Contribution ID: **194** Type: **Demonstration**

Fusion Demonstration: Ion Kinetic Transport and Stellarator Optimization

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Two representative fusion applications have been chosen to show the power of grid computing for this community. The first is the grid-based stellarator optimization, run in the RDIG VO; the second is Ion Kinetic Transport, which is running in the fusion VO.
Both applications have been successfully ported from a supercomputer to the EGEE infrastructure. The porting of the first implied the use of mathematical methods that allow asynchronous completion of parallel jobs without loss of efficiency, implying a shift from iterative (gradient-based) methods to results-based, spool-driven (genetic, stochastic interpolation) ones, together with tools for application-specific job and data management.
The second application was tailored to run in this kind of architecture. In its first version, all the jobs are serial and the huge amount of information needed for every job is sent to the catalogue. In its second phase, an iterative method is developed.

3. Impact

A grid portal prototype, Grid InterFace (GIF), is presented, which is designed to be a complete solution for the Stellarator optimisation application. A Python script that generates several calculations of the target function was created. Another script is spawned after every job completion. It adds the calculated function value and gives the current best genome to the user, selects the parents from the pool to breed and generates a new job to spawn.
The Ion Kinetic Transport application is based on a script that launches the number of needed jobs, composed of the calculation of 1000 trajectories in the plasma. Then the trajectories are analysed and used to update the plasma background. A new set of jobs is launched by the script according to this background and so on, until the calculation converges (about 30 iterations are needed). Finally the transport properties of the device are obtained without any approximation.

URL for further information:

http://vo.nfi.kiae.ru/pmwiki/pmwiki.php?n=Main.StellaratorOptimization
http://www-fusion.ciemat.es

4. Conclusions / Future plans

Stellarator optimization applications in fusion science need a special application-driven, non-predictable workflow manager not fullfilled by existing middleware. The authors present a prototype that serves as an interface and a driver environment for such application.
Ion Kinetic Transport application, suited to run in the grid infrastructure, produces novel scientific results and avoids the customary approximations that are used to solve the 5D kinetic fusion equation.

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

Fusion, Non-predictable workflow, grid portal, optimisation, workflow, stellarator, Kinetic Theory

1. Short overview

Grid computing has demonstrated to be very useful for a kind of special application that is customary within the fusion community. A stellarator optimisation application has demonstrated the efficiency and the ability of the EGEE grid to meet the demands of such computations. The Ion Kinetic Transport application has

opened new lines of research and has shown the limitations of some customary approximations that have been developed in Fusion research.

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

The use of the grid for solving fusion problems is very promising and the applications that are shown in this demo can show grid capabilities in this field. A 3D animation demonstrating the stellarator optimisation process may significantly attract conference participants to optimisation problems. ON the other hand, the Ion kinetic Transport shows clearly how the grdi can help to solve problems relaxing the customary, sometimes unjustified, approximations, used in collisional transport estimates

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