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Mathematical model of a single-dimension multi-parameter oscillator based on a three-phase core-less linear motor

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Abstract: This paper uses the example of a three-phase core-less linear motor to create a mathematical model of single-dimension multi-parameter oscillator. The oscillator is composed of an U-shaped stationary guide-way with permanent magnets corresponding to the motor's stator, and a movable set of coils subjected to the alternating electrical voltage (equivalent of motor's forcer). The system's parameters are either mechanical (number of magnets and coils, size of the magnets, distances between magnets, size and shape of the coils) or electromagnetic (auxiliary magnetic field and permeability). A voltage applied to each of the coils serves as the external excitation while displacement of the coils is the output parameter. Faraday's law of induction and Lorentz force yield base laws for creating the model and a Gaussian function of distance is used to determine the value of auxiliary magnetic field. The solution to the introduced mathematical model of the studied mechatronic system (consisting of the partial differential and integral equations) have been compared with the experimental results showing a good coincidence.

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