Modeling, Simulation and Control of Dual Electromagnet Active Magnetic Levitation

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Introduction: With this research the Virtual Prototype of the dual electromagnet Active Magnetic Levitation System was realized. The mixed mode of Partial Differential and Ordinary Differential Equations is used to realize the levitated object motion.

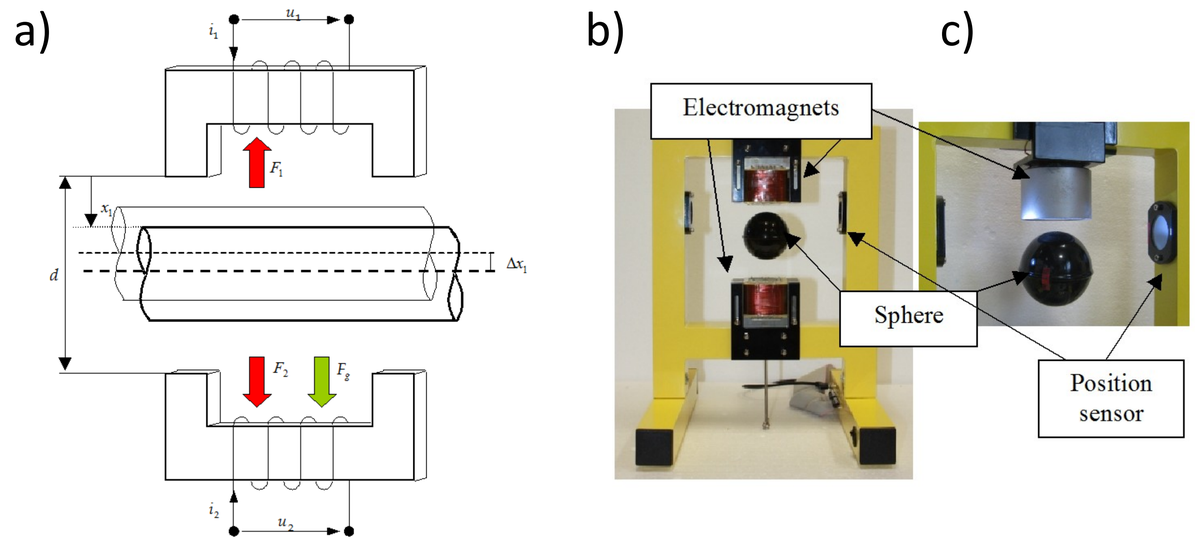

Figure 1. Dual electromagnet Active Magnetic Levitation: a) Idea of operation; b) MLS2EM (www.inteco.com.pl); c) modified version with cylindrical electromagnet

Computational Methods: To obtain a complete dynamical model solved in time-domain the synergy of the following components was applied: electromagnetic force calculation using magnetic field physics interface, dynamic motion equation, controller formula, control and state constraints.

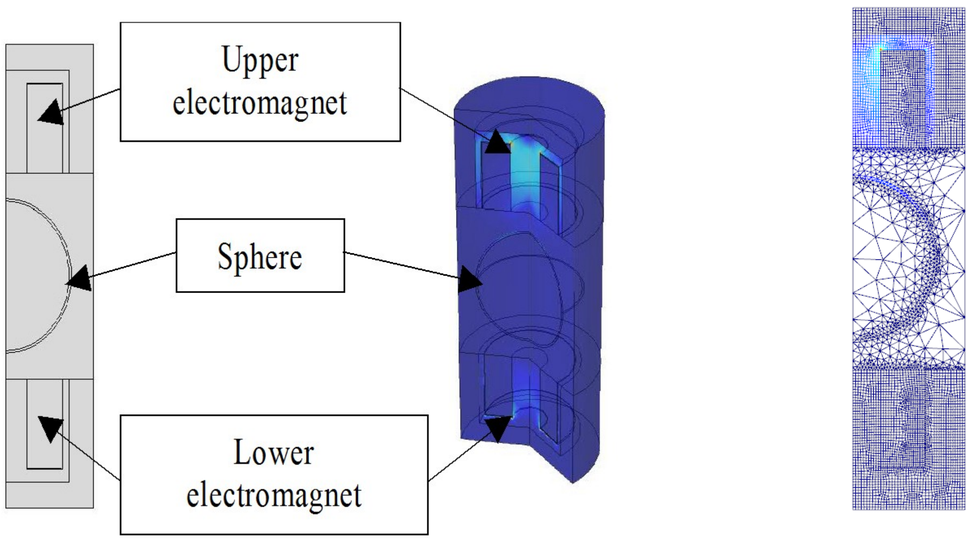

Figure 2. Dual electromagnet AML model

Results: The object levitation was realized in two scenarios: a) in the gravity field with external excitation force generated by the lower electromagnet (Fig. 3), b) without the gravity field in the differential control mode (Fig. 4).

