



# Open-End Winding Electric Drives with Zero-sequence current Cancellation

**Open-end winding drive cancels zero-sequence current magnetically, simplifying control and raising motor torque by >15%.**

Researchers at Purdue University have developed a novel motor-winding configuration that solves a persistent problem in the design of electric vehicle (EV) motors. Open-end winding motors, in which both ends of the stator windings are accessible instead of being connected internally, are getting more attention in EVs and electric aircraft drive applications for the many advantages they provide. In particular, they are attractive for their ability to provide higher torque density without significant modification to the existing electric motor design. However, conventional open-end winding motors suffer from circulation non-torque producing zero-sequence current, which limits the output torque to 85% of the maximum achievable torque. This unique design eliminates this problem, using magnetism to enable a more than 15% increase in total output torque. It also simplifies the modulation techniques to further improve the efficiency and reliability of the system.

**Technology Validation:** Two-level open-end winding (OEW) electric drive motors were computationally tested against NPL.H three-level OEW motors. The NPL.H motor produced lower CMV (zero-sequence voltage) leading to reduced zero-sequence current compared to the 2-level inverter-based OEW. These results were used to validate the design of the proposed OEW motor, which successfully cancels out the zero-sequence current, eliminating the circulation current. This will enable more than 15% increase in total output torque improving system torque density.

## Advantages:

- Cancels out the circulating current magnetically
- Eliminates complicated modulation technique
- Easily installed

## Technology ID

2025-LEE-70888

## Category

Aerospace & National  
Security/Hypersonics &  
Propulsion Systems  
Semiconductors/Devices &  
Components  
Automotive & Mobility  
Tech/Micromobility & Smart  
Urban Infrastructure

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- Maximizes output torque
- Reduces common-mode electromagnetic interference noise

**Applications:**

- Electric vehicles (EV)
- Electric aircraft industry

**TRL:** 3

**Intellectual Property:**

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**Keywords:** electric aircraft propulsion system, Electric vehicle drive, open-end winding motor, zero-sequence cancellation