EFFICIENT METHOD OF SOLUTION OF LARGE SCALE ENGINEERING PROBLEMS WITH INTERVAL PARAMETERS BASED ON SENSITIVITY ANALYSIS

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In this paper sensitivity analysis method [1] will be applied to solution of finite element equations of truss structures and non-stationary diffusion equation with interval parameters.
Only linear-elastic model of truss structures is considered. The finite element equations have the following form

$$\mathbf{K}(\mathbf{h})\mathbf{u} = \mathbf{Q} \tag{1}$$

where **K** is a stiffness matrix, **u** is a displacement vector, **Q** is right had side of the equation and **h** is a vector of uncertain parameters. Only uncertain Young modulus and uncertain area of cross-section is considered.
In order to calculate the interval solution (i.e. displacement vector **u**) it is necessary to calculate derivative $\frac{\partial \mathbf{u}}{\partial \mathbf{h}}$. According to many numerical experiments and some theoretical results it is convenient to assume that in some engineering applications the function **u**=**u**(**h**) is monotone. Under such assumption it is possible to predict how to calculate the extreme solutions. Presented method gives quite accurate, however only approximate results.
Monotonicity assumption is not always true. Because of that the results are not always exact.
The function **u**=**u**(**h**) is highly nonlinear, because of that presented algorithm is better than first order Taylor expansion. On the following web page [2] it is possible to compare presented algorithm, the exact results and the first order Taylor expansion using appropriate web applications.
The procedure of solution of non-stationary diffusion equation with interval parameters will be presented in the full version of this paper.

References

[1] Pownuk A., *Numerical solutions of fuzzy partial differential equation and its application in computational mechanics*, in Fuzzy Partial Differential Equations and Relational Equations: Reservoir Characterization and Modeling (M. Nikravesh, L. Zadeh and V. Korotkikh, eds.), Studies in Fuzziness and Soft Computing, Physica-Verlag, 2004
[2] http://zeus.polsl.gliwice.pl/~pownuk/interval_truss.htm