Development of a modeling toolbox for CORC® cable performance evaluation

Topic Area:
Enabling Technologies

Partner	Company
Lawrence Berkeley National Laboratory	Advanced Conductor Technologies Inc.; Superpower Inc.
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Project Summary:

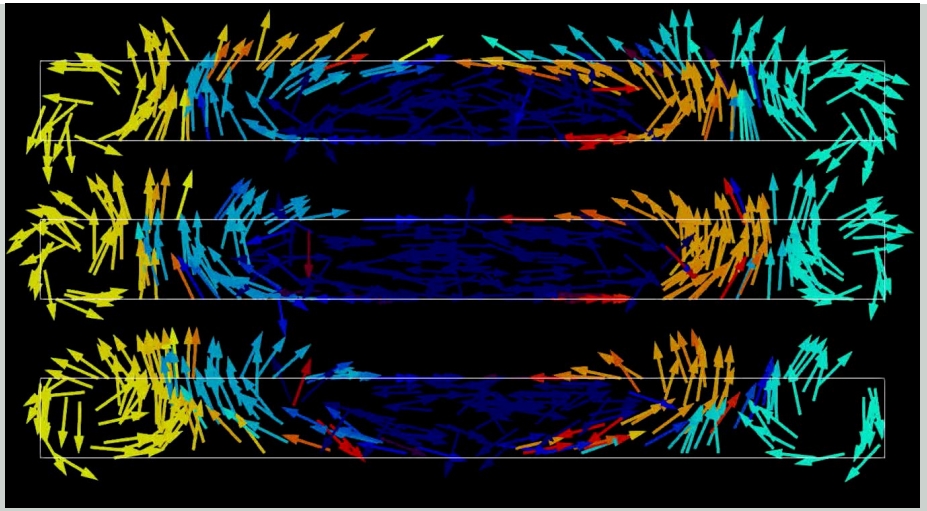
Developing special purpose C++ software framework for computational modeling of HTS cables and magnets,

Fusion Impact:

CORC® wires have characteristics uniquely qualified for fusion. The software development undertaken here is a step towards a comprehensive simulation capability to help optimize CORC® wire parameters

Business/Market Impact:

Business impact is pending further code development – expected to be available late 2023



Period of Performance:	Federal Share:	Cost Share:
6/3/21-9/30/22	$192,000	$50,000

Publications

- The work was presented at ah International workshop:
- Christian Messe. A Special Purpose Finite-Element Framework for High-Temperature Superconductor Applications. 8th International Workshop on Numerical Modelling of High Temperature Superconductors (HTS 2022), Kévin Berger (Université de Lorraine - GREEN), Jun 2022, Nancy, France. hal-03791404

- And an invited journal paper is currently under review:
- C. Messe, et al., "BELFEM: A Special Purpose Finite Element Code for the Quasi-Magnetostatic Modeling of High-Temperature Superconducting Tapes, Invited submission, Sup. Sci. and Tech. 2023

- Some of the formulation was also published with other collaborators in the following publication:
- N. Riva, A. Halbach, M. Lyly, C. Messe, J. Ruuskanen and V. Lahtinen, " H - φ Formulation in Sparselizard Combined With Domain Decomposition Methods for Modeling Superconducting Tapes, Stacks, and Twisted Wires," in IEEE Transactions on Applied Superconductivity, vol. 33, no. 5, pp. 1-5, Aug. 2023, Art no. 4900405, doi: 10.1109/TASC.2023.3240389.

Impact

- The software is designed to be:

1. open-source under LBNL BSD; this should enable further development and integration with complementary modeling techniques in the future.
2. Utilizes new mathematical formulation for HTS; the code is specifically designed for REBCO tapes in complex geometry, particularly motivated by CORC. In particular, the REBCO layer is modeled as a 2D surface embedded in a 3D structure in a mathematically proper manner.
3. Leverage parallel computing (e.g. NERSC); the intent is for the code to enable simulations of the impact of parameter uncertainties, e.g. variation in tape performance, in contact resistance, etc.
4. Utilizes fast solver from LBNL's CRD; again, the ability to model complex geometries and to solve fast should provide insight into the impact of cable parameters that is currently not available via modeling.