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Sat-Mo-Po.09-09: Advanced 3D Modeling of AC Losses in Superconducting Magnetic Energy Storage Systems for Maritime Applications

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The POSEIDON project, funded by the European Union, seeks to develop an HTS Superconducting Magnetic Energy Storage (SMES) systems for maritime applications. A key challenge in this endeavor is the accurate modeling of AC losses, which represent a major heat load on the cryogenic system and critically influence system optimization. This study presents a novel numerical model based on the integral form of Maxwell's equations to address this issue. The proposed method facilitates the analysis of three-dimensional geometries while significantly reducing computational demands compared to traditional finite element H-formulation approaches. The study is structured into three parts: first, the numerical methodology is introduced and validated against conventional modeling techniques, comparing accuracy and computational efficiency. Second, the experimental methodology, employing a calorimetric approach, is described in detail. Finally, the numerical results are compared with experimental data, followed by a discussion of future directions and implications for modeling superconducting electrical machines.

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