6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11-15 June 2018, Glasgow, UK

Vibration Analysis of Thin Solids with Randomized Linear Algebra

Harri Hakula

Department of Mathematics and System Analysis
Aalto University, P.O. Box 11100, FI-00076 Aalto, Finland
Harri.Hakula@aalto.fi

Keywords: *Eigenproblems, Randomized Linear Algebra*

Asymptotic eigenanalysis of thin solids such as thin shells of revolution involves solution of large number of parameter dependent eigenproblems [1]. The interest is typically in the lowest modes and the objective is to find connections between quantities of interest and the deterministic parameter, for instance the rate of change of the lowest eigenvalue as function of the dimensionless thickness.

In this talk we demonstrate the effectiveness of randomized linear algebra in computational mechanics context. The algorithms discussed are straightforward applications of the ideas presented in the seminal review paper by Halko et al. [2]. Although the algorithms include random input, the output, i.e., the eigenpairs, exhibit only negligible variance due to *concentration of measure* phenomenon.

In essence the algorithms are iterative methods with a priori fixed number of steps. This means that space and time requirements can be controlled precisely. Moreover, in typical high-level numerical programming environments (MATLAB, Mathematica) the implementations are remarkably compact. The entire MATLAB version for the positive-definite generalized eigenproblem is 40 lines of code.

Our numerical experiments indicate that the randomized methods are competitive with built-in Krylov-based ones implemented in MATLAB and Mathematica.

REFERENCES

[1] E Artioli, L Beirão da Veiga, H Hakula, and C Lovadina. On the asymptotic behaviour of shells of revolution in free vibration. *Computational Mechanics*, 44(1):45–60, 2009.

[2] N Halko, P G Martinsson, and J A Tropp. Finding Structure with Randomness: Probabilistic Algorithms for Constructing Approximate Matrix Decompositions. *SIAM Review*, 53(2):217–288, January 2011.