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Mathematical model and a prototype of a linear motor controlled by a periodic magnetic field

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Abstract: A mathematical model and a prototype of a linear motor in which the rod moves progressively are presented. The motion of the rod occurs due to the periodic motion of cylinders with electric coils integrated in them. The net displacement of the cylinders for a period is equal to zero. The periodic motion of the cylinders is caused by the force generated by a periodic magnetic field (the magnetic field periodically switches on and off). The space between the rod and the cylinders is filled in with a magnetorheological fluid. The viscosity of the magnetorheological fluid (and, hence, friction) at constant temperature depends on the magnitude of the magnetic field and the concentration of the particles and changes as the magnetic field changes. This provides an asymmetry of the friction for forward and backward motions, which enables the forward net displacement of the rod for the period. A mathematical model of such a motion is presented. An expression for the average velocity of the motion of the rod is obtained for the case where the force of friction is assumed to be small in comparison of the motive force. The value of the average velocity is studied as a function of the excitation parameters and the properties of the magnetorheological fluid. On the basis of the theoretical principles outlined above, a prototype of the linear motor was created.

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