MUNICH AEROSPACE – NEW HORIZONS IN AVIATION AND SPACE

In 2010, through Munich Aerospace and its pooling of research, graduate programmes and teaching, an alliance has been formed between the **Technical University Munich** (TUM), the **Bundeswehr University Munich** (UniBwM), the **German Aerospace Center** (DLR), as well as **Bauhaus Luftfahrt** (BHL).

To promote excellent, scientific young academics, Munich Aerospace awards a PhD scholarship on

Development of AI-based on-board guidance & navigation procedures for the safe and optimal execution of avoidance manoeuvres in the context of autonomous collision avoidance in multi-spacecraft systems

Research group

Low Earth orbit has become a sought-after resource for private space companies in recent years. Due to the commercialisation of spaceflight, access to space is becoming increasingly cost-effective and thus interesting for private actors. In addition to more than 2,000 functioning satellites, there are also more than 23,000 uncooperative space debris objects from a size of 10 cm in space around the Earth. With the build-up of various mega-constellations and satellite swarms, a further increase in both the number of active satellites in orbit and the number of uncooperative space debris is to be expected.
Collision avoidance is therefore not only immensely important for individual satellites but becomes more complex the more satellites are involved in a mission. Missions in which a large number of satellites fly in formation in close proximity to each other or so-called mega-constellations with thousands of satellites in multiple orbits are being studied. Autonomous formation flight and collision avoidance within a satellite formation as well as with space debris guarantee to ensure the safety and usability of the resource space in the long term.

PhD topic

Within the framework of the research group, methods for collision avoidance, formation control and error management of multi-spacecraft-systems are developed based on Artificial Intelligence. All-encompassing autonomy, internal optimal decision-making processes and safety strategies are a core research area for safe, autonomous flight in multi-spacecraft-systems. Autonomous operation is necessary to be able to react quickly and reliably in the event of an imminent collision. With the use of AI, spacecraft can be given self-awareness so that decisions can be made independently in orbit and reaction times are shortened. It must be ensured that the AI makes safe and optimal decisions and that it reacts safely when faults occur.
The process chain of predicting collision hazards, decision-making for the individual and overall behaviour of the multi-spacecraft-system, and the planning and execution of optimal, possibly coordinated, avoidance manoeuvres is highly complex and must be considered holistically. The present thesis topic deals with the planning and execution of avoidance manoeuvres. The aim is to develop guidance and navigation procedures based on Artificial Intelligence for autonomous collision avoidance, both within the multi-spacecraft-system and with space debris objects.

Your profile

- Above average Master's degree in a relevant field (e.g. aerospace engineering, physics, mathematics or similar)
- Knowledge in Guidance, Navigation & Control (GNC) and orbital mechanics of spacecraft
- Interest or experience in the application of Artificial Intelligence methods, in particular machine learning, deep learning and reinforcement learning, would be advantageous
- Very good written and spoken English

The Scholarship

The Munich Aerospace scholarship amount is 1.575 € per month granted for a minimum of 12 months and limited to a maximum of 3 years. Munich Aerospace scholarship holders are entitled to attend the Munich Aerospace Graduate School, formed by the TUM Graduate School and the DLR_Graduate_Program, and have access to special events and trainings. An additional grant of up to € 6.100 per year will be available to cover expenses that are directly related to the PhD project (e.g. textbooks, laptop, conference travels, public transport, housing subsidy). The scholarship holder is part of a Munich Aerospace research group and receives additional technical support from the research group head. The candidates receive their PHD from TUM or UniBwM.

Interested?

Please send us your application including relevant documents (cover letter, CV, diplomas, transcript of records) in PDF format to Professor Roger Förstner (raumfahrt@unibw.de) or Maren Hülsmann (maren.huelsmann@unibw.de). The application deadline is April 14, 2021.

We are looking forward to your application!