

# Compilation day

## Équipe persyval HPES

Friday, September 18, 2015

Maison Minatec, Grenoble, France



10:30-11:30h : Invited talk : **Paul Kelly**, Imperial College London

14-16h : PhD defense : **Fernando A. Endo**

### Invited talk : « Compiler technology for solving PDEs with performance portability »

**Abstract:** We have become used to the idea that higher-level languages supporting a higher level of abstraction come with a price in performance. In contrast, we should expect that the more information the compiler has about the structure and properties of our code, the more scope it should have for optimisation. This talk is about our experience in the Firedrake project of trying to make good on this idea. We are building software tools for solving PDEs on unstructured meshes, mainly using the finite element method. We support a concise high-level programming model, based on the FEniCS Project's Unified Form Language, while mapping onto a high-performance implementation entirely automatically via an intermediate representation for loops over the mesh, called PyOP2. Our compiler is based around three layers of domain-specific program representation, each supporting different optimisations. The resulting software tools, implemented in Python, achieve higher performance than established C++ and Fortran codes. This is joint work with the whole Firedrake team (<http://firedrakeproject.org>).



**Bio:** Paul Kelly (<http://www.imperial.ac.uk/people/p.kelly>) leads Imperial's Software Performance Optimisation research group, and he is also co-Director of Imperial's Centre for Computational Methods in Science and Engineering. His research contributions span single-address-space operating systems, scalable large shared-memory architectures, compilers (bounds checking and pointer analysis), graph algorithms, performance profiling, and custom floating-point arithmetic. His main current focus is on engaging with applications specialists to develop software tools for multicore architectures, overcoming the limitations of conventional compilers through "active libraries" that exploit properties of a particular application domain to achieve high performance while maintaining a clean, abstract program structure.

## Title : « Génération dynamique de code pour l'optimisation énergétique »

**Abstract:** In computing systems, energy consumption is limiting the performance growth expected from transistor scaling. Consequently, computer architecture and software development paradigms will have to change if we want to avoid a performance stagnation in the next decades. In this new scenario, new computer designs are one of the possible solutions. We may see a growing complexity in processors. On the other hand, software development should cope with the problem of extracting performance from these complex systems. This thesis contributes by proposing a methodology and developing a proof of concept of a run-time auto-tuning tool for general purpose embedded-class processors. To study the proposed approach, this thesis also contributes by developing and describing an embedded processor simulator.



**Bio: Fernando A. Endo** is a PhD student and researcher at the Software Infrastructure and Tools for SoC Laboratory from CEA. He graduated in electrical engineering from both The University of Campinas, in Brazil, and the INSA Lyon, in France. After his thesis, Fernando is going to join the EOLE project, which is reaserching a novel pipeline architecture based on value prediction, in the ALF team at INRIA Rennes, under the supervision of André Seznec.

- devant le jury composé de :
  - M. **Florent de DINECHIN** professeur, INSA de Lyon, Rapporteur
  - M. **Paul KELLY**, professeur, Imperial College London, Rapporteur
  - M. **Frédéric PÉTRO**T, professeur, Grenoble Institute of Technology, Examineur
  - Mme **Karine HEYDEMANN**, maître de conférences, Univ. Pierre et Marie Curie, Examinatrice
  - M. **Henri-Pierre CHARLES**, directeur de recherche au CEA, Directeur de thèse
  - M. **Damien COUROUSSÉ**, ingénieur chercheur au CEA, Grenoble, Encadrant de thèse