

NSPDE2021 - Computational exercise 2

Download the zip file FEM2d handout.zip.

(1) Modify your 1D FEM code from the previous sheet to use the `gauss_1d.m` code which computes the Gauss quadrature points over $[-1, 1]$. (If you are not using MATLAB, look this up online.) Experiment using 1 or more quadrature points and compare with results from last week. Ideally, consider both the H^1 and L^2 norm of the error.

(2) Code 1D FEM of order 2 and repeat the above.

(3) Complete the codes in the handout to produce a code for the solution of $-\Delta u = 10$ in $\Omega = [0, 1]^2$ with $u = 0$ on $\partial\Omega$. (If you are not using MATLAB, either translate the MATLAB code or look for the pieces online.) Experiment with your code with different data to make sure the code always works. You could also try implement Neumann conditions.

(4) Implement a routine for computing H^1 and L^2 errors and use it to compute the experimental order of convergence (EOC) of the FEM code.

(5) Using for instance the MATLAB pdetoolbox, create an unstructured mesh and use it within your 2D FEM code.

(6) Write a new 2D FEM code for the solution of general second order elliptic problems. The diffusion coefficient should be a 2×2 matrix, the convection coefficient a 2×1 vector and the reaction term a scalar.