The Electromagnetic Transmission

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Turbofan engines suffer efficiency losses from an optimal speed disparity between fan and core components; geared turbofans (GTFs) address this via mechanical gearboxes but introduce friction and maintenance complexity. This research involved the axial-flux electromagnetic generator and transmission (AFEMGT), a novel contactless device integrating magnetic power with electrical generation for aerospace propulsion systems. The AFEMGT resolves these engineering challenges through a robust electromagnetic mechanism enabling simultaneous speed reduction and power generation in the field of electronic and electrical engineering with no prior precedent. A 1:10 scale prototype with Halbach arrays and laminated silicon steel material serving dual roles flux channels and stator cores, was constructed and tested across six input speeds. Results demonstrated 95.7% system efficiency (79.6% mechanical, 16.1% electrical output), torque density of 18.1 Nm/kg, and precision gear ratio of 3.51:1 (±0.02). Thermal losses averaged 1.7% with low temperature rise, validating inherent reliability and sustainability advantages over alternatives. Scale projections indicated 19.2 MW power transfer capability with 2.4 MW electrical generation, satisfying commercial turbofan requirements. The system eliminates the technical need for lubrication, reduces environmental emissions and vibration, and provides passive overload protection for future generations. The interdisciplinary integration of electromagnetic, mechanical, and systems engineering principles extends to renewables, marine propulsion, and the automotive industry. This work advances fundamental aircraft design with a unique methodology to deliver transformative technological innovation with measurable impact on energy efficiency.

Awards Won:

Fourth Award of $600