A Hands on Investigation Prototyping, Testing, and Iterating Axial Flux Motors for Wide-spread Industry Adoption.

Abstract:

This research investigates the feasibility of axial flux (AXF) motors in the maritime and automotive industries. Through both literature review and iterative prototyping & testing, this study evaluates the performance advantages, manufacturing difficulties, and material constraints of AXF motors.

Throughout the study a series of prototypes were constructed progressing from an initial 3D printed coreless design to an advanced configuration using composites materials, silicon steel laminations and N52 grade neodymium magnets. For experimental testing and data collection a Vedder electronic speed controller (VESC) ran the motor. In addition a series of scopes including a 4-channel independent ground and a 2-channel universal ground oscilloscope were used to determine the prototype's efficiency as well as the voltage/rpm (KV) and current/Nm (KI) coefficients. These tests conducted on the final prototype yielded a KV measurement of 112, a relatively low coefficient reflecting the high-tourque nature of AXF motors, demonstrating their expected characteristics.

While AXF motors have obvious advantages over the more conventional radial flux motor, high torque density, greater compactness, and enhanced efficiency, the study points out several key obstacles in their wide-spread adoption into industry: complex manufacturing processes required for the construction of their stators, the high stresses undergone by the rotors, and their reliance on rare earth metals such as neodymium for high strength magnets. The findings of this study suggest that they prove to be an attractive alternative to the conventional radial flux motors widely but before their widespread adoption large innovations to their manufacturing methods and material sourcing will be a necessity.