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Optimisation applications support in RDIG Fusion VO

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Two examples of CPU-intensive numerical optimisation applications were found in Russian nuclear fusion and plasma science: optimisation of stellarator magnetic field configuration and optimisation of the reflectometry radiowave shape in ITER plasma.
The first application has been successfully ported from a supercomputer to the EGEE infrastructure. This porting has revealed two issues. First, the grid dictates use of mathematical methods that allow asynchronous completion of parallel jobs without loss of efficiency. For optimisation, that means shifting from iterative (gradient-based) methods to results-based spool-driven (genetic, stochastic interpolation) ones.
Second, tools for such application-specific jobs and data management are required.
The second application is in its development phase. The functional requirements are the same, but it requires orders of magnitude more CPU than the first one. Supercomputers cannot fulfill it's demands.

3. Impact

A novel grid portal prototype, Grid InterFace (GIF), is presented. GIF is designed to be a complete solution for the optimisation applications. It consists of a web interface, script-driven job management engine, object database, HTTPS sandbox I/O service, WMProxy and LB clients.
An application developer uses the portal to describe all aspects of a grid application.
An authorized end-user can define the parameters and spawn a calculation for the application. In case of the genetic optimisation application, an initial developer-defined Python script generates several grid jobs. Each job calculates a target function value at a random point. Then, the system submits the jobs and waits for their completion.
Another script is spawned after every job completion. It adds the calculated function value and it's point to the persistent genome pool, gives the current best genome to the user, selects the parents from the pool to breed and generates a new job to spawn.

If demonstration is requested please explain what visual or interactive aspects of the contribution necessitate a demonstration rather than a presentation or poster?

A 3D animation demonstrating the stellarator optimisation process may significantly attract conference participants to optimisation problems that are unusual for the grid environments, as well as improve their understanding of the stellarator optimisation. Participants could also be interested in the fore mentioned portal prototype.

URL for further information:

http://vo.nfi.kiae.ru/pmwiki/pmwiki.php?n=Main.StellaratorOptimization

4. Conclusions / Future plans

Existing and prospective optimisation applications found, for instance, in fusion science, need a special application-driven non-predictable workflow manager not fullfilled by existing middleware. The authors present a prototype of such system that serves as an interface and a driver environment for such applications. About two man-years will be required to make the portal production-grade and run the reflectometry signal optimisation application on the grid.

Provide a set of generic keywords that define your contribution (e.g. Data Management, Workflows, High Energy Physics)

Non-predictable workflow, grid portal, fusion, genetic, optimisation, script-driven.,

1. Short overview

Grid alternatives are more expensive and, hence are less available, but usually seem more appropriate for numerical optimisation computations.
A stellarator optimisation application has demonstrated the efficiency and the ability of the EGEE grid to meet the demands of such computations. A reflectometry signal optimisation application, currently being developed, has similar functional requirements but needs the computational power obtainable only in a grid.

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