Modelling an HTS dynamo using a segregated finite-element model

Mark D. Ainslie¹, Loïc Quéval², Ratu C. Mataira³, Rod A. Badcock³, Chris W. Bumby³

¹) Bulk Superconductivity Group, Department of Engineering, University of Cambridge, UK
²) Group of Electrical Engineering Paris (GeEpS), CentraleSupélec, University of Paris-Saclay, France
³) Robinson Research Institute, Victoria University of Wellington, New Zealand

**Modelling Framework**

![Experimental HTS dynamo schematic](image)

**Electromagnetic model:**

2D (infinitely long) \( H \)-formulation

COMSOL Multiphysics 5.3a

**Assumed wire properties:**

SCS4050-AP, width 4 mm, extrapolated to 12 mm for the model

1 μm HTS layer, artificially expanded to 5 μm to improve computational speed

50 μm substrate (Hastelloy), 266 nΩ·m

25 μm top/bottom copper stabiliser, 3 nΩ·m

For the HTS wire only, the output increases linearly. The inclusion of generated heat reduces the output, this effect increasing with frequency.

Including the whole wire architecture produces results observed in experiments: a linear output for low- \( f \), a plateau & then reducing output for high- \( f \).

For high- \( f \), current sharing between the layers in the HTS wire architecture become important; in particular, current flow into the Cu stabiliser due to excessive overcritical currents developing in the HTS layer.

The numerical models give an important insight into what is occurring inside the HTS wire in the HTS dynamo.