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FINITE DIFFERENCE NUMERICAL SIMULATION OF Nb_3Sn PERFORMANCES WHEN SUBJECTED TO BENDING STRAIN

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ABSTRACT

A model for the simulation of current distribution in Nb_3Sn strand subjected to pure bending strain is described. Improved Deviatoric strain scaling is assumed for the critical current-strain dependence.

The strand is discretized in elements representing groups of twisted filaments surrounded by the stabilization matrix and a distributed constant circuit model is applied for current transfer among filament bundles. System equations are solved by a finite difference method in Mathworks environment. The frame of the code is preliminary validated by means of comparison with analytical solutions for different simplified situations.

The critical current dependence on bending, temperature, magnetic field and strand properties is investigated, using this simulation code with different boundary conditions. Numerical results of this computational tool in comparison with transport critical current measurements underline the critical impact of the geometrical strand modeling and in particular the role of transverse matrix resistivity and twist-pitch values on current redistribution and on voltage runaway point.

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