

Training Opportunity for Luxembourgish Trainees

Reference	Title	Duty Station
LU-2019-TEC-MMA	Space Automation and Robotics	ESTEC

Overview of the unit's mission:

The section is located within the Mechatronics and Optics Division, which provides technical expertise and engineering support in the areas of automation and robotics, space mechanisms, life & physical sciences and environment control & life support (ECLS), optics and opto-electronics.

The division is structured in four sections:

- Automation and Robotics Section
- Life & Physical Sciences and ECLS Section
- Optics Section
- Opto-Electronics Section

The Automation and Robotics Section in particular is responsible for the creation and maintenance of an industrial technology base for the automation aspects of space based operations and their remote control. As such, the domain of competence of the group includes the specification and control of space robotics systems (from manipulators to autonomous vehicles) and laboratory supporting automation and robotics in manned and unmanned missions.

The Automation and Robotics Section operates a series of laboratories, which provide the tools to support the section activities and in which prototyping and functional verification of Automation and Robotics systems take place.

For a more detailed description of the terms of reference, activities and assets of the section see

<http://www.esa.int/robotics> .

Overview of the field of activity proposed:

The trainee will be supporting the Automation and Robotics section at ESTEC, and in particular the Automation and Robotics Laboratories (ARL). The lab has recently upgraded its infrastructure in the field of orbital robotics and is currently actively pursuing activities and R&D in the very relevant fields of On-Orbit Servicing (OOS), Active Debris Removal (ADR) and low gravity locomotion and landing. ESA currently are investigating two missions aimed at Active Debris Removal and On-orbit Servicing, that the lab is supporting.

In addition the lab continues its traditional important role in planetary robotics, primarily in support of Exomars and future Mars missions.

This position is in the area of orbital robotics (in particular On-Orbit Servicing and Active Debris Removal) and low gravity ground interaction (e.g. mobility on asteroids for exploration, sampling or mining). Our trainees are given a high degree of autonomy, are expected to be responsible for tasks and help with the day-to-day maintenance.

The exact tasks will depend on the candidate's final qualifications, interests and the needs of the section and will be from among the following:

On-Orbit servicing, Active Debris removal and low gravity ground interaction:

- Support and supervise industrial activities on the ARL flat floor in the area of on-orbit servicing and active debris removal

The ARL has recently acquired a flat floor and a number of air-bearing platforms. Currently the lab is undertaking or initiating a number of industrial activities that will use the lab. The candidate will in particular be supporting:

- One project for validation of locomotion concepts based on legged mobility for low gravity environments such as asteroids or moons
- One industrial activity to cross-validate the flat floor facility with an orbital robotics simulator in industry. An air-bearing floor provides excellent contact dynamics but is constrained to two dimensions (3 DOF). By constraining other Dynamics simulation facilities to the same 3DOF, we achieve rigorous cross-validation between the different facilities.

- Research & Development on autonomy for space debris capture
The lab is currently supporting the CleanSpace activities in which the question of autonomy has been identified as being of particular significance. The candidate will be presented with the opportunity to develop hardware and execute tests aimed at performing a detailed investigation of the difficulty vs. necessity of autonomy required for capturing un-cooperative targets with a robotic arm in a free-floating environment. The work will leverage previous developments within the section in the field of visual surveying and autonomy to investigate the capture operation.
- Research & Development on novel robotic systems using air bearings/cushions
The ARL is evaluating novel air-bearing concepts in order to de-couple the inertia of the air-bearing from the item under investigation. This will allow for further improvement in the quality of the simulated orbital environment. Typical tasks are: Finding requirements, concept development, evaluation of solutions and bread boarding of prototypes.
- Mobility system onboard software control architectures in open source Robotic Frameworks
The integration of complete robotic systems shows particular complexity in the software integration of different algorithms, control laws, and subsystem control modules. Currently ARL is involved in the process to choose a standard rover operating system. The candidate will have the opportunity to be involved in the evaluation process
- Definition and development of new low gravity robotic mobility platforms and subsystem prototyping.
The ARL has a target to have a regular cycle of developing new platforms to be used as planetary robotics testbeds (e.g. wheeled or legged rovers), where the lessons-learned and experiences of previous robotics developments can be incorporated. The candidate will be involved in the definition of such systems in terms of mechatronic sign, interfaces and resources and wherever needed implement subsystem prototyping activities.

Other

- Collaboration with third parties companies in the frame of hardware development and procurement
The ARL has a constant need to upgrade and adjust its inventory in order to support new activities. The candidate will be intimately involved in this process by directly interacting with third parties to discuss concepts, negotiate prices, in order to procure equipment or software.
- Support relevant R&D activities or CDF studies when necessary.
The section staff supervises a number of industrial R&D activities in all fields related to space robotics. The candidate will have the opportunity to participate in reviews and otherwise support the activities as required. Some support to the CleanSpace activities may also be expected.
- Support to the operations of the Automation & Planetary Robotics Lab.
The ARL recently went through a complete reorganization and infrastructure upgrade, with the goal to optimise the operational resources and foster more parallel research activities. As certain final aspects of the upgrades are on-going, particularly in the field of orbital robotics, the candidate shall work closely with the head of the ARL in the deployment and calibration of new robotic facilities (metrology, hardware research platforms, etc.) and in the definition of lab operational guidelines and procedures. Within this task the candidate will obtain experience in the complex organisation and operation of a high-tech lab facility as well as gain an overview of all the research activities performed in ESA in the field of Automation and Planetary Robotics.

Required education:

- Applicants should have just completed (conclusion not older than two years) or be in their final year of a university course at Master's level in a technical or scientific discipline.
- Candidates must be fluent in English or French, the official languages of the agency
- Recent graduate in the field of Robotics, Mechatronics, Mechanical, Space engineering, or Computer Science with strong software experience.
- Electronics experience is an asset
- Demonstrated experience in initiating and running practical projects.