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Thu-Af-Po.03-07: Design and Analysis of a 10 kW-Class Axial-Flux Permanent Magnet Motor for Electric Propulsion Systems

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Axial-flux permanent magnet (AFPM) motors have gained significant attention in industries such as electric vehicles and ships due to their compact size, high torque density, and superior efficiency. While various AFPM designs have been proposed, this study focuses on the yokeless and concentrated armature structure, which offers unique advantages by eliminating the stator yoke. This reduces motor weight, thereby enhancing torque density, and decreases iron losses to improve overall efficiency. In this research, an AFPM motor was designed and optimized to achieve an output of 10 kW or more. The motor employs a single-stator dual-rotor configuration with permanent magnets mounted on both rotor surfaces, reducing magnetic flux leakage. To further enhance performance, the stator was designed with a soft magnetic composite (SMC) core, while the rotor utilized solid magnetic materials to achieve a balance between weight and magnetic properties. An optimization approach using 3D finite element analysis (FEA) was applied to refine the motor design. The optimized motor demonstrated higher efficiency and lower losses compared to the initial design, all while maintaining the target output of 10 kW. This study shows the potential of AFPM motors not only in compact electric vehicles but also as a scalable solution for high-efficiency propulsion systems.

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