Flexibility of approximation in parametric integral equation system (PIES) applied to elastoplastic boundary value problems

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ABSTRACT

Elastoplastic boundary problems are most often resolved by FEM or BEM [1]. They are effective, but they also have some drawbacks - both of them require discretization of the domain. The number of used finite elements (or cells) depends not only on the shape complexity, but rather on the required level of solution's accuracy. Therefore, an approach in which approximation of the shape is separated from the approximation of boundary functions should be developed. It requires analytical modification of the classical BIE by including parametric curves and surfaces to the mathematical formalism. As a result PIES has been developed and successfully applied for solving various problems [2].

The main advantage of PIES in elastoplastic problems [3] is that the plastic zone can be defined efficiently using one Bézier surfaces. It can also be modified very easily by control points, what is crucial as the spread of the plastic region is not known a priori. Moreover, since approximations are separated also various effective methods for approximation of boundary functions can be used. Because the plastic zone is not discretized, so far the global approximation by Lagrange polynomial has been used. However, in cases where plastic strains occur locally some local methods could be better.

The main aim of this paper is to apply different methods of approximation of boundary functions. Initially, approximation by Lagrange polynomials is performed in two or more zones depending on the distribution of plastic strains. Then, one of the so-called local methods is applied. Inverse distance weighting (IDW) method [4] predicts a value using the measured values surrounding the prediction location. Some examples were considered in order to compare all approaches with analytical solutions. Finally, it can be stated that PIES allows for flexible changing of approximation methods what gives the possibility for obtaining very accurate results.

REFERENCES

[1] M. Ameen, *Computational elasticity*, Alpha Science International Ltd., Harrow, (2005).
[2] E. Zieniuk, A. Bołtuć , "Non-element method of solving 2D boundary problems defined on polygonal domains modeled by Navier equation", *International Journal of Solid and Structures*, **43**, 7939-7958 (2006).
[3] A. Bołtuć, "Parametric integral equation system (PIES) for 2D elastoplastic analysis", *Engineering Analysis with Boundary Elements*, **69**, 21-31 (2016).
[4] D. Shepard, "A two-dimensional interpolation function for irregularly-spaced data", *Proceedings of the 1968 ACM National Conference*, 517–524 (1968).