

## Training Opportunity for Portuguese Trainees

Reference	Title	Duty Station
PT-2015-TEC-SWS(2)	<b>Compilers for future Flight SW needs</b>	ESTEC
<p><b>Overview of the Unit missions:</b></p> <p>The Software Systems division has the responsibility in domain of software engineering <a href="http://www.esa.int/Our_Activities/Space_Engineering/Software_Systems">http://www.esa.int/Our_Activities/Space_Engineering/Software_Systems</a>. In particular the division covers verification and validation techniques for checking mission-critical software, software technology for flight as well as ground systems, real-time software embedded in spacecraft systems and payloads; ground facilities software, including electrical ground support equipment, testbenches, databases and simulation and modelling tools; The division is supporting all ESA satellite projects in the above domains.</p>		
<p><b>Overview of the field of activity proposed:</b></p> <p>Within the domain of Spacecraft Flight Software, Software Validation Facilities the Flight Software Systems Section offer a training opportunity within;</p> <p><b>Introduction of the LLVM compiler in the European Space Community</b></p> <p>Programming languages have to be compiled to be executed on the microprocessor and the understanding of the level of optimisation provided by the new compilers is fundamental to generate safe and reliable applications at all levels. Compilers should be also aware of the underlying hardware and generate code to minimise as much as possible the effect of unpredictability due to the new features introduced in the new microprocessors, like caches, dual issue pipeline, branch prediction, etc.</p> <p>GCC is the default compiler used for nearly all software development in the European space community these days. However, it has a 25-year old monolithic codebase which presents a very difficult maintenance. Conversely the LLVM compiler is built with a modular based architecture that makes it very easy to adapt and apply novel techniques to improve compilation in various ways.</p> <p>To support current and future ESA microprocessors it is necessary to maintain the quality of the compiler and increase its capabilities. New features introduced by ESA's new microprocessors could potentially be better exploited by using novel compiler techniques.</p> <p>The candidate shall perform this study using his/her abilities to analyse the advantages and drawbacks of using LLVM in the European industry, in particular:</p> <p><b>Task A:</b></p> <ul style="list-style-type: none"> <li>- Analyse the use of LLVM as a suitable compiler for the European industry (e.g. integration of LLVM with the real-time operating systems currently used by the European space community).</li> <li>- Study and propose novel techniques to improve the determinism of application execution and interrupt handling.</li> <li>- Adapt EagleEye, a reference mission, to LLVM for characterization and comparison between LLVM and GCC.</li> <li>- Identify new use cases enabled by LLVM (e.g. automatic code generation, test automation tools, etc)</li> </ul>		

**Task B:**

- Develop a prototype LLVM front-end for SOIS Electronic Data Sheets (EDS), including the parser, the Abstract Syntax Tree (AST) and code generation to LLVM IR.

Depending on the duration of the contract and the technical background, the candidate shall perform one or both tasks.

**Required Education:**

Applicants should have just completed, or be in their final year of a University course at Masters Level (or equivalent) in a technical or scientific discipline.

Applicants 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.

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