

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

Analysis and Development of AI-based Concepts for Ground Based Collision Avoidance in Single- and Multi-Satellite-Systems

Research group

Low Earth orbit has become an even more sought-after resource for private space companies in recent years. Due to the commercialisation of spaceflight, gaining access to space is becoming increasingly cost-effective and thus more interesting for private stakeholders. In addition to more than 2,000 functioning satellites, there are also more than 23,000 uncooperative pieces of debris in orbits around Earth with an object size of larger than 10 cm. 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 as regards individual satellites but becomes more complex when more satellites are involved in a single mission. In particular, missions are undergoing analysis in which a large number of satellites are flying in close proximity to each other in formation and so-called mega-constellations with thousands of satellites in multiple orbits. A high degree of automatization and autonomy with reference to orbit control and collision avoidance within satellite formations / constellations as well as with space debris are significant measures that ensure the safety and usability of space as a resource over the long term.

PhD topic

The increasing number of resident space objects produced by inactive satellites and other space debris impede satellite operations because in the case of close approaches to active satellites the collision probability has to be estimated and a decision has to be made on the implementation of collision avoidance maneuvers. From the outset a space mission is subject to constraints and each collision avoidance maneuver will have a negative impact on mission time, manpower and fuel consumption. Therefore, in the event of such a close approach its accurate assessment is vital. A wrong decision may lead to a catastrophic aftermath as in the case of the Cosmos-Iridium collision in 2009. To ensure a quick and reliable response in the case of a threatening collision, research into and the development of AI-based algorithms for collision avoidance shall be undertaken. The highly complex process chain of determining collision risks, decision making for single and multi-satellite systems as well as planning and execution of optimized collision avoidance maneuvers, if interconnected, are to be analyzed holistically. It must be ensured that the AI analysis comes to a safe, reliable, and optimal conclusion, and any errors which occur are recognized and result in a correct decision being made.

Your profile

- Above-average Master's degree in a relevant field such as aerospace engineering, physics, mathematics or similar
- Knowledge in satellite orbit dynamics
- Interest or experience in the application of Artificial Intelligence methods, in particular knowledge of machine learning, deep learning and reinforcement learning, would be advantageous
- Excellent 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 Dr. Hauke Fiedler (hauke.fiedler@dlr.de) or Dr. Ralph Kahle (ralph.kahle@dlr.de). The application deadline is April 14, 2021.

We are looking forward to your application!