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Wed-Af-Po.07-05: A semi-analytical stress analysis method for interturn separation in dry-wound electromagnetic coil

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The finite element analysis method is a commonly used and accurate approach for calculating the stress in electromagnetic coils. However, for dry-wound coils with nonlinear contact behavior, especially those with many turns, these methods are often time-consuming and may have convergence issues. Therefore, this study proposes a semi-analytical stress analysis method specifically designed to address the separation of turns in dry-wound electromagnetic coils. Primarily, we derive an integral expression for the electromagnetic stress within the continuous integral electromagnetic coil. Secondly, we employ the concept of average displacement to identify the separation and contact phenomena, thus determining different boundary conditions. Finally, by iteratively solving for these boundary conditions, we obtain the ultimate stress distribution. We compare these computed results with finite element methods to validate the accuracy of our approach. What sets this method apart is its ability to achieve accurate results without the need for establishing many contact pairs, resulting in significant computational resource savings. This method holds great significance for iterative design searches and optimization in dry-wound electromagnetic coil applications.

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