New Rotor Magnet Configuration Delivers Greater Efficiency at a Lower Price

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WARF: P150363US01

Inventors: Thomas Lipo, Zhentao Du

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a newer and more efficient magnet configuration for electric rotors.

Overview

Permanent magnet machines (PMs) are common in electric and hybrid vehicles, renewable energy and other industrial applications. These utilize permanent magnets made from rare earth materials (such as neodymium and dysprosium) instead of coils as part of synchronous generators. Interior permanent magnet machines (IPMMs) specifically contain these magnets embedded in the rotor for improved performance.

Unfortunately, rare earth magnets are costly and in limited supply. Traditional rectangular designs for IPMM rotors also suffer from pulsating torque, which causes structural vibration, acoustic noise, diminished machine performance and damage to drive components.

The Invention

UW–Madison researchers have developed a streamlined sinusoidal rotor magnet design for interior permanent magnet machines.

By altering the classic rectangular block design for embedded magnet stacks in favor of a sinusoidal, axially varied orientation, researchers have increased the efficiency of rotors in IPMMs in a twofold fashion: Not only does this new design reduce the amount of magnet material necessary for rotor production, but it also provides an optimized distribution of flux that significantly reduces torque pulsation and spatial harmonics. The new design is easy to manufacture and is complementary to rotors already in existence.

Applications

- Hybrid and electric motor vehicles
- Industrial electromagnetics and automation

Key Benefits

- Minimizes use of permanent magnet material
- Curtails costs associated with rare earth elements
- Reduces torque pulsation and subsequent vibration-related damage
- Simple to manufacture

Stage of Development

Modeling and simulations demonstrate a significant reduction in torque pulsation as compared to a 2007 Toyota Camry hybrid motor. The inventors are ready to build a prototype for testing and are searching for relevant industrial partners.

Additional Information

For More Information About the Inventors

- Thomas Lipo

Related Technologies

- WARF reference number P02287US describes a permanent magnet machine with high efficiency, high torque density and inexpensive materials.
- P130317US01 illustrates another iteration of more efficient and reduced use of rare earth permanent magnet materials as intended in vernier motor design.

Publications

- Du Z. S. and Lipo T. A. 2015. IEEE Energy Conversion Congress and Exposition. 1773-1780.
- Zhao W. and Lipo T. A. 2014. IEEE Transactions on Industrial Electronics. 61, 5779-5787

Tech Fields

- Engineering : Electric machines
- Engineering : Engine technologies

For current licensing status, please contact Michael Carey at mcarey@warf.org or 608-960-9867