PhD-course on Iterative Methods for Linear Systems of Equations

Practical assignments day 5

In this assignment we will investigate how we can parallelise ILU and SSOR.

Download the file `precon.m` from the course webpage.

Assignment1

- Implement the preconditioned CG algorithm (see theoretical assignments day 2).

- Add to the script `precon.m` code to create an SSOR preconditioner (without relaxation parameter. Your preconditioner must have the form $M = LL^T$. Use this preconditioner as input for your PCG routine. Investigate how the number of iterations to solve the system $Ax = b$ depends on n, the number of gridpoints in each direction.

- Same assignment, but now use the incomplete Cholesky preconditioner without fill-in. Use the matlab routine `cholinc` to compute the preconditioner.

Assignment 2

- Make a red-black ordering (or checkerboard ordering) of the unknowns. This ordering splits the unknowns into two groups such that none of the unknowns within a group has a direct neighbour in the group. The resulting matrix has the block form

$$A = \begin{pmatrix} A_{11} & A_{12} \\ A_{21} & A_{22} \end{pmatrix}$$

in which A_{11} and A_{22} are diagonal matrices.

- Make an SSOR preconditioner on basis of the reordered matrix. Compare its performance with the SSOR preconditioner that you used in the first assignment. Why is this preconditioner better suited for parallel computing than the one you used in assignment 1?

- Same questions, now for the incomplete Cholesky preconditioner.