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Development of large-scale numerical electromagnetic field analysis model for SCSC cables

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Reducing AC losses in coated conductors is one of the important issues for HTS applications to electric power devices and magnets. Multifilament structure is a method to reduce AC losses. From the view point of improving the robustness of a multifilament coated conductor for local normal transitions, it is preferable to have a finite transverse conductance. When copper is plated over the superconductor filaments to allow current sharing, the effect of multifilament structure to reduce AC losses can be obtained only after the decay of coupling currents. To make coupling time constant shorter, we proposed the spiral copper-plated striated coated-conductor (SCSC) cables.
We need to evaluate ac losses in the SCSC cables accurately by numerical electromagnetic field analyses for actual applications. For accurate analyses, we have to consider following two essential factors. First, we need to model the copper-plated multifilament conductors'structure appropriately to consider the coupling currents. Second, we need to develop large-scale three-dimensional numerical electromagnetic field analysis model not but analysis model of cross-section of the cable to consider the structure of the spirally-wound conductors.
We are developing a large-scale electromagnetic field analysis model for SCSC cables. We combine T-formulation and thin-strip approximation in the model, while there is a normal conductor between filaments whose thickness is same with superconductor layer. Additionally, in order to consider second factor, we use finite long model not but infinite long model with translational symmetry boundary condition. Because analyses with this model could require huge degree of freedoms (DOFs), we use hierarchical matrices to make faster the computation and reduce memory consumption. For example, an 80-mm long SCSC cable consists of 16 tapes, which we analyze as a test case, has 2.7 million DOFs.

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