

# Job Title: Internal Research Fellow (PostDoc) in Guidance Navigation and Control

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## EUROPEAN SPACE AGENCY

Research Fellow Opportunity in the Directorate of Technology, Engineering and Quality.

ESA is an equal opportunity employer, committed to achieving diversity within the workforce and creating an inclusive working environment. Applications from women are encouraged.

### Post

#### Internal Research Fellow (PostDoc) in Guidance Navigation and Control

This post is classified F2 on the Coordinated Organisations' salary scale.

### Location

ESTEC, Noordwijk, The Netherlands

### Description

Within the Systems Department (TEC-S), the GNC, AOCS and Pointing Division (TEC-SA) is responsible for:

- Engineering and research and development of Attitude and Orbit Control Systems (AOCS) for satellites including Failure Detection Isolation & Recovery (FDIR);
- Engineering and research and development of Guidance, Navigation and Control (GNC) systems for space vehicles including interplanetary cruise, aero assistance, precision landing, ascent, rendezvous and docking, re-entry, formation flying and drag-free systems;
- Technology development for AOCS and GNC sensors;
- End-to-end engineering and research and development on high pointing accuracy systems;
- Research and development of advanced control, estimation & optimisation techniques and tools;
- Development of control engineering standards in the frame of ECSS and ESA Standardisation Boards. Within the Division, the "Guidance, Navigation and Control Section" (TEC-SAG) is specifically in charge of:
- Designing and implementing Guidance, Navigation and Control (GNC) systems for space vehicles, including interplanetary cruise, aero assistance, precision landing, ascent, rendezvous and docking, re-entry, formation flying and drag-free systems;
- Proposing and managing Mission Enabling Technology R/D activities in the following areas:
  - Entry, Descent and Landing
  - Ascent and Re-entry
  - Rendezvous and Formation Flying
  - Vision-based and Hybrid Navigation
- Technology development for GNC sensors;
- Research and development of advanced control, estimation and optimisation techniques and tools;
- Defining, maintaining and operating the necessary computing and laboratory facilities in support of the above activities.

Interested candidates are highly encouraged to visit the ESA website.

### Field(s) of activities/research

Intelligent control is defined as a class of control techniques that use various artificial intelligence computing approaches like neural networks, Bayesian probability, fuzzy logic, machine learning, evolutionary computation or genetic algorithms. Within the variety of missions covered, until today, the GNC Section has showcased and used control techniques for Multivariable Linear-Time-Invariant systems: H-infinity, Structured Singular Value (SSV), Quantitative Feedback Theory (QFT), Model-Based Predictive Control (MPC), and Linear Parameter Varying (LPV). The GNC Section has also developed and applied control techniques for Multivariable Non-Linear systems like Non-Linear Dynamics Inversion (NDI), Feedback Linearization (FL), Sliding Mode Control (SMC), and recently Numerical Optimization (NO).

The field of research will be on Intelligent Control (IC) for space missions and it will be focused on the design, development, and benchmarking of IC techniques for the upcoming complex scenarios regarding science, space transportation and exploration missions. The benchmarking of the IC techniques will be focused on the following areas: Performance versus Stability, Agility (to follow a guidance command), Precision (transient state and permanent state), Perturbation rejection, Robustness (over spacecraft dynamics uncertainties, variations over life cycle), Propellant consumption (propulsion system), and Actuator saturation (non-linear system).

The proposed program of work consists of a length of time of 24 months and will comprise the following objectives to be achieved:

- Objective 1: Survey the current state of the art in intelligent control applied in non-space industrial process (transportation, manufacturing, personal computing) and space missions. This will comprise a survey of the non-space sector versus the space missions. This survey shall comprise as a minimum the following IC techniques: machine learning, evolutionary computation, genetic algorithms, fuzzy logic, neural networks, and Bayesian probability.
- Objective 2: Based on science, exploration and space transportation ESA missions, investigate and assess new, efficient, and cost-effective methods for the control space systems by means of IC techniques. This objective will take into account the new complex upcoming missions (e.g. HERACLES Moon scenarios) where the Human-In-The-Loop control loop may be present and required. This objective will also comprise the investigation and benchmarking of problematic and solutions of autonomy on-board versus ground control.
- Objective 3: Design and develop IC controllers for a series of missions within the science, exploration and space transportation domains. The development of the controllers will be performed making use of the existing tools of the GNC Section and incorporating the required new techniques and technologies as to maximize efficiency and minimize the development time.
- Objective 4: Test, verify, validate the IC controllers developed using the GNC Testing Facilities of the Section located in the ESTEC laboratories. The testing facilities comprise Model-In-the-Loop simulators, Processor-In-the-Loop facilities, and Hardware-In-the-Loop facilities (robotics).

## Technical competencies

Ability to conduct research autonomously

Breadth of exposure coming from past and/or current research/activities

Research/publication record

Knowledge relevant to the field of research

Interest in space and space research

Ability to gather and share relevant information

## Behavioural competencies

Innovation & Creativity

Continuous Learning

Self Motivation

Communication

Problem Solving

Relationship Management

Cross-Cultural Sensitivity

## Education

Applicants should have recently completed, or be close to completion of a PhD in aerospace engineering, physics, or mathematics. Preference will be given to applications submitted by candidates within five years of receiving their PhD.

## Additional requirements

Applicants should have good analytical skills and be able to work autonomously in a multi-cultural environment.

Applicants must be fluent in English and/or French, the working languages of the Agency.

## Other information

For behavioural competencies expected from ESA staff in general, please refer to the ESA Competency Framework.

The Agency may require applicants to undergo selection tests.

**The closing date for applications is 18 October 2017.**

In addition to your CV and your motivation letter, please add your proposal of no more than 5 pages outlining your proposed research. Candidates must also arrange for 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.

If you require support with your application due to a disability, please email [contact.human.resources@esa.int](mailto:contact.human.resources@esa.int).

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Please note that applications are only considered from nationals of one of the following States: Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland, the United Kingdom and Canada and Slovenia as well as Bulgaria, Cyprus, Latvia, Lithuania, Slovakia as European Cooperating States (ECS).

Priority will first be given to candidates from under-represented Member States.

In accordance with the European Space Agency's security procedures and as part of the selection process, successful candidates will be required to undergo basic screening before appointment