition at Silverstone against more than one hundred universities from around the world. In 2022, the team won first place overall in FSUK with their final internal combustion vehicle entry. In 2023, the team switched to electric power, requiring a complete vehicle redesign, specifically for the powertrain and drivetrain. Leading up to the 2025 campaign, the team used KISSsoft to design and manufacture their single-stage planetary gear train for their car, with this hard work culminating in the team's first running EV vehicle in UGR25.

The drivetrain team faced many technical challenges when designing the gear train for UGR25. The primary constraints surrounding the design were the limited available space at the rear of the vehicle, the weight minimization to maximize performance, the high torque density required, and maintaining drivetrain efficiency and reliability. For the UGR25 gear train, the primary goals were to reduce the gear face width while still meeting the required gear ratio and to increase the contact ratios between both pairs of meshing gears to minimize wear.

This would reduce the overall mass and space taken up by the gearbox within the drivetrain. The properties input to KISSsoft were the power and speed, provided by the motor, and the torque calculated from these inputs. The material and oil selection were also input into the software allowing for accurate safety factors and reliability to be calculated. 34 CrAlNi 7-10 gas nitriding steel was selected. Using both the rough and fine sizing macrogeometry tool in KISSsoft, the gear train design could be optimized precisely, while still meeting the required transmission ratio.

KISSsoft, and its complementary educational resources, has allowed the drivetrain team to be able to quickly and effectively gain confidence on the software and gear train design itself. It has also been adopted in gear train design by many new members of the team's Concept entry to FSUK. The overall design and associated parameters of the team's designs could be clearly displayed in KISSsoft using its 'Generate Report' function, detailing various calculations conducted by the software such as backlash, geometry, toothing tolerances, and general influence factors. This function allows for a clear and concise report to be created on the gear train that the team presents to the design judges at the FSUK competition.

KISSsoft enabled the team to specify and modify shaft and bearing sizes, and to evaluate their safety factors under applied loads. Being

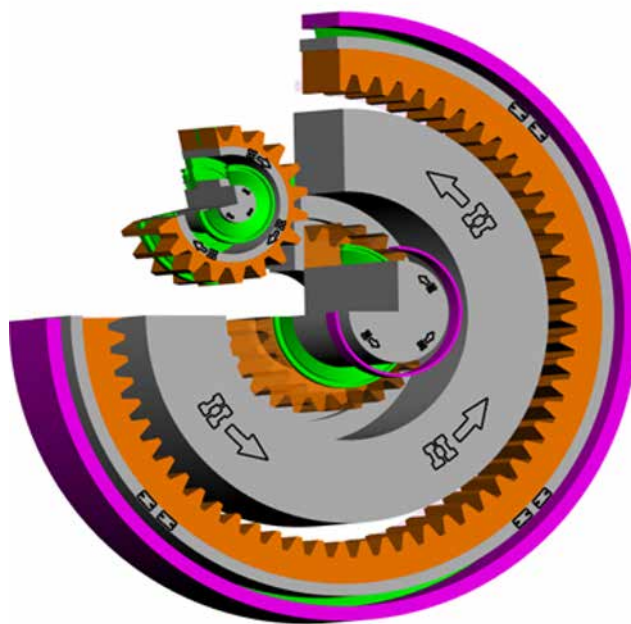


Figure 1: UGR25 epicyclic gearbox in KISSsoft. (Courtesy: KISSsoft)

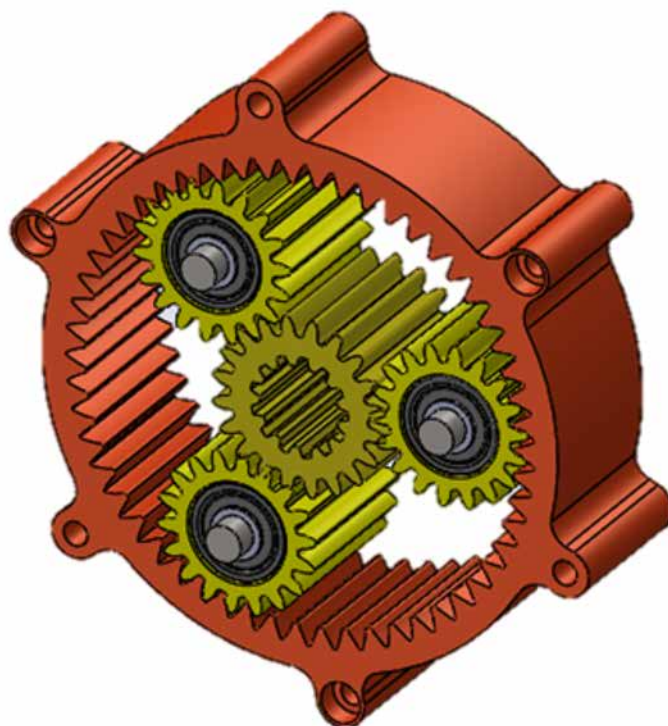


Figure 2: CAD assembly of UGR25 epicyclic gearbox in SolidWorks. (Courtesy: KISSsoft)

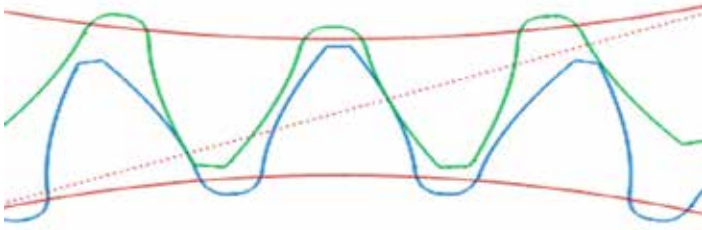


Figure 3: Meshing diagram generated in KISSsoft. (Courtesy: KISSsoft)

able to model these assembly components within KISSsoft allowed the team to export designs to SolidWorks and model the gearbox seamlessly, saving valuable design time and improving assembly accuracy. This can be seen in Figure 2, which was generated from the KISSsoft model in Figure 1. KISSsoft’s ability to provide exact DXF files of the gear profile allows the team’s manufacturer to confidently manufacture the gears.

KISSsoft allows the incorporation of tip and root relief in the design, reducing contact shocks and enhancing gear manufacturability, which is constrained by the wire EDM process. The UGR25 gearbox’s design was completed in February 2025, with it being the team’s most optimized model to date. The desired contact ratios, necessary final drive, backlash, and stress safety factors were all met, all

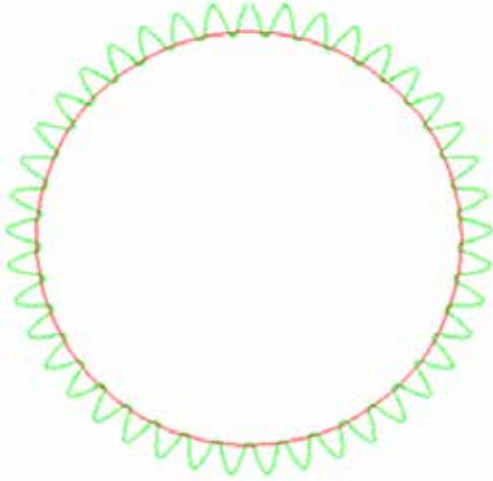


Figure 4: Gear profile generated from KISSsoft. (Courtesy: KISSsoft)

while reducing face width and overall mass of the gear train. Upon inspection of the gearbox post-running, the team observed no wear and close correlation with KISSsoft calculations. KISSsoft continues to be used by the team’s drivetrain engineers, in both their EV and Concept class entry going into the 2026 campaign. 🏁

ABOUT THE AUTHOR

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