Contribution ID: **59** Type: **not specified**

Eigenvalue Tracking for the Sensitivity Analysis of Higher Order Modes

Tuesday 23 August 2016 09:00 (30 minutes)

The electromagnetic field distribution as well as the resonating frequency of various modes in cavities are very sensitive to small geometry deformations. We propose the application of Isogeometric Analysis (IGA) for the spatial discretization of the problem since IGA allows for the exact description of the domains and for a straightforward and convenient way of handling geometrical variations, [1].

The variations are given by measurements. A small number N of relevant and independent deformations can be extracted by using a truncated Karhunen–Loève expansion [2]. The random deformations are used in an uncertainty quantification workflow to determine the sensitivity of the higher order modes. For the propagation of uncertainty a stochastic collocation method based on sparse grids defined from numerically-generated orthogonal polynomials is employed. It requires the repeated solution of Maxwell's eigenvalue problem for the perturbed cavity with different realizations in the parameter space, e.g. $2^k N^k/k!$ evaluations in the Clenshaw-Curtis case, where k is the polynomial degree and $N \gg 1$ cf. [2].

This contribution focuses on the efficient solution of the repeated eigenvalue problems. We propose to create a homotopy between points in the parameter space and use a Newton-like approach [3] to solve the eigenvalue problem along the homotopy. This is can be efficiently parallelized while tracking the eigenpairs is still guaranteed.

[1] Jacopo Corno, Carlo de Falco, Herbert De Gersem und Sebastian Schöps. Isogeometric Simulation of Lorentz Detuning in Superconducting Accelerator Cavities. In: Computer Physics Communications 201 (Feb. 2016), S. 1–7. issn: 0096-3003. doi: 10.1016/j.cpc.2015.11.015.

[2] Dongbin Xiu. Numerical Methods for Stochastic Computations: A Spectral Method Approach. Princeton University Press, 2010.

[3] Dan Yang und Venkataramana Ajjarapu. Critical Eigenvalues Tracing for Power System Analysis via Continuation of Invariant Subspaces and Projected Arnoldi Method. In: IEEE Transactions on Power Systems 22.1 (Feb. 2007), S. 324–332. issn: 0885-8950. doi: 10.1109/TPWRS.2006.887966.

Presenter: GEORG, Niklas (TU Darmstadt)

Session Classification: Student Session