

Development of an integrated Cast3M mesh generator in TACTICS

Wednesday, 22 September 2021 12:25 (25 minutes)

In the framework of thermo-hydraulic studies for tokamaks using superconducting magnets, the TACTICS code was developed at CEA. This tool is based on the same pseudo 3D approach as the one used by similar codes such as SuperMagnet, Venecia or 4C. TACTICS thus allows the simulation of the thermal and thermo-hydraulic behavior of a superconducting coil comprising CICC, and possibly includes the modelling of the cryodistribution. For this purpose, it couples three codes, THEA for the 1D thermo-hydraulics in the conductors, Cast3M for the 2D thermal diffusion in cross sections representing the structures (jackets, insulation and casing if any) and Simcryogenics for the cryodistribution.

During cryomagnetic system design activities, several coil options have to be studied. When preparing each TACTICS model, the Cast3M module can be the one demanding the longest development time, mainly for building the 2D geometry and the associated mesh. A methodology was thus elaborated for rationalizing the structure of input data, their entry and their processing in the Cast3M module for generating the corresponding 2D mesh.

Due to the variety of possible coil architectures affecting the structures (number of conductors, jackets features, presence of radial plates, casings geometry, layout of case cooling channels, etc.), a tree structure data was configured and a software was developed for facilitating and increasing reliability of data entry. The TACTICS Cast3M module was adapted for treating the generated input data and for building the 2D mesh with the lowest possible intervention of the user. Different levels of detail were implemented for the insulation materials inside the winding pack, and the corresponding relevance was assessed, notably regarding the temperature margin criterion.

Category

Multi-scale and multi physics design methods

Keywords

TACTICS, Cast3M, mesh generator, thermal, thermo-hydraulics

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Session Classification: Multi-scale D3