Spectrum of Finite Element Method Laplace operator on irregular triangular lattice

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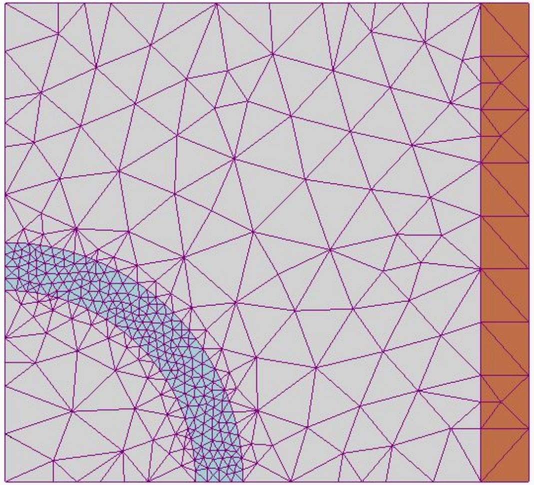
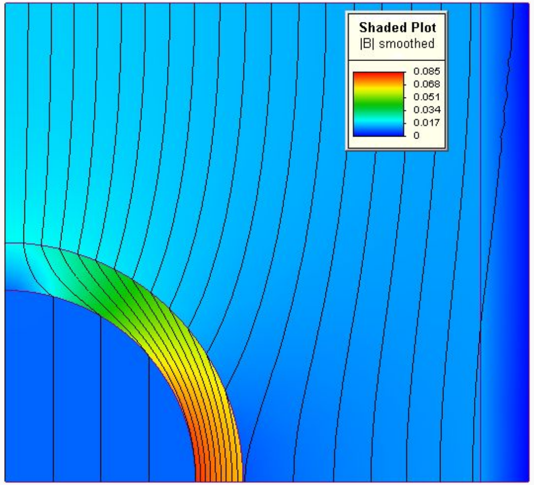
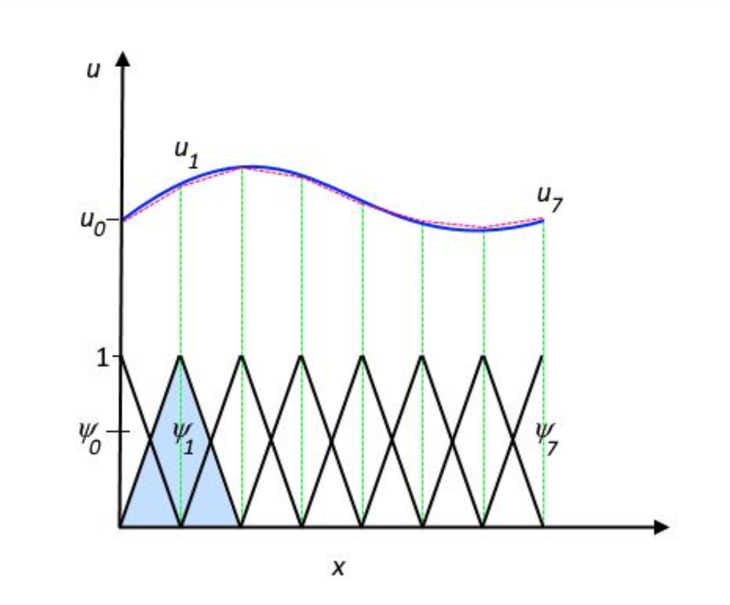
Earth

... or is it...?

Finite Element Method - A 5s Background







[*Finite Element Method*, WikiPedia]

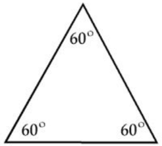
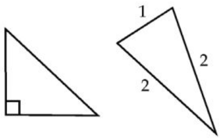
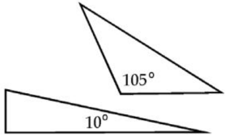
The ambiguous case of ‘fine’ elements

8.2 General Element Quality Checks

Element quality is a subject often talked about and never fully understood. The reason for this is complex but is related to the fact that quality is relative and the solution, by definition, is approximate. In the formulation of finite elements a local parametric coordinate system is assumed for each element type and how well the physical coordinate systems, both element and global, match the parametric dictates element quality. Below you see some graphics representing element quality and you should attempt to follow them, however, there will be a point of diminishing return if you try too hard to get every element within the acceptance criteria. Your judgment is your only guide in those cases. Always perform quality checks on the meshes you create. Check with “local experts” regarding the appropriate values for each element type required by your element checking computer programs. Be aware that, in these situations, “correct” answers can vary a great deal as illustrated in the following table where the range between “OK” and “very poor” is quiet wide.

