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Abstract

A computationally efficient nonlinear constitutive model is developed for magnetostrictive materials using energy minimisation and discrete-energy averaging techniques. Computational time was considerably reduced through a local linearization of the material response and subsequent calculation of magnetic moment orientations. Application of this model towards the transducer design is illustrated by integrating it with FEM package (COMSOL Multiphysics®) through the LiveLink™ for MATLAB® to obtain the response of Galfenol rod actuator under influence of current density. This paper presents the magnetic and mechanical response of Galfenol subjected to elastic stresses and magnetic fields applied using the current-carrying coil. The transducer consists of current carrying coil solenoid, air domain and Galfenol rod. The analysis is performed for 2D axial symmetric case due to symmetric nature of transducer. Since 2D analysis requires less computational memory as compared to 3D analysis, this makes the model be more computationally efficient. Magnetic BVP are solved using the 2D axial symmetric Magnetostatics analysis in COMSOL Multiphysics® by considering both anhysteretic and hysteretic behavior of Galfenol to obtain the actuator characteristics i.e B-H and Strain-H.

Figures used in the abstract

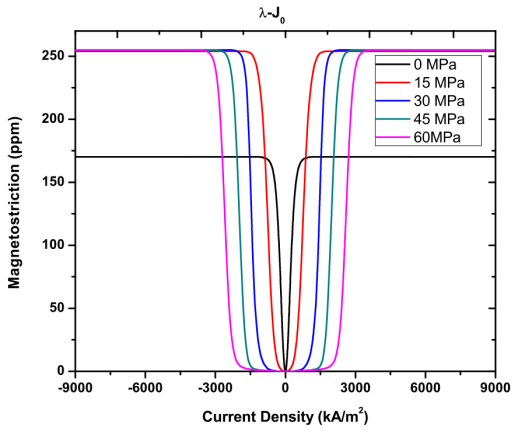

Figure 1: Simulation Magnetostriction vs Magnetic Field results at various pre-stress values.