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ADAPTIVE REDUCTION OF FINITE ELEMENT MODELS OF GEOMETRICALLY COMPLEX MECHANICAL COMPONENTS

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ABSTRACT

There is an increasing demand for using high resolution finite element models of individual elastic components in multibody simulation together with detailed contact analysis. Due to the large amount of degrees of freedoms in such finite element models techniques for construction of reduced models with much fewer degrees of freedoms that still capture the flexible body dynamics with sufficient accuracy is of paramount importance in industrial applications. Basically, the approach is to construct a subspace of the finite element trial space that still captures the dynamics within a desired accuracy. A classical technique to construct such a subspace is to use a truncated eigenfunction expansion which typically captures global behaviour well but cannot give a reliable local solution. The latter is often crucial for instance in durability analysis.

In this talk we present an adaptive model reduction method that builds on a multiscale splitting of the solution where the coarse scale (global) part is represented by global eigenfunctions and the fine scale (local) part is represented using an eigenfunction expansion for localized patch problems. The localized patch problems are used to capture the local effects of the contact force, for instance acting on a gearwheel tooth, and are only active in the vicinity of forces. The number of eigenfunctions, in the global and local problems, is determined using an adaptive algorithm that is based on a posterior error estimates. We also address the initial discretization error in the high resolution finite element model.

We present applications involving real 3D mechanical components including gearwheels and bearing components.