

Application of a GRID Technology for a Monte Carlo Simulation of Elekta Gamma Knife

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Describe the scientific/technical community and the scientific/technical activity using (planning to use) the EGEE infrastructure. A high-level description is needed (neither a detailed specialist report nor a list of references).

Number of patients cared with radiotherapy methods has recently increased due to the development of linac and multi leaf technologies. The high precision in the dose distribution possible with the new machines needs the development of more accurate codes to determine the treatment plan. MonteCarlo methods allow big precision in the dose distribution calculation but are very CPU time consuming. The application makes use of the power of the GRID to validate treatment plan systems (TPS).

Report on the experience (or the proposed activity). It would be very important to mention key services which are essential for the success of your activity on the EGEE infrastructure.

In order to run a Geant4 application on the GRID, the first step was to install the used libraries at the various sites. The second step was to prepare a shell script to automatically submit jobs and download the outputs at their end. In this respect, it has been very useful to set a threshold in the number of jobs "done" before starting the downloading & merging phase. The last step was to choose the best quality factor between the number of events and the number of jobs to be submitted. The key services, that are essential to run a TPS Monte Carlo application on GRID, are a low-latency Workload Management System and a more reliable monitoring system of available computing resources.

With a forward look to future evolution, discuss the issues you have encountered (or that you expect) in using the EGEE infrastructure. Wherever possible, point out the experience limitations (both in terms of existing services or missing functionality)

Sometimes jobs stay "Scheduled" for a very long time even if there are some free CPUs

available. WMS, on matchmaking phase, does not take in account the real status of resources. In fact, during the submission of a large production, the matchmaking of the n-th job does not take into account that the (n-1) jobs have just been submitted, so jobs are not uniformly spread across the CEs. Another problem is the low efficiency (about 60%) due to many jobs aborted for unknown reasons.

Describe the added value of the Grid for the scientific/technical activity you (plan to) do on the Grid. This should include the scale of the activity and of the potential user community and the relevance for other scientific or business applications

The GRID can represent the solution for the large computing requirements of Monte Carlo applications in radiotherapy which are embarrassingly parallel. The GRID can, in fact, be of great utility to provide physicians with a fast computing resource able to calculate detailed and precise Monte Carlo based treatment plans without requiring the hospital to set-up and manage a dedicated computing centre.

In this contribution we refer to a Monte Carlo application created to simulate the Elekta Gamma Knife, a stereotactic radiotherapy machine to treat the brain lesions.

The application makes use of the Geant4 toolkit and reproduces all Gamma Knife features (like collimators' geometry) so to simulate a realistic energy deposition.

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