Application of Grid techniques in the CFD field

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Abstract

Besides the widely used Reynolds-averaged Navier-Stokes (RANS) solver, Large Eddy Simulation (LES) and Direct Numerical Simulation (DNS) are becoming more and more practical in today's Computational Fluid Dynamics (CFD) studies. All these techniques are in constant pursuit of ever larger computing resources in order to produce acceptable and reasonable results. A new technique, the Grid technique, offers the possibility of aggregating the capabilities of distributed computing resources. In this paper, we shall present a brief description of the Grid technique and describe current progress in the study of its application to CFD between the Cambridge eScience Centre and the CFD group at the Cambridge University Engineering Department.

Globus Toolkit

A definition of the Grid as given by the Globus group [1] reads: "The Grid refers to an infrastructure that enables the integrated, collaborative use of high-end computers, networks, databases, and scientific instruments owned and managed by multiple organisations." The metacomputer could be used here to denote a networked virtual supercomputer, which is constructed dynamically from geographically distributed resources linked by high-speed networks. Such a metacomputer integrates distributed devices including supercomputers, large databases, archival storage devices, advanced visualisation devices, etc. The Globus Toolkit [1, 2] provides a set of services and software libraries to support Grids and Grid applications. The Toolkit includes software for security, information infrastructure, resource management, data management, communication, fault detection, and portability.

Condor

Usually in the CFD community, a High Performance Computing (HPC) environment is used to deliver a large amount of compute power over a short period of time, for example, large shared memory multiprocessor machines or dedicated linux clusters. By contrast, High-Throughout Computing (HTC) provides a computing environment that delivers large amounts of computational power over a long period of time. In this way, the computing power available is not concerned with operations per second, but operations per month or per year. We are more interested in how many jobs can finish over a long period of time rather than how quickly an individual job can finish. The key to HTC is to efficiently harness the use of all available resources. The Condor project [3] produces a software system that creates a HTC environment. When a job is submitted, Condor finds an available machine on the network and begins running the job on that machine. Condor has the capability to detect that a machine running a job is no longer available, for instance, when the owner of the machine starts his own work. As personal desktops and PCs becoming faster and cheaper, the use of Condor becomes more attractive on networks with large numbers of PCs and workstations.

Grid and CFD

A joint project between the Cambridge eScience Centre and the CFD group at the Cambridge University Engineering Department has been set up to develop a distributed problem-solving environment that will enable CFD studies involving turbulent and reacting flows in complex industrial geometries. In order to realise this objective, the Globus Toolkit and Condor are to be tested in the coming months. Currently, the Globus Toolkit is in everyday use at the Cambridge eScience Centre as part of the UK eScience Grid. At the same time, a web portal is under development for user friendly access to the Grid environment. More detailed information will be given in the formal paper.

Keywords

CFD, Grid, Globus Toolkit, Condor

References

[1] http://www.globus.org/.

[2] Foster, I., Kesselman, C., "Globus: A Metacomputing Infrastructure Toolkit", *Int. J. Supercomputer Applications*, 11(2):115-128, 1997.

[3] http://www.cs.wisc.edu/condor/.

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