# Elastic Multibody Simulations of Gear Drives with Contact using Higher Order Ansatz Functions

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## Abstract

Gear drives are central components in a variety of systems, e.g. combustion engines of cars, ships and wind turbines. In order to analyze and predict the durability and performance of these gear drives, accurate predictions of stresses, contact forces and transmission errors are required. To that end, simulations are typically performed using linear finite element analyses (FEA). These simulations, however, incur a high computational effort. Thus, using only static FEA is common in industrial practice. As an alternative, rigid descriptions using multibody systems (MBS) can be used. Yet, MBS may yield inaccurate results for contact forces and accelerations since these models severely neglect elastic effects such as tooth bending. As a remedy to the long turnaround times of FEA and the inaccuracy of rigid MBS descriptions, using an elastic multibody (EMBS) description with quadratic tetrahedral meshes is proposed. Consequently, this work investigates the contact description in gear drives with elastic multibody models and higher-order ansatz functions. In order to obtain high efficiency, model order reduction techniques are applied to EMBS models. Here, a basis of pre-calculated modal shape functions and static mode shapes is used to describe deformations. These deformations are then coupled with a floating-frame-of-reference formulation to large, non linear reference motions to account for large rotations. Further, to simplify automatic meshing, we use ten node tetrahedral elements for meshing. Contact calculations are then performed using integrationpoint-to-segment formulations.

## Keywords

elastic multibody systems, EMBS, floating frame of reference, contact, tetrahedra