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Reactor Vibration Reduction Using Global Topology Optimization Algorithms

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Abstract: The segmented core reactor is small in size and low in cost. It not only has good electromagnetic compatibility, but also has a larger inductance value due to the multi-section air gap structure. However, under the interaction of electromagnetic force and magnetostriction at the air gap, the reactor core is deformed, causing vibration and generating louder noise than other ordinary reactors. An optimization method based on topology optimization and genetic algorithm is proposed in this paper to reduce the segmented core reactor's vibration during operation. In this method, a novel reactor design is obtained using topology optimization, besides the inductance value is ensured. Firstly, the electromagnetic-mechanical coupling model of the reactor is established to analyze the vibration and deformation of the reactor. Secondly, topology optimization is performed to make strain energy reach the minimum, now the deformation of the reactor core is minimized to realize the optimal design of noise reduction and vibration reduction of the reactor. Thirdly, since the change of the air gap structure will affect the inductance value, the genetic algorithm is combined to keep the inductance value of the reactor. Finally, the finite element numerical method is used to calculate the optimized parameter values before and after the optimization. The results show that the deformation of the air gap and the vibration acceleration of the reactor has been significantly reduced, which provide theoretical support for the design of lower noise reactor.
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Keywords: reactor; electromagnetic-mechanical coupled model; electromagnetic vibration; topology optimization

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