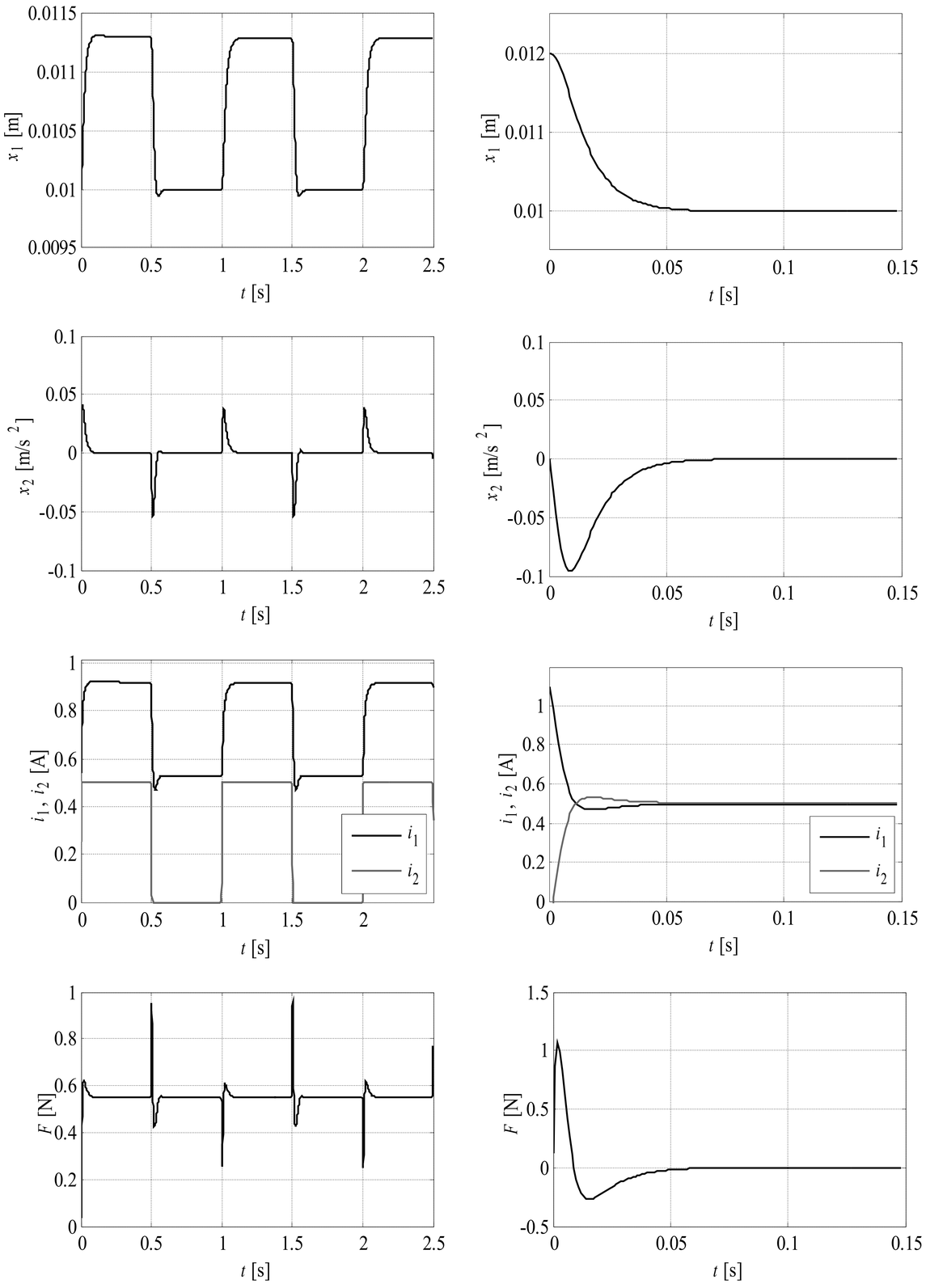

Figure 3. Levitation at external excitation

Figure 4. Levitation in the differential control mode

Conclusions: The prototyping supported by COMSOL Multiphysics allows to proof the concept and to obtain a fully functioning model. The dynamical model with the embedded controller provides a basis for further control research.

References:

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