Training Opportunity for Portuguese Trainees

Reference	Specialist Area	Duty Station
PT-2015-TEC-SWE	**On-board software systems**	**ESTEC**

Overview of the Division missions:

In the particular domain of software engineering, the responsibilities of the Software Systems division include (see http://www.esa.int/softwareengineering&standardisation):

- *system-software co-engineering:* reviewing several software projects has shown the need to create a link between the work of the system team and the software team. The goal of this line of activities is to offer to system and software teams the same set of methods and tools, unified within a common process. This would allow them to express the architecture of a system and its properties, and to verify as early as possible the system properties in an informal way (simulation, object-oriented models, data models, behavioural models, state machines, message sequence charts, proof-based design, and so on).

- *requirements engineering and modelling:* this includes new ways of expressing and verifying requirements (natural language analysis), models to compute complexity and cost, and requirement traceability using specialised tools such as DOORS and appropriate traces into the models.

- *design methods:* the proven HOOD method, augmented with the HRT-HOOD for Hard Real-Time systems, is still efficient and responds to users' needs. HRT-UML is an attempt to adapt UML through stereotypes to hard real-time needs. The use of object orientation also allows using frameworks for a component-based design.

- *automatic code and test generation:* software productivity has to increase to 10 times its current level and needs to be automated. This requirement includes automatic code generation as well as automatic test generation from behavioural models, for example, that enables an automatic sequence of events from a test objective. Statistical testing is a way to focus the test effort towards a given goal. It is possible to link this testing to the emerging notion of software failure rate.

- *cross-development environments:* because of the radiation in space, specific processors are used. They include specific features that require support from cross-development environments. Examples of this are the compilers, the run-time and operating systems, the linkers, the debuggers, the target simulators, and so on. Current languages supported are Ada83, Ada95, and C.

- *schedulability analysis:* this a way to prove, at design, that a set of tasks will be always scheduled (that is, no deadline will be missed) under a given operational condition.

- *software engineering environments:* they provide so-called horizontal services of traceability and configuration management, and include the so-called vertical tools (the development tools).

- *architectures:* the goal is to define generic architectures for families of application, for example,based on dependability criteria. The section investigates on-board distributed fault-tolerant real-time architectures for payloads.

- *standardisation:* this includes the ECSS-E40 family (including the systematic tailoring of the standard for each software project, possibly automated by a tool) and the co-chairmanship of the ESA Board for Software Standardisation and Control.

Overview of the field of activity proposed:

The proposed opportunity consists in performing research and development activities in one or several of the domains indicated above. Such an activity includes internal developments, where the methods, tools or prototypes have to be developed or integrated within Estec (requirement modeling tools, automatic code generators, automatic test generators, compilers and tools evaluation, advanced architectures based on new technologies, related building blocks). Others may consist in monitoring industry in developments specified by Estec in Statement Of Works (participation to the redaction of S.O.W for reusable architectures, compilers improvement, and follow-on of technical aspects of industry activities).

The priority is currently given to system-software co-engineering, on-board software reference architecture and model based software engineering. An activity has already provided elements of architectural concepts for the on-board reference architecture, based on the use of a component model. Another activity will investigate the functional chains implemented in the on-board software and map them onto the architectural concepts.

The purpose of the traineeship activity is to gather all the elements delivered by the industrial R&D activities, and to reproduce them in the laboratory of the division, in order to verify what is working, what is missing, what could be improved. The ultimate result of this activity is a prototype spacecraft platform on-board software, based on the architectural concepts, implementing generic functionalities, and running on space hardware in the laboratory. This prototype is intended to be used later on to produce reference specification for project use.

The holder of the position will get familiar with the existing prototype, and will improve it from several standpoint:
- improvement of the PUS design patterns and possibly adaptation to the new version of the PUS which is more suitable for automatic configuration.
- adding some functional chains of the on-board software of a spacecraft platform with the models, generate the code and get it run on the Leon space computer.

The TASTE toolset available in the TEC-SW laboratory is able to support code generation and integration. The on-board software will be ported on various specific platforms such as a classical monoprocessor, a distributed system through e.g. SpaceWire or 1553, a multi-core platform and a Time & Space Partionned (TSP/IMA) platform.

Technical keywords are metamodel, model transformation, architectural model, component model, automatic code generation, model transformation, correct by construction, formal verification, model checking, schedulability analysis, TSP, IMA, mutlti-core, etc.
Techniques are SysML, UML, Marte, AADL, Simulink, Scade, Taste, Ocarina, PolyOrb, Rtems,

Required Education:

Applicants should have just completed a University course at Masters Level (or equivalent) in an Engineering or scientific field.

Candidates must be fluent in English or French, the official languages of the Agency.

Candidates should have good interpersonal and communication skills and should be able to work in a multi-cultural environment, both independently and as part of a team.