

Title

Topology Optimization for Practical Design of Interior Permanent Magnet Synchronous Motor (IPMSM) for Electrified Vehicles

Description

In recent years, electrified vehicles such as battery electric vehicles, plug in-hybrid electric vehicles, fuel cell electric vehicles and hybrid electric vehicles have attracted much attention due to an urgent need to reduce CO₂ emissions from transportation and energy dependency on crude oil. Honda has set a target achieving two-thirds of its total global sales to be electrified by 2030. Traction motor is one of the essential components for the electrified vehicles and, IPMSMs are commonly used for the traction motors due to their high torque density, high power density, high efficiency and ease of use. The design of rotors which consist of magnets and electrical steel sheets is important for IPMSMs since not only torque, efficiency and quietness but also cost depend on it.

Honda has developed a novel method combining topology optimization and parametric optimization for practical design of rotor in collaboration with the research group of Prof. Igarashi at Hokkaido University. In the proposed method, first, the shape and position of the magnets are determined parametrically under manufacturing constraints. Then the shape of the electrical steel sheet is determined non-parametrically using the Normalized Gaussian Network (NGnet) method with respect to the remaining space of the rotor. Since rotors used in electrified vehicle are rotated at a very high speed, the rotor has to be designed considering not only magnetic but also mechanical characteristics. Therefore, mechanical simulation is coupled with the optimization method to optimize magnetic performance while limiting maximum stress and displacement. In the presentation, optimization results applied to rotors of traction motors for electrified vehicles will be described.

Presenter

Makoto Ohtani

Bio

Dr. Makoto Ohtani received a PhD in Physics in 2004 from Tohoku University, Japan. He spent the year 2004 as a postdoctoral researcher at Kanagawa Academy of Science and Technology, Japan. From 2005 to 2008, he was a guest researcher at National Institute of Standards and Technology, USA. From 2008, he joined Honda R&D Co., Ltd., Automobile center. Now he is assistant chief engineer and works on topology optimization of various automotive parts.

