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MDA based modeling and developing parallel computing applications

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Parallel computing application development is a major area of interest in the domain of high performance scientific and industrial computing. In this paper, we introduce the way to use Model Driven Architecture (MDA) methodology as an approach to model and develop high performance computing applications for solving energy sciences problems. By this approach, the models play important role in whole process of modeling and developing parallel applications. The computation independent model (CIM), platform independent model (PIM) and platform specific model (PSM) of MDA help us to build application with complex and efficient algorithms.

As the discipline development matures, subject classification becoming more fine and narrow, branches are becoming increasingly independent, so the Energy Sciences problems are becoming even more multidisciplinary and it is impossible to do whole application by single area specialist. The traditional way of HPC application development cause more difficulties. We recommend organizing the "Relay race of specialists in developing HPC applications''. The specialists are from multi subject area such as domain specialists, mathematical modeler, numerical modeler, MDD modeler, and programmer. In this application development relay race from domain specialists to programmer each specialist contributes to the application in own role of profession and pass the baton to next specialist. Here the MDD modeler play the role of bridge between the numerical modeler and software developer group.

The pressure is one of the main research objects in simulation the fluid dynamics in the reservoir for recovery the oil and gas. We modeled and developed parallel application for pressure with MDA. In order to create PIM and PSM models with UML we designed four HPC components. At the last step of development, we transformed the PSM model to java code automatically.

MDA based methodology has several advantages in modeling and developing parallel applications as follow: 1) It is possible to organize group of specialists in various subject area to solve one problem in high quality. 2) It is possible to solve different Energy Science problem with four HPC components. 3) It become easier to maintenance and extend the application.

Keywords: MDA, parallel application, HPC, simulation