Job Title: Internal Research Fellow (PostDoc) in Advanced Optimisation Techniques

Req ID **8710** - Posted **11/07/2019**

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 Advanced Optimisation Techniques

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

Location
ESTEC, Noordwijk, The Netherlands

Description
This research fellowship will be shared among the European Space Agency's establishments ESTEC and ESOC, and in particular the Directorate of Technology, Engineering and Quality (ESTEC) and Directorate of Operations (ESOC).

In the first year, the Research Fellow will be based in the Advanced Concepts Team (ACT), a group of research fellows (post-docs) and young graduates who originate from a broad variety of academic fields and aim at an academic career. Its task is to monitor, perform and foster research on advanced space systems, innovative concepts and working methods. It interacts externally almost exclusively with academia and operates as a truly interdisciplinary team bound to high scientific standards. Via its research, the team acts as a cross-departmental pathfinder to explore novel, potentially promising areas for ESA and the space sector, ranging from applied to basic fundamental research topics. The ACT has been a main actor in developing and maintaining the generic optimization code called pagmo/pygmo, pioneering topics such as massively parallel evolutionary computations for trajectory design, differential algebra in orbital mechanics and more.

During the second year, the Research Fellow will be based in the ESOC Mission Analysis Section, Flight Dynamics Division in Darmstadt, Germany. The Flight Dynamics Division is responsible for orbit-related computations for all ESA Missions. The Mission Analysis Section focusses on mission design and mission preparation activities. The work carried out will be in the context of an effort to renew all software infrastructure of the division with a focus on making use of pygmo within new Mission Analysis applications. In this second year, the Research Fellow will be embedded into an application oriented environment where the ideas, methods and algorithms conceived in the first year will contribute to addressing actual space operations optimization problems.

Candidates are highly encouraged to get familiar with the research done by the ACT (http://www.esa.int/gsp/ACT/mad/index.html) in field of optimization and mission analysis, and in particular with the open source projects pagmo (https://github.com/esa/pagmo2) and pykep.(https://github.com/esa/pykep)

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

Field(s) of activities/research
During the first year, the successful candidate will be trained and eventually contribute to the development of the open source software pagmo/pygmo (https://github.com/esa/pagmo2) and its interface with the existing IT infrastructure for spacecraft operations and trajectory optimisation. This will include coding new optimization algorithms in pagmo, or interfacing pagmo with existing ones, as well as testing performances on space related problems.

Pagmo (C++) or pygmo (Python) is a scientific library for massively parallel optimization. It is built around the idea of providing a unified interface to optimization algorithms and to optimization problems and to make their deployment in massively parallel environments easy.

Efficient implementations of bio-inspired and evolutionary algorithms (genetics, PSO, evolutionary, etc..) are sided to state-of the art optimization algorithms (Simplex Methods, SQP methods, interior points methods ….) and can be mixed to build a super-algorithm exploiting algorithmic cooperation via the asynchronous, generalized island model.

Pagmo and pygmo can be used to solve constrained, unconstrained, single objective, multiple objective, continuous and integer optimization problems, stochastic and deterministic problems, as well as to perform research on novel algorithms and paradigms and easily compare them to state of the art implementations of established ones.

During the second year, the successful candidate will integrate and use the developed skills and optimization pipelines on the new flight dynamics infrastructure being developed in ESOC in C++ and Python. The infrastructure is intended as the baseline for all orbit related computations at ESOC. It will be used for modelling of spacecraft dynamics, numerical integration of trajectories, mission design, manoeuvre optimization and orbit determination.
Scientifically she/he will in particular:
- Propose and perform research in the field of Advanced Optimization Techniques via the use of pagmo/pygmo, where appropriate together with universities of ESA Member States (in particular through the Ariadna scheme www.esa.int/ariadna).
- Become an active member of the pagmo open source community.

In the first year, as ACT researcher, she/he will:
- Publish results in peer-reviewed publications and communicate research to broader audiences inside and outside ESA;
- Lead and assist interdisciplinary projects with other ACT researchers;
- Participate together with the team in the assessment of proposed space system concepts and propose new concepts and assessment studies;

In the second year, as member of the Mission Analysis Section, she/he will:
- Contribute to the development of new Flight Dynamics infrastructure, integrating pygmo.
- Lead the implementation of pygmo in mission analysis applications for preparation of solar system exploration missions.
- Innovate the use of complex global optimization techniques for mission analysis and mission operations.

Technical competencies
Knowledge relevant to the field of research
Research/publication record
Ability to conduct research autonomously
Breadth of exposure coming from past and/or current research/activities
General interest in space and space research
Ability to gather and share relevant information

Behavioural competencies
Innovation & Creativity
Continuous Learning
Communication
Teamwork
Self Motivation
Problem Solving

Education
Applicants must have obtained PhD in Celestial Mechanics, Operations Research, Evolutionary Computations, subject of the thesis being relevant to the description of the tasks outlined above. Applicants must hold a degree in either Engineering, Informatics, Computer Science, Mathematics or Physics.

Additional requirements
Solid programming skills in C++11 and Python are mandatory and experiences in open source projects and a proven open science attitude are an asset.
In addition, applicants should have:
- Ability for and interest in prospective interdisciplinary research;

- Aptitude to contextualise specialised areas of research and quickly assess their potential with respect to other domains and applications;
- Academic networking to add functioning links to universities and research institutes;
- ability to work in a team, while being able to work individually regarding his/her own personal research plans and directions;
- Natural curiosity and a passion for new subjects and research areas;
- Interest in applying academic knowledge in a space missions operations environment.

Specificities

This position of Research Fellow with the ESTEC/ACT and ESOC/Mission Analysis is similar to a regular academic post-doc placement, however with a few notable key differences:

- RFs have no teaching obligations. However, they will likely be involved in the mentoring of Young Graduate Trainees and stagiaires (student interns) within the team;
- As the team does not have a professor-like position, ACT RFs are academically more independent than most post-docs. This implies more freedom but also more responsibility for their research directions and approaches;
- ACT RFs are joining a diverse, changing and interdisciplinary research team embedded in a large space agency, in contrast to a more specialized, focused research group with close or similar competences;
- ACT RFs need to actively reach out to other disciplines, to bring in their competences to interdisciplinary research projects and to encourage other researchers to join them in their core research projects (research at the intersections of disciplines);
- In addition to their research work, Mission Analysis RFs have the opportunity to participate in ongoing ESA mission preparations activities.

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 22 August 2019.

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.

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.

According to the ESA Convention the recruitment of staff must take into account an adequate distribution of posts among nationals of the ESA Member States. Priority will first be given to internal candidates and secondly to external candidates from under-represented Member States when short-listing for interview.
(http://esamultimedia.esa.int/docs/careers/NationalityTargets.pdf)

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