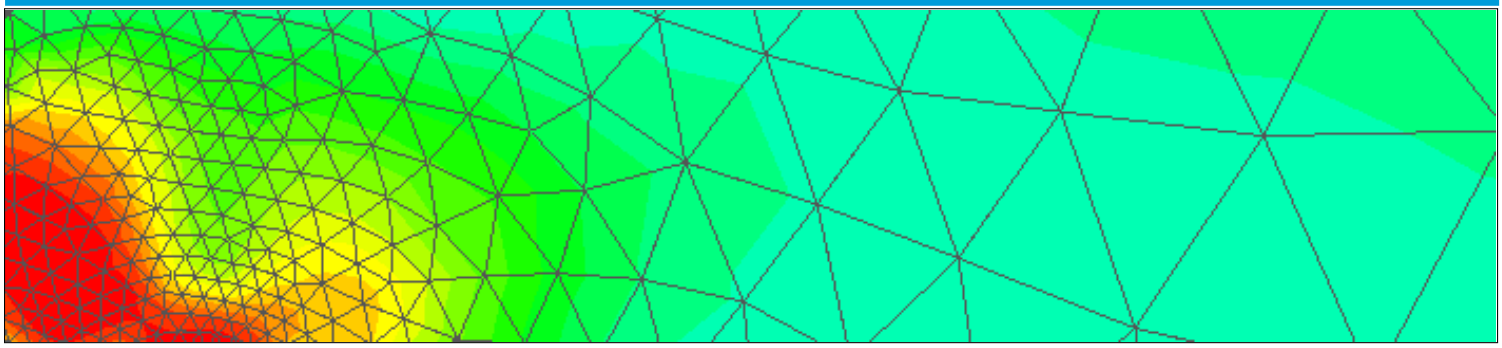
TECHNISCHE UNIVERSITÄT DARMSTADT

Masters Thesis

"FEM with Floquet for stability in rotor systems."

Computational Engineering / Allg. Maschinenbau
Start: ab Oct. 2017



Project description

The finite element method (FEM) is an ubiquitous tool to the modern academic and industrial engineer. Its ability to deal with multivariant materials across complicated geometric domains is at present unrivalled and is likely to dominant into the near future. Therefore advances in and increased functionality of FEM is of great utility across many disciplines.

The stability of elastostatic structures is often determined via complex eigenvalues analysis (CEA) of a second order system of equations with a large degree of freedom. These discretized equations in turn come for a FEM, such as the Rayleigh-Ritz method using simple but very numerous shape functions. However for many problems involving variant time, e.g in rotor dynamics, explicit time-periodicity enters the equations of motions. CEA is no longer the correct approach instead a matrix called the monodromy matrix from Floquet theory needs to be obtained. Although Floquet theory has been well known for a hundred years, this exciting project makes the technique of determining stability via the Floquet multipliers available to FEM for the first time.

The candidate will build upon the working prototype currently in-progress within the group to apply the technique development to a more sophisticated FEM meshing and environment. Applicability of technique to PERMAS, or FEAP (finite element method program) is to be investigated. FEAP is an open source FEM solution written in C and therefore completely accessible to the student. PERMAS is the closed commercial FEM solution offered by our nascent industrial partner INTES. The technique is to be showcased with a paradigmatic application to a stability problem in rotor dynamics.

The student will meet twice a week with supervisor to discuss project progress and

- Learn C programming and subversion control git on the Linux OS.
- Engage with the FEM software FEAP and/or PERMAS
- Apply the finite element method to a showcase example involving time-periodicity.
- Use OpenMP or MPI to parallelize the FEM code on the graduate schools cluster.

Many of the above techniques are not normally covered by an undergraduate program in mechanical engineering, so the opportunity to add a considerable number of new skills to the student resumé is offered which will set him up for a good possible career in academic or industrial research.

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