Using Isogeometric Analysis for the Shape Optimization of Rotating Electric Machines Coupled by Harmonic Stator-Rotor Coupling

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ABSTRACT

Recently, due to the energy transition, the interest in electric energy converters, in particular electric machines has increased significantly. Therefore, simulations are also becoming more important in order to obtain efficient and robust designs of these machines. Commonly, a workflow based on analytical estimates and the classical Finite Element Method is used for 2D and finally 3D models. Particularly in the case of electrical machines based on cylindrical geometries, the accuracy depends heavily on the resolution of the mesh, especially in the air-gap region. Both an exact representation of cylindrical surfaces as well as a high spatial resolution can be obtained when using Isogeometric Analysis, which uses B-Splines and/or Non-Uniform Rational B-Splines as basis for geometry and solution space. Furthermore, in IGA, the geometry can be conveniently and smoothly transformed by moving control points of the Splines, making it unnecessary to remesh the domain when modifying the geometry. This makes IGA very well suited for shape optimization of machines [1]. This contribution deals with shape optimization of a rotating permanent magnet synchronous machine discretized with IGA. The rotation is implemented by discretizing rotor and stator domain separately and coupling them using a Mortar-type harmonic stator-rotor coupling [2]. Shape optimization is used to minimize the total harmonic distortion of the electromotive force, considering the rotating rotor.

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