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Three-dimensional finite element simulation of electromagnetic analysis of a variable electromotive-force generator

Analytical and experimental analysis of a variable electromotive-force generator (VEG) with a variable overlap between the rotor and the stator shows its advantages in hybrid electric vehicle and wind turbine applications with an enhanced fuel efficiency and expanded operational range, respectively. In this study, electromagnetic analysis of a modified two-pole DC generator with an adjustable overlap between the rotor and the stator is studied using three-dimensional finite element software ANSYS. The generator stator is modeled with two opposite pole pieces whose arcs span between 15^0 and 90^0 in the counterclockwise direction and between -15^0 and -90^0 in the clockwise direction. A semicircular cross-section cylinder is used to model the generator rotor. A tetrahedral mesh is used to provide a solution for changes in the electromotive force at different frequencies and overlap ratios. For a constant electromagnetic flux density and a fixed number of coils, the changes in the electromotive force at different overlap ratios between the rotor and the stator are obtained in static and transient conditions; the two main components of the total magnetic loss in an electric machine, the eddy current loss, and the hysteresis loss are found. There is a very good correlation between the results from the finite element simulation and those from analytical and experimental studies.

Biography

Weidong Zhu is a Professor in the Department of Mechanical Engineering at the University of Maryland, Baltimore County, and the founder and director of its Dynamic Systems and Vibrations Laboratory and the Laser Vibrometry Laboratory. He received his double major BS degree in Mechanical Engineering and Computational Science from Shanghai Jiao Tong University in 1986, and his MS and PhD degrees in Mechanical Engineering from Arizona State University and the University of California at Berkeley in 1988 and 1994, respectively. He is a recipient of the 2003 National Science Foundation CAREER Award, the 2007 American Society for Nondestructive Testing Fellowship Award, the 2008 Chang Jiang Scholar Chair Professorship in General Mechanics from the Ministry of Education of China, and the 2009 Daily Record's Maryland Innovator of the Year Award. He is a Fellow of ASME and an Associate Editor of the ASME Journal of Vibration and Acoustics. His research spans the fields of dynamics, vibration, control, applied mechanics, structural health monitoring, and wind energy, and involves analytical development, numerical simulation, experimental validation, and industrial application.

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