IPIES for Uncertainly Defined Shape of Boundary, Boundary Conditions and Other Parameters in Elasticity Problems

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Abstract: Modeling of uncertainty is a very important problem and arouses great interest among researchers. However direct application of existing mathematical methods is often useless in practice. We present IPIES method [1] for solving uncertainly defined boundary value problems of elasticity. The PIES method was previously obtained and widely tested for precisely (exactly) defined problems. Many studies have confirmed PIES advantages over other methods, like well known FEM and BEM methods.

Mentioned methods have also corresponding interval methods, such as IFEM and IBEM. However, in these methods solutions accuracy depends on (finite or boundary) elements number. So, discretization increases the amount of interval data and results in solutions overestimation. Therefore, the IFEM and IBEM researchers mainly focused on modeling uncertainty of boundary conditions and other parameters only.

We present research on the impact of all uncertainly defined input data (necessary to define the problem) on IPIES solutions. We consider 2D elasticity problems modeled by Navier-Lamé equations. We define uncertainty of the shape of boundary, boundary conditions and other parameters (in elasticity: Poisson's ratio and Young's modulus). We model uncertainty using modified directed interval arithmetic, applied in IPIES. To verify obtained strategy, we test an impact of change in data uncertainty on interval solution. We also compare obtained solutions with solutions of precisely defined problems. For the error calculation we use total differential.

Keywords: uncertainty, interval arithmetic, boundary value problems, IPIES, elasticity problems

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References

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