

Design of an Efficient, Lightweight Flying Capacitor Multilevel Converter for Electrified Flight

Motivation and Application

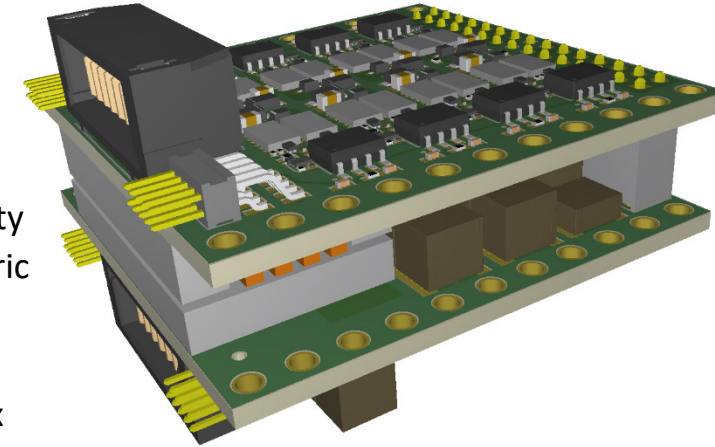


- Air travel accounts for ~200 million tons of CO₂ emissions annually (3% of US greenhouse gas emissions)^[1]
- Air travel demand is expected to double every fifteen years
- Electrification of flight requires efficient, lightweight, and reliable power conversion
- Hardware must be flight qualified

Pictured: Ampaire Electric EEL flight

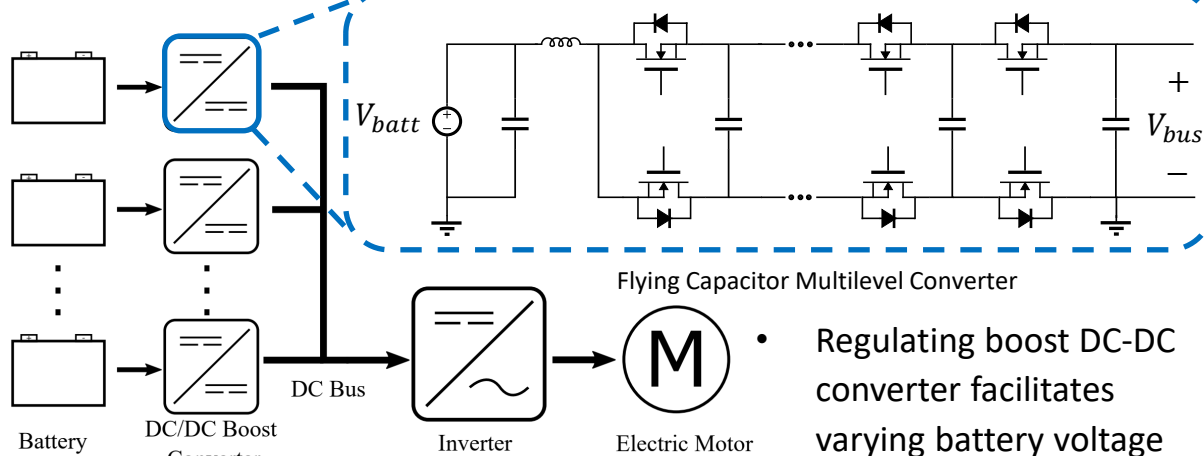
Hardware Prototype

- Snubbers enable decreased overlap loss without sacrificing conduction path
- Paralleled switches enable increased areal power density
- Derated energy density metric used to optimize flying capacitor part/count
- Custom inductor achieves 3x mass reduction



3D rendering of 8-level boost FCML prototype

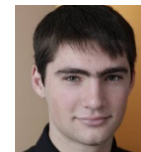
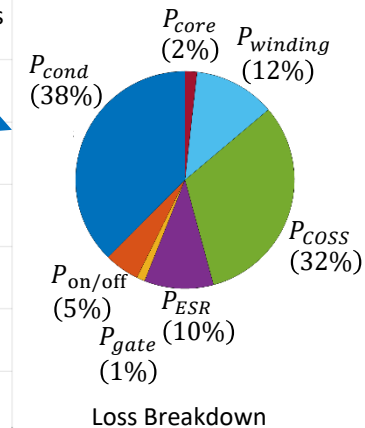
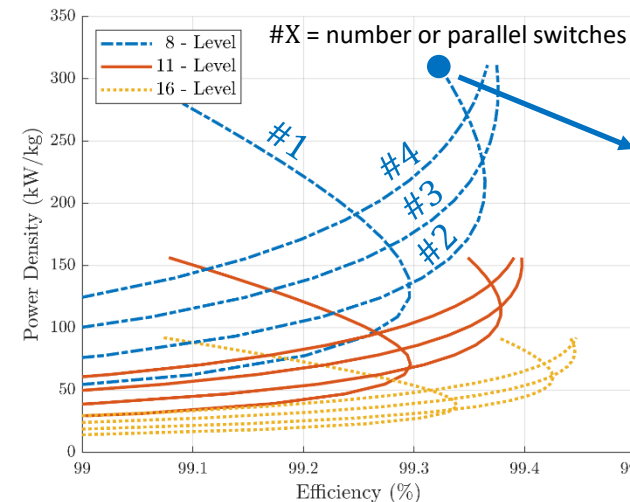
Proposed Solution



Electric Aircraft Drivetrain Architecture

Regulating boost DC-DC converter facilitates varying battery voltage and inverter load demand

Modeled Performance



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[1] <https://www.epa.gov/greenvehicles/fast-facts-transportation-greenhouse-gas-emissions>