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High definition 3D finite element analysis of low temperature Rutherford cable

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A multi-scale mechanical model of Rutherford type, low temperature superconducting cable is discussed in this paper.
First, the numerical approach for the mechanical analysis of the cable using bi-metallic description of the strands is presented. The process of the three-dimensional geometrical reconstruction of the cable during operation, up to the scale of the strand, is described. The homogenization of the mechanical properties of the superconducting bundle is explained, and several options for the description of the strand annular topology are compared on the basis of local models. The inclusion of a high definition three-dimensional sub-modelling of the strand geometry is illustrated, up to the superconducting filaments scale. The geometrical reconstruction of cable stacks longer than a twist pitch is finally demonstrated. In a second part of this paper, we present the first attempts of confrontation of this finite element model with experimental results performed on stacks of conductors, with a view in estimating the cable current transport capability thanks to existing scaling laws.

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