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Dual Rotor Homopolar AC Machine (DHAM)

Dual-rotor homopolar AC machine delivers high torque density without rare earths, enabling efficient EVs and storage systems.

Researchers at Purdue University have developed dual rotor homopolar alternating current machines (DHAMs) that can operate either as a motor or a generator. To date, permanent magnet alternating current (PMAC) machines have been the dominant source of motors in the car market or other markets that use power dense AC machines. However, these machines typically utilize rare earth materials for their construction and are expensive to manufacture. Non-rare earth PM machines have been realized; however, they suffer from lower power densities. The Purdue researchers' DHAMs can be constructed without rare-earth materials while meeting the torque requirements of the vehicular market. The magnets in the researchers' DHAMs need not be constructed from rare earth materials due to the superior cooling qualities of their machines. The researchers disclose 6 different forms of DHAMs, each of which has a novel dual rotor topology, DC flux source in the form of stationary or rotating permanent magnets or a field winding, and a segmented stator. The DHAM utilizes both radial and axial flux paths. Stationary magnets or field winding facilitate cooling and electric connections to the field and eliminate mechanical stresses in high-speed machines. The rotors themselves are nominally lossless, which also facilitates high-speed applications. The segmented nature of the stator facilitates manufacturing, leads to a high packing factor, and facilitates the construction of large machines. The researchers' DHAMs also have a wide constant power speed range, making them ideal for applications such as motors for flywheel energy storage systems or electric vehicles.

Technology Validation: One of the researchers' disclosed DHAMs can generate a projected power density of about 32 kW/L at about 91% efficiency (inverter losses included).

Advantages:

- Does not require construction with rare earth materials

- Meets torque requirements of the vehicular market

Technology ID

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Category

Energy & Power Systems/Energy Storage

Semiconductors/Devices & Components

Automotive & Mobility

Tech/Micromobility & Smart Urban Infrastructure

Further information

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- Capable of high-speed operation

- High manufacturability

- Wide constant power speed range

Applications:

- Motors for hybrid, plug-in hybrid, and electric vehicles

- Motor-generators for energy storage systems

TRL: 3

Intellectual Property:

Provisional-Gov. Funding, 2020-11-04, United States

Utility-Gov. Funding, 2021-10-30, United States

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