Harmonic and Transient Magnetic Analysis of Single Turn Coils Fed By a Current Pulse at Medium Frequency

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Abstract

Single turn coils are used in pulsed magnetic technologies for which both magneto-harmonic and transient magnetic analysis are required. We suggest studying one single turn coil example made of a conducting massive coil, an optional conducting field shaper and an internal conducting tube supposed to be deformed. The aim of this study is to evaluate the accuracy and reliability of a 2D axi-symetrical numerical model by comparing with 3D reference calculations in order to build an approximate but reliable analytical solution that might ease the coupling with electrical, mechanical and thermal physics.

In this work we propose to:
- First explain the introduction of a 3D complete model and the corresponding approximate 2D axi-symetrical model in COMSOL software,
- Perform magnetoharmonic computations:
o Draw the potential, flux, current and Lorentz force density profiles,
o Extract some needed information on the coil, such as the equivalent resistance, inductance and force coefficient that acts onto the internal tube to deforme.
- Perform transient magnetic computations
o Draw the potential, flux, current and Lorentz force density profiles,
o Analysis of the relationship between the current, the voltage and the force.

Reference

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Figures used in the abstract

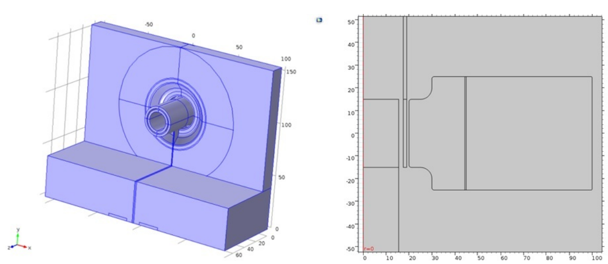

Figure 1: 3D geometry of the single turn coil (left) and 2D axi-symmetrical approximation (right).

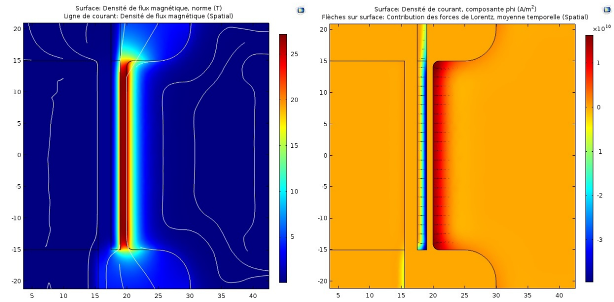

Figure 2: Magnitude of flux density (left) and magnitude of Lorentz force density (right).

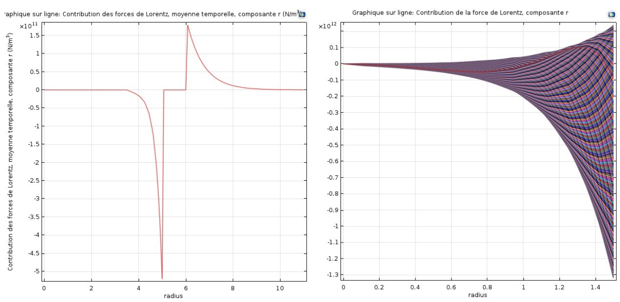

Figure 3: Lorentz force density as a function of radius (left) and transient Lorentz force density as a function of radius and time inside the tube to deform and weld (right).