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Introduction of the magnetic scalar potential ϕ in the T-A and J-A formulations for efficient electromagnetic simulations of High Temperature Superconductors

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Superconducting devices are likely to play a crucial role in the energy transition addressing power generation, transmission, distribution systems, transportation and even quantum computing. Therefore, developing models that enable fast and highly accurate simulations is important for advancing the technology. This work introduces the \textbf{T}-\textbf{A}-ϕ and \textbf{J}-\textbf{A}-ϕ formulations in 2D, offering the potential to reduce the number of degrees of freedom by modeling the non-conductive parts of a device using magnetic scalar potential. The coupling between the \textbf{A} and ϕ formulations is key for this approach and is detailed in the text. The case studies are a single 2G HTS tape and a CORC^{\textregistered}˜cable. The formulations are compared in terms of AC losses, the distributions of magnetic flux densities, and current densities. The validation is carried out using experimental data of AC losses. The results are in good agreement. The key parameter for achieving high accuracy is the boundary mesh between the \textbf{A} and ϕ domains.

Topic

Innovative methods and tools for modelling large-scale HTS systems

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