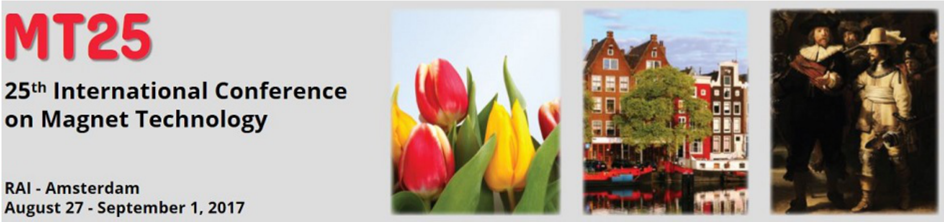

Contribution ID: **955** Type: **Regular 15 minutes Oral Presentation**

LEDET-ANSYS coupled modeling of transients in superconducting magnets

Thursday 31 August 2017 12:30 (15 minutes)

The transient behavior of a superconducting magnet is influenced by numerous simultaneous nonlinear effects occurring at different spatial and time scales in the electro-magnetic, thermal, and mechanical domains. Recent efforts towards precise and time-efficient modeling follow two distinct approaches. On the one hand, complex and interdependent phenomena are simulated by means of multi-physics finite-element programs. High accuracy is achieved by subdividing the analyzed system into a large number of elements, which is computationally expensive. Modeling effects occurring at a spatial scale corresponding to superconducting wires is possible, but very time consuming for large objects, such as fusion, accelerator, and research magnets. On the other hand, complex phenomena can be simulated using equivalent lumped-element networks, whose response approximates effects occurring in multiple domains. Models based on this approach are generally faster to solve, but are less suitable for simulating effects depending on complex geometries. A new simulation environment for modeling electro-magnetic and thermal transients in superconducting magnets is presented, which couples a 2D lumped-element model developed in LEDET (Lumped-Element Dynamic Electro-Thermal) and a 3D finite-element model developed in ANSYS©. Both models have been independently validated against experimental results and found in good agreement.
The coupled model allows simulating electrical, magnetic, thermal, and mechanical transients in superconducting magnets with good accuracy and time-effectiveness. Multiple nonlinear effects are included in the model, such as inter-filament and inter-strand coupling currents in the superconductor, iron-yoke saturation, eddy currents in various magnet metallic elements, and their combined effect on the magnet behavior during transients.

Submitters Country

USA

Primary authors: Dr BROWER, Lucas (LBNL); Dr RAVAIOLI, Emmanuele (LBNL)

Co-author: SABBI, GianLuca (LBNL)

Presenter: Dr BROWER, Lucas (LBNL)

Session Classification: Thu-Mo-Or33

Track Classification: G7 - Multi-Physics Design and Analysis