Identification of a Magnetostrictive Material Model

Ielizaveta Kholmetska, Jan Chleboun
Czech Technical University in Prague, Faculty of Civil Engineering
ielizaveta.kholmetska@fsv.cvut.cz, chleboun@mat.fsv.cvut.cz

Pavel Krejčí
Institute of Mathematics of the Academy of Sciences of the Czech Republic;
Czech Technical University in Prague, Faculty of Civil Engineering
krejci@math.cas.cz

Abstract

The project focuses on modeling magnetostrictive materials. It is motivated by real-world phenomena and applications; take, for example, magnetostrictive energy harvesters or vibration sensors. There are mathematical models proposed by experts in this field. Like in [2], we focus on the identification of model parameters and on the comparison of the model response with the experimental data. We have received data of measurements of a galfenol specimen that were used in [2]. In galfenol, however, the hysteresis phenomenon is demonstrated only weakly. As a consequence, a simpler model without hysteresis has been proposed in the current research. Since the galfenol hysteresis loops are narrow, they are included into a measurement error. A new, simpler model has been identified from the measured magnetic and magnetostrictive cycles at different constant stresses. Although the model behavior has corresponded to observed data rather satisfactorily, it has turned out that some measured phenomena cannot be explained by the model. This drawback is especially pronounced in the magnetostrictive response under large mechanical stress. To improve the model response, a new model has been proposed. It lacks hysteresis, too, but includes a feedback based on the current level of magnetization observed in a galfenol specimen in a magnetic field. The identification of the parameters of the feedback model is the subject of the presentation.

References

1. D. Davino and P. Krejčí and A. Pimenov and D. Rachinskii and C. Visone. Analysis of an operator-differential model for magnetostrictive energy harvesting. Submitted to Communications in Nonlinear Science and Numerical Simulation.
2. D. Davino and P. Krejčí and C. Visone. Fully coupled modeling of magneto-mechanical hysteresis through ‘thermodynamic’ compatibility. Smart Materials and Structures 22 (2013), 095009 (14 pp).