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Development of a multi-physic platform OLYMPE for magnet fusion design: progresses update and applications

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In the framework of tokamak design studies, the magnet system dimensioning stands as a crucial point, magnets being strong drivers for reactor performances. In this aim superconducting magnets design path to manufacture and integration should prior undergo several stages of development, including the detailed analysis for defined operation cases. Those studies are linked to several physic domains (electromagnetics, mechanics, thermohydraulics, thermal) that should be interfaced together. The platform OLYMPE was developed at CEA in this objective, aiming at addressing those complex multi-physic problems in an integrated tool, which is expected to increase analyses efficiency.

The different OLYMPE submodules will be described and their dedicated simulation domain explained, together with their interconnection logic. As a matter of fact several combinations of those modules are established into converging loops and can assess the refinement of magnet design in the aim to increase design ergonomic accuracy. Namely examples will be given with following loops:

- TF system design coupled with thermohydraulics: it ensures the compliance of TF design with temperature margin criterion.
- TF system design coupled with electromagnetics: it ensures the compliance of TF design with topologically-induced magnetic field map
- Overall TF design coupled with thermohydraulics and cryogenics: it ensures the optimization of TF design and its operation conditions with overall system merits (e.g. cost factor).
- TF system design coupled with mechanics: it ensures the compliance of TF design with local stress criterion

The outcomes and methodologic merits of those loops will be illustrated by applications on DEMO configurations, and performances cross-checks or comparisons with simpler models will also be provided to quantify the accuracy enhancement.

Furthermore the management of the overall input database and the GUI interface will be presented in the aim of improving tool operability.

Finally discussions on this emerging OLYMPE tool qualities will also be exposed, including calculation performances merits and further development perspectives.

Category

Multi-scale and multi physics design methods

Keywords

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