A Study on the Conditioning of Finite Element Equations with General (Anisotropic) Meshes via a Density Function Approach

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The conditioning of the finite element stiffness matrix and the Jacobi preconditioned stiffness matrix is investigated using a density function approach proposed by Fried in 1973. It is shown that the approach can be used to develop bounds on the smallest eigenvalue and the condition number that are sharper than existing estimates in one and two dimensions and comparable in three and higher dimensions. The new results reveal that the mesh concentration near the boundary has less influence on the condition number than the mesh concentration in the interior of the domain. This is especially true for the Jacobi preconditioned system where the former has little or almost no influence on the condition number. Numerical examples are presented.

References:

[1] L. Kamenski and W. Huang. A study on the conditioning of finite element equations with arbitrary anisotropic meshes via a density function approach. J. Math. Study, 47(2):151–172, 2014.

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