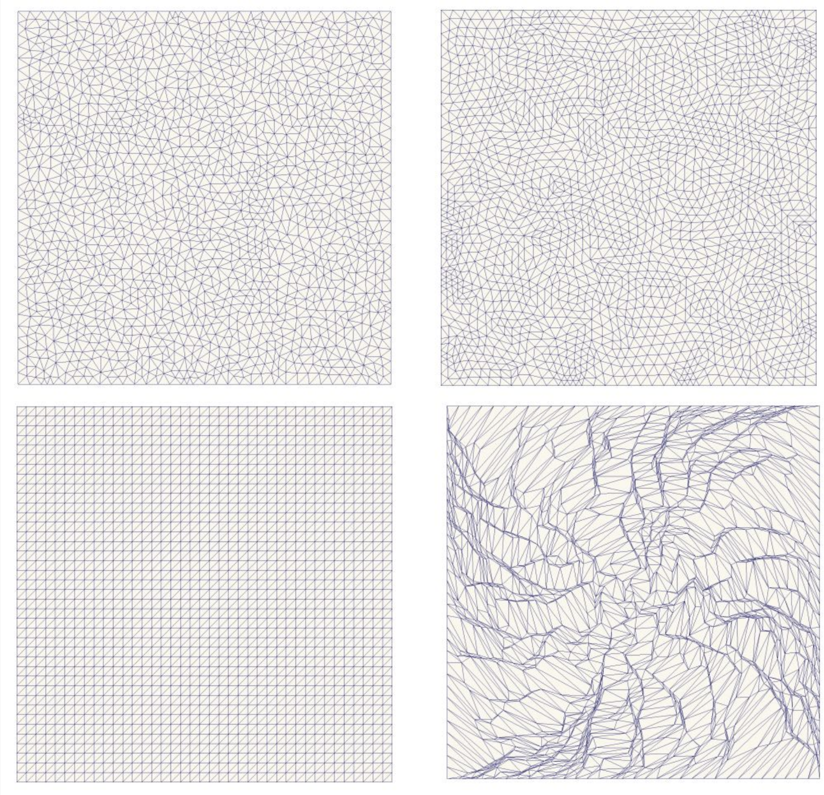
Solid elements use the determinant of the Jacobian Matrix and compare to the ideal value.

Some common element quality measures are detailed below:

BEST	OK	VERY POOR
		

[*Practical Finite Element Analysis*, Nitin S. Gokhale, 2008]

Numerical test in literature



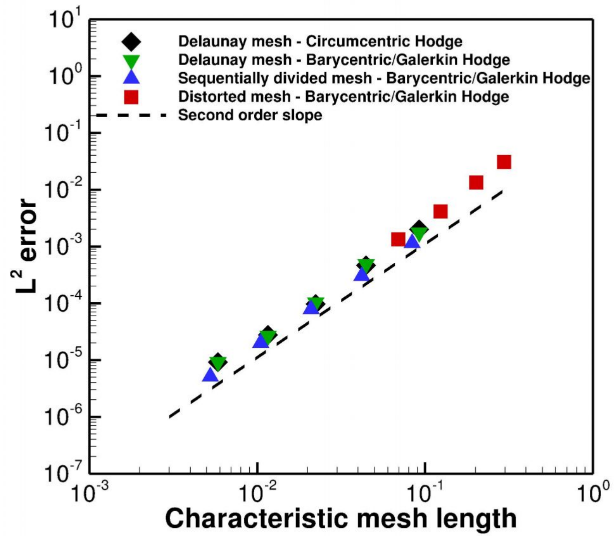
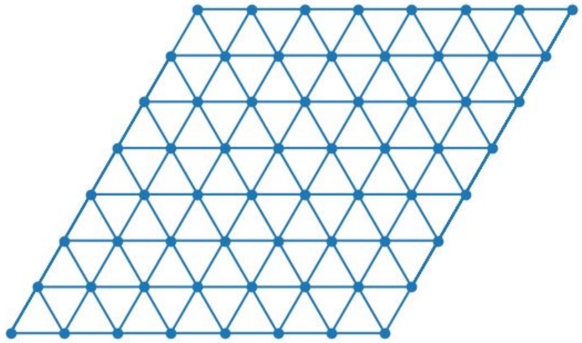
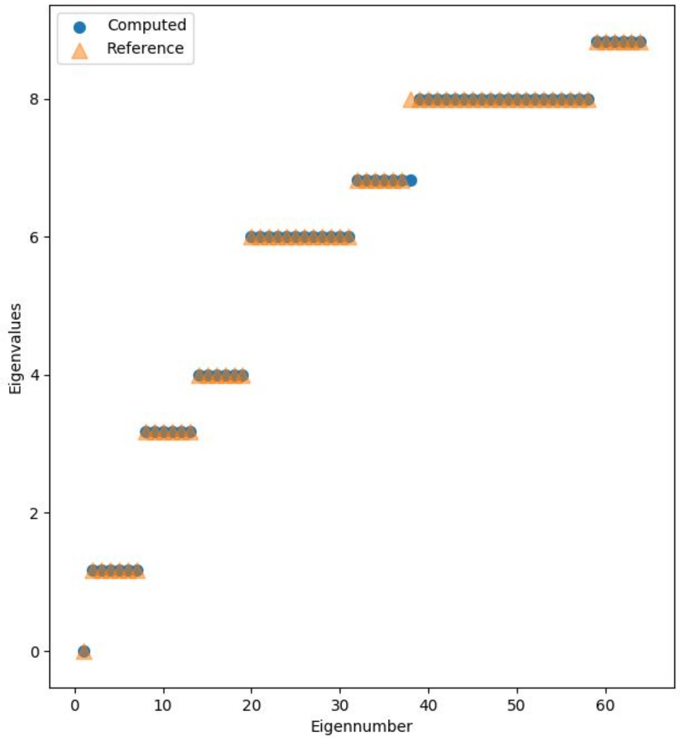


Figure: The numerical convergence of the L^2 error of p for the scalar Poisson Eq. with Neumann boundary conditions.

[*Practical Finite Element Analysis*, Nitin S. Gokhale, 2008]

Numerical Test - Laplace operator on Triangular grid





Unstructured Mesh testing