ELECTROMAGNETICS STRUCTURAL COUPLING SIMULATION OF ELECTRIC MOTOR

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ABSTRACT

Electric motors are widely used in a variety of industrial applications. They can be found in compressors, industrial fans, pumps, household appliances, machine tools, etc. Noise and mechanical vibrations are of the main sources that may lead to a breakdown of an electric motor. It is therefore essential to study the vibration behavior of electric motors in order to avoid unforeseen mechanical failures. In this study, we look at the vibrations and noise produced by the transient electromagnetic forces on the stator of a permanent magnet motor. In this manuscript, a seamless workflow to model the acoustic noise and vibration of an electric motor using the Finite Element Method FEM is presented. As a new feature in ANSYS Maxwell 2014, harmonic indices of electromagnetic forces can be automatically calculated using Fourier Transform. 2D and 3D analyses are adopted and harmonic indices can be calculated in both cases. The workflow will start by (1) electromagnetic forces are initially calculated within Maxwell as distributed force densities on the stator. These distributed force densities are spatially integrated to provide lumped forces and torques on the tips of the teeth that experience the majority of the electromagnetic forces, (2) the calculated forces are then easily mapped to ANSYS Mechanical 15.0 in a harmonic analysis environment. A modal analysis study is performed as an essential step to identify the resonance frequencies at which operation should be avoided, (3) velocity profiles are calculated and mapped to an acoustic run to predict the noise level, (4) Finally, optimization studies are made over the complete system to improve the motor design and reduce noise. A simulation environment (ANSYS Workbench) is used to integrate a seamless workflow.

Keywords: Electromagnetics, Acoustics, Harmonic Analysis.