Research Fellowship in GNC and AOCS Verification Techniques

Directorate of Technical and Quality Management

ESTEC, Noordwijk, The Netherlands

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Overview of the Division's mission

The Control Systems Division is responsible for project support and technology development of space applications in the following areas.

- Design and implementation of Guidance, Navigation and Control Systems for Planetary exploration missions, Launchers, Ascent and Re-entry vehicles, Formation Flying Systems;
- Design and implementation of Attitude and Orbit Control Systems for Earth Observation, Telecom, Navigation Satellites and Astronomy Observatories;
- Failure Detection Isolation and Recovery of GNC and AOCS;
- Technology development of AOCS/GNC sensors and inertial actuators;
- Development of advanced control, estimation and optimization techniques and tools;
- Enabling R/D activities for Autonomous Rendezvous and Formation Flying, Ascent and Re-entry vehicles, Entry, Descent and Landing Systems, Vision-based and Hybrid Navigation;
- Performance analysis for launchers and re-entry vehicles including safety;
- Definition, maintenance and operation of the necessary tools and laboratory facilities in support of above activities.

Overview of the field of research proposed

The field of research lies in advanced GNC and AOCS verification techniques for space systems. Agency wide these systems include launchers (VEGA and Ariane 6), in-orbit servicing vehicles (ATV and evolutions), re-entry vehicles (MSR, IXV, PRIDE) and satellites (EUCLID, LISA Pathfinder, PLATO, Metop SG etc...)
GNC verification involves the execution and analysis of a very large number of high-fidelity simulations which allow to predict the system behaviour under all possible parameters variations, including degradations and failure scenarios.
Conventional Monte Carlo analysis combining extreme values and random sampling of input parameters may not lead to reliable performance prediction with associated probability levels because the computational demands associated to these methods become impractical with complex systems.
It is then necessary to develop methodologies based on a combination of numerical optimization algorithms and simulation techniques. The typical GNC validation activity is to demonstrate stability or to guarantee that as set of performance output variables (attitude and position errors, thruster actuations and propellant budget, dynamic pressure loads etc...) do not violate specified values. These guarantees must be provided with desired probability and confidence levels under all possible admissible uncertainties and perturbations (wind, noise, flexible modes, sloshing etc..).

The Agency recently started applying Cross Entropy methods to solve these problems, however a long term effort is necessary to industrialise the process.
Full mastering of modelling and simulation techniques for high fidelity space systems will be a prerequisite to perform and develop relevant validation strategies using optimization assisted simulations. In order to propose such alternative validation strategies, this activity will involve the construction of GNC test strategies and plans based on such methods. Reference missions will be used on the Agencies high fidelity GNC and AOCS simulators to assess these technologies.
Numerical parallel processing techniques shall be applied to improve the simulation efficiency.

Who can apply

The programme is open to suitably qualified women and men. Preference will be given to applications submitted by candidates within five years of receiving their PhD.

The Research Fellow Programme is open to nationals of the following states: Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland, and the UK, or Canada as a Cooperating State, Bulgaria, Estonia, Hungary, Latvia, Slovakia and Slovenia as European Cooperating States (ECS).

Required qualifications

Applicants must have recently completed their PhD studies in Mathematics or Control Engineering.

Applicants should have good analytical and communication skills and should be able to work in a multi-cultural environment in an autonomous manner.

Applicants must be fluent in English and/or French, the working languages of the Agency. A good proficiency in English is required.

How to Apply

Please fill in the online application form attaching to it, **in one document only,** your CV, your motivation letter and your research proposal.

Candidates must also arrange for up to **three letters of reference** to be sent by e-mail, before the deadline, to **temp.htr@esa.int**. The letters must be sent by the referees themselves. The candidate's name must be mentioned in the subject of the email.

Applications satisfying the general conditions for eligibility, to be submitted **by 6 May 2015**, will be evaluated and successful applicants will be invited for an interview.

Interested candidates are highly encouraged to visit the ESA website: www.esa.int.