

Presentation Handout

Parallelization of Matlab Program for Simulations of High-Reynolds-Number Flow of Fluid Through Pipes

Qiang Liu, Dr Richard Clarke, Associate Professor Jim Denier
School of Mathematical Sciences, University of Adelaide
qiang.liu@student.adelaide.edu.au

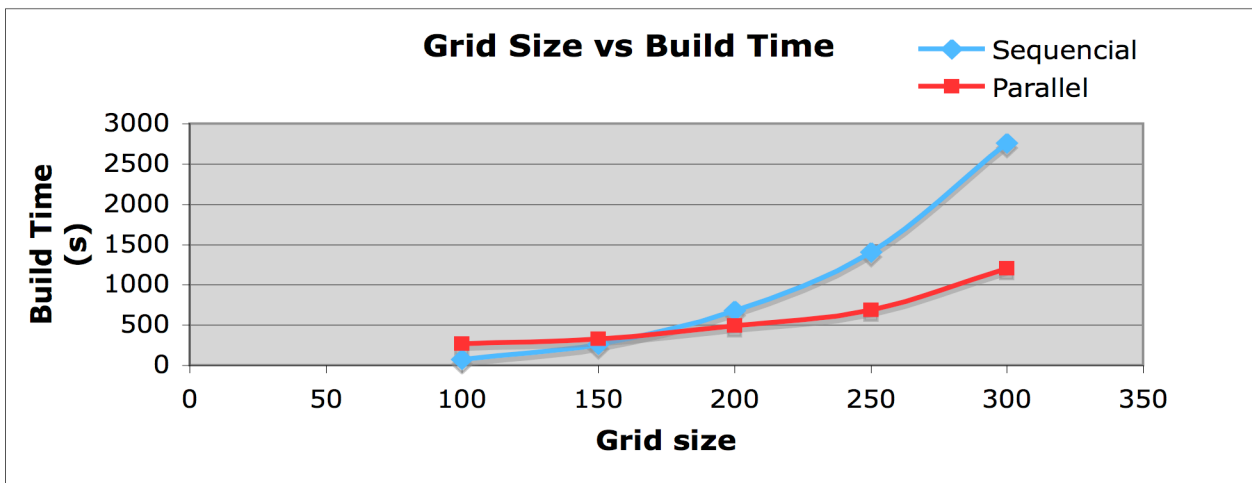
Overview

Modern Computational Fluid Dynamics are usually studied by modelling fluid flows using numerical schemes, which are used to solve the complex partial differential equations that describe these flows.

One popular numerical scheme is the finite difference method. However, the solutions to this can be very computationally expensive, especially if we desire better simulations with better resolutions. For this reason, it is desirable to solve these problems using parallel computing.

Parallel Matlab

Matlab codes have been developed to model the flow of fluids through a curved pipe (a torus). For this project the codes are modified so that they can be executed in parallel. Parallelization of the code is done using Matlab's Distributed Computing Engine (MDCE). A plot of the performance comparison between the sequential and parallel codes is shown below. It can be seen that for small grid sizes, parallel programs are slower due to communication overheads between nodes. However there are exponential increases in performance once the problem become sufficiently large.



Octave

GNU Octave was also investigated as a possible free, open source alternative to Matlab. However it has been found that the Octave build process is very complex and does not always guarantee similar performance (in terms of accuracy) with Matlab.

Hardware and Software Used

SAPAC Hydra Cluster (IBM eServer 1350 Linux cluster)
Matlab version 7.3.0.298 (R2006b)
Matlab Distributed Computing Engine version 3.0 (R2006b)
Octave version 2.9.9 with SuiteSparse version 2.4.0