Oblig 1; INF5640

Høst 2006

1 Overview

The purpose of this assignment is to learn to write an `MPI` program for solving a simple PDE. The assignment will also provide you with a chance of getting familiar with the Linux cluster `chilopodus.simula.no`.

2 Deadline and submission

The deadline for submitting the assignment is Tuesday, October 17, 2006. You should submit a simple report (typeset using e.g. LaTeX) plus the source code together with a `Makefile` that can be used to compile the code. A simple `README` file should also accompany the source code to explain how the program can be run and what input arguments should be given etc.

3 Mathematical model

The following simple 2D wave equation is to be solved in the unit square $(x, y) \in [0, 1]^2$:

$$\frac{\partial^2 u}{\partial t^2} = \nabla^2 u. \tag{1}$$

Define your own choice of initial and boundary conditions, together with a time period $0 < t \leq T$ for solving (1). The initial and boundary conditions should be chosen such that there exists an analytical solution to (1).

4 Numerical strategy

Design an explicit scheme for solving the above wave equation. Explain the stability condition if applicable.

5 Parallelization

Divide the solution domain into $P = M \times N$ rectangular subdomains, where the number of processors P can be given at run-time. (The number of unknowns and time steps should also be given at run-time.) Use `MPI` routines for necessary communication between the processors. Measure the time used by the program as a function of P, discuss thereby the speedup property. Please also compute the size of the error at $t = T$.

In your first version of the parallel code, `MPI_Send` and `MPI_Recv` (or `MPI_Sendrecv`) commands should be used. In an improved version, non-blocking `MPI_Isend` and `MPI_Irecv` commands should be used. (How do you achieve overlapping of computation and communication?)

6 Useful commands on chilopodus

```
qsub -l nodes=x -o output_file_name <pbs-script>
qstat -a
qdel <job id>
/home/xingca/bin/wallcmd 'ps aux' | grep <your_username>
/home/xingca/bin/wallcmd 'pkill -u <your_username>'
```