Sample Project: Development and Optimisation of the geometrical modeller code and other core modules

Code	EP2386
Programme	FCT
Department	EP
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Title

Development and Optimisation of the geometrical modeller code and other core modules

Description

The Geant-Vector prototype is a software initiative for the simulation of the passage of particles through a detector whose goal is to make efficient use of modern hardware at all performance dimensions. In particular, it aims towards the optimal use of multi-threading technology at small granularity as well as that of SIMD vectorization on both ordinary CPU and "accelerator devices" such as graphical processing units.

Within this program, various core libraries and modules have to be reengineered/implemented towards this goal. The trainee will join the international software development team in charge of these developments and contribute actively to its success.

Concrete tasks will include:

development and optimization of code in the geometrical modeller library (general optimizations, vectorization of geometrical algorithms and base classes) which is one of the foundations of detector simulation

development and application of tools to support the prototype work

tools to verify optimisation of the code (binary code inspection/instrumentation, plugin to show assembly in eclipse, static code analysis using clang)

performance monitoring, performance database

development of web support tools

optimization, development and R&D work on the random number generator suite

vectorisation of generators and distributions

study to achieve reproducibility in multithreaded simulations

contribute to the ongoing development of core base libraries used across the project

e.g., implement support for new architectures (ARM NEON, ALTIVEC, GPU) in the Vc vectorization library

Required qualification and skills:

Degree in computer science and/or physics (or similar) with a high computational background.

Proficient in C++ including template (meta)programming

Knowledge and previous exposure to high-performance computing (multithreading, vectorization (possibly at level of instrinsics), GPU CUDA, OpenCL)

Sound software engineering knowledge.

Skills

<p>
 template (meta)programming, high-performance computing, multithreading, vectorisation, CUDA, OpenCL, software engineering</p>

Disciplines

Information Technologies