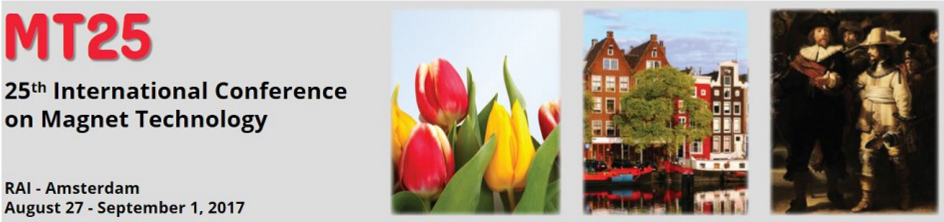

Contribution ID: **644** Type: **Poster Presentation of 1h45m**

Research on Temperature Rise and Temperature Control for Giant Magnetostrictive Transducer

Tuesday 29 August 2017 13:15 (1h 45m)

Terfenol-D has giant energy density (25kJ/m3) and relatively high thermal conductivity (13.5w/ (m•k) at 20℃). It is the core component of giant magnetostrictive transducer (GMT) which has been widely used in the field of ultra-precision machining and precision fluid control technology. However, when GMT operates under 6000Hz high frequency magnetic field, hysteresis loss, eddy current loss and copper loss of excitation coil lead to serious temperature rise. The temperature of Terfenol-D rod can reach above 120℃ without a cooling device. The temperature rise of Terfenol-D rod seriously affects the precision of GMT. So, it is necessary for GMT to analyze temperature rise and temperature control under high frequency. This paper includes two parts: (1) Based on the theory of Jiles-Atherton model, Maxwell's equations, Newton's law and Fourier's heat transfer equation, a nonlinear electromagnetic-mechanical-thermal multi-field coupled finite element model for GMT is established. The temperature rise characteristics and output responses of GMT are analyzed. (2) Based on the convection heat transfer theory and the thermal compensation method, a new combined temperature control device is presented. It consists of two main structures which are servo valves for compulsive oil-cooling and thermal compensation mechanism of nonmagnetic stainless steel. According to the theoretical and experimental researches, when the velocity of the fluid is greater than 0.5m/s, the temperatures of Terfenol-D rod can be controlled within 21.7℃ under the excitation field of 6000 Hz. The temperature error can be limited below 0.5℃, and the axial output displacement error by temperature rise can be controlled less than 0.65 μm. These studies can effectively guide the design and application of GMT under high frequency magnetic field.

Submitters Country

China

Author: Dr LI, Yafang (Key Laboratory of Electro-Magnetic Field and Electrical Apparatus Reliability of Hebei Province, Hebei University of Technology, China)

Co-authors: Prof. WANG, Bowen (Key Laboratory of Electro-Magnetic Field and Electrical Apparatus Reliability of Hebei Province); Prof. HUANG, Wenmei (Key Laboratory of Electro-Magnetic Field and Electrical Apparatus Reliability of Hebei Province); YAN, Rongge (Hebei University of Technology)

Presenter: Prof. HUANG, Wenmei (Key Laboratory of Electro-Magnetic Field and Electrical Apparatus Reliability of Hebei Province)

Session Classification: Tue-Af-Po2.10

Track Classification: G7 - Multi-Physics Design and Analysis