Verified Solution of Finite Element Models with Uncertain Node Locations

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Abstract

Finite element models for mechanical truss structures where all of the physical model parameters are uncertain are considered. Not just the material values and applied loads, but also the positions of the nodes, are assumed to be inexact but bounded and are represented by intervals. In this case the application of the finite element method results in a system of linear equations with numerous interval parameters exhibiting nontrivial dependencies which cannot be solved conventionally.

We have previously employed a general-purpose iterative solver for parametric systems of equations, coupled with software for enclosing the range of multivariate polynomials arising in the parameter dependencies, to solve problems in the case of uncertain material values and loads only; see Garloff, Popova, and Smith (2009). With the addition of interval pruning techniques, simple problems with uncertain node locations have also been solved; see Smith, Garloff, and Werkle (2009).

With the further addition of a monotonicity analysis of all the parameters, we aim to provide tight guaranteed enclosures for the element forces and node displacements for a larger class of finite element models.

References

Garloff, J., E. D. Popova, and A. P. Smith. Solving Linear Systems with Polynomial Parameter Dependency in the Reliable Analysis of Structural Frames. In N. Sims and K. Worden, editors, *Proceedings of the 2nd International Conference on Uncertainty in Structural Dynamics*, pages 147–156, Sheffield, UK, June 2009.

Smith, A. P., J. Garloff, and H. Werkle. Verified Solution for a Simple Truss Structure with Uncertain Node Locations. To appear in K. Gürlebeck and C. Könke, editors, *Proceedings of the 18th International Conference on the Applications of Mathematics and Computer Science in Architecture and Civil Engineering*, Weimar, Germany, July 2009.