# Multi-Objective Design Optimization of Electric Propulsion Drive Systems for Aviation

## SPEAKERS


**JiangBiao He**
*Associate Professor*
*University of Kentucky*

**Benjamin Luckett**
*Ph.D. Candidate*
*University of Kentucky*


## ABSTRACT


Driven by the global motivation to achieve zero-emission transportation, the mobility sector has been experiencing a rapid revolution of electrification. Unfortunately, the mature technologies used in the present electrification of ground vehicles and ships cannot be directly applied when tackling the distinct set of challenges posed by the working environment of an aircraft, which is characterized by high altitude, severe operating conditions, and complicated mission profiles. When designing an electric propulsion system which will be subjected to these harsh circumstances, reliability must heavily influence all decisions. But simultaneously, the drivetrain needs to be lightweight, compact, efficient, and cost effective as well. These various objectives typically prove to be impossible to satisfy concurrently, and therefore trade-offs need to be established in order to extract the highest overall system performance. The degree of importance placed upon each objective and the resulting compromises can be troublesome to explicitly quantify when designing a single system, but a Pareto front of many candidate power converters can be established without these constraints. The most optimal design for a specific application can then be chosen from this qualified set.

This tutorial focuses on multi-objective design optimization of electric propulsion drive systems for hybrid and electric aircraft. The discussed approach employs a genetic algorithm which generates many high performing designs that exhibit optimal trade-offs between competing objectives, such as reliability and specific power. Computationally efficient time-based electro-thermal simulations of multiple converter topologies, which forms the backbone of the framework, will be discussed. Also, the sizing and selection of all system elements realized though off-the-shelf components will be examined. Finally, a software package has been developed which encapsulates the described framework, and its functionality will be showcased throughout the tutorial.


## About The Speakers:

**JiangBiao He:**
JiangBiao He is an Associate Professor and the endowed Pigman Faculty Fellow in the Department of Electrical and Computer Engineering at the University of Kentucky (UK). Before joined academia, he worked in multiple large industry R&D centers, most recently as a Lead Engineer at GE Global Research in Niskayuna, New York. Prior to joining GE in 2015, Dr. He was employed with Rockwell Automation and Eaton Corporate Research working on advanced motor drives and power converters. He obtained his Ph.D. in Electrical Engineering from Marquette University, Wisconsin.

Dr. He's research interests have been focusing on high-performance motor-drive systems and power electronic converters, mainly for transportation electrifications and grid applications. At GE, he led the execution of the first megawatt-scale medium-voltage high-speed propulsion demonstration for hybrid-electric aircraft in the global aviation area, which won the GE Whitney Technical Excellence Award (highest recognition for breakthrough technology innovation at GE-GRC). He is the author/coauthor of around 150 peer-reviewed technical articles, one textbook, and 10 U.S. patents.

Benjamin Luckett:
Benjamin Luckett graduated from the University of Kentucky in 2020 with bachelor's degrees in Electrical and Computer Engineering. He is now pursuing his PhD in Electrical Engineering at the University of Kentucky. His research interests include the modeling and optimization of power conversion systems for transportation, and specifically aviation, applications.

ITEC2024