# Power-Dense and Non-Synchronous Electric Motors

Tech ID: 33180 / UC Case 2022-838-0

## BACKGROUND

Many industries in the 21st century are aiming to decarbonize emissions from power generation and use. This has stimulated interest in new and efficient designs of electric motors to help society transition from combustion-based systems. An all electric power train with a high-power-density could be a suitable replacement for incumbent propulsion technologies such as aviation. The attention on high-power-density motors has researchers focused on motor topologies with low weight and high efficiency. Existing electric motor systems suffer from relatively low power densities owing to iron cores and copper/aluminum wire. The introduction of high-temperature superconducting (HTS) technology has helped to raise the current density of the motor's wires. To date, however, HTS-based topologies have been synchronous designs with rotating windings that require expensive, heavy cooling system architecture.

## TECHNOLOGY DESCRIPTION

To help address these issues in all-electric powertrains, UCSC, in collaboration with the Air Force Research Laboratory, has focused on several non-synchronous topologies to improve torque density, power-to-weight ratio, and efficiency. UCSC research has reported on a new design topology of a doublerotor flux-switching motor leveraging high temperature superconducting coils and air-core stator. To date, the UCSC research team has achieved a maximum power density of >30 kW/kg which is accomplished by a 16pole/12slot motor geometry, and the efficiency under take-off and cruise conditions was found to be on average >93%.

## APPLICATIONS

- Aircraft propulsion

## ADVANTAGES

- demonstrated power density of >30 kW/kg to date
- >93% average efficiency under take-off and cruise conditions
- simpler and lighter cooling system as compared to synchronous machines

## INTELLECTUAL PROPERTY INFORMATION

| Country | Type | Number | Dated | Case |
|---|---|---|---|---|
| Patent Cooperation Treaty | Published Application | WO 2023/225478 | 11/23/2023 | 2022-838 |

## RELATED MATERIALS

- Saeidabadi, Saeid, et al. "A Double Rotor Flux Switching Machine with HTS Field Coils for All Electric Aircraft Applications." IEEE Transactions on Applied Superconductivity (2023) - 04/21/2023
- Saeidabadi, Saeid, et al. "Flux Switching Machines-for All-Electric Aircraft Applications." 2022 International Conference on Electrical Machines (ICEM). IEEE, 2022 - 09/05/2022

## CONTACT

Marc Oettinger
marc.oettinger@ucsc.edu
tel: 831-502-0253.



## OTHER INFORMATION

**CATEGORIZED AS**

- **Engineering**
  - Engineering
- **Transportation**
  - Alternative Propulsion

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