

Finite Element Analysis of Structures with imprecise Young's modulus using P-Box modeling

R.R.Srinivasa¹⁾, R.L.Mullen²⁾, and M.V.Rama Rao³⁾

¹⁾ Duke Energy, 400 South Tryon- Room Code (1920-05), Charlotte, NC 28285, USA,
Ranganath.Srinivasa@duke-energy.com

²⁾ School of Civil and Environmental Engineering, University of South Carolina,
Columbia, SC 29208, USA, rlm@cec.sc.edu

³⁾ Vasavi College of Engineering, Hyderabad - 500 031 INDIA, dr.mvrr@gmail.com

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Abstract

Imprecise probability identifies a number of various mathematical frameworks for making decisions when precise probabilities (or PDF) are not known. Imprecise probabilities are normally associated with epistemic uncertainty and define the uncertainty in terms of bounded possibilities or unknown probabilities between a specified lower and upper bounds.

In this paper, a new formulation for finite element analysis of structures with imprecision in Young's modulus defined using p-box structures. P-box structures are computed for the Young's modulus of members of the structure making an analogy of the previously developed interval finite element solution procedures of the authors (Muhanna and Mullen, 2001, Zhang, Mullen and Muhanna, 2010 and Rama Rao, Mullen and Muhanna, 2011). Both discrete p-box structures and interval p-box Monte Carlo algorithms are presented. A solution, using discrete p-box structures, is compared with an interval Monte Carlo based p-box analysis under the assumption of independent random variables. A truss structure is presented as an example problem to illustrate the capabilities of the new approach. The computational efficiency of the p-box finite element methods is also demonstrated.

References

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