Abstracts

Basic examination on elastic vibration control of an electromagnetic levitation system for thin steel plate

by

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Abstract

A method involving the application of electromagnetic technology is under consideration for improving the surface quality of conveyed steel plates. However, these studies have been conducted using experience-based techniques for the tuning of the controller such as the optimal control theory. The sliding mode control theory can solve this problem in the levitation mode of the steel plates. In this study, we aim to develop a noncontact support system for thin steel plates with high robustness using sliding mode control, which is tolerant to factors such as disturbance with respect to control signals and the external force of the system. We applied the 1DOF model and a continuous model for the modeling of sheet steel. Then, experiments were carried out under several conditions, and the obtained results were compared with the optimal control results. As a result, it was verified that the suppressive effect of the sliding mode control on disturbance is sufficient and the application of the continuous model enables the construction of a system with robustness to the disturbance of the external force.

Keywords: Steel plate, electromagnetic levitation, disturbance, elastic vibration, continuous model, optimal control, sliding mode control

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Vibration isolation control of electromagnetic levitation system for thin steel plate
(Basic research on rigid steel plate)

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Abstract

In thin steel plates used in many industrial products, flaws on the plate surface and peeling during a surface treatment process are induced due to the use of many rollers in the conveyance process. These lead to the deterioration of the quality of the plate surface. Electromagnetic levitation techniques can solve many problems in the conveyance modes of sheet steel. The authors have proposed a magnetic levitation control system for maintaining the relative distance of the plate surface and the electromagnet, and carried out an experiment on digital control. In this study, the equipment was designed so that electromagnets, which are used for the magnetic levitation of a steel plate, vibrate vertically. For basic research, a controlled object was assumed to be a single-degree-of-freedom model and PD control was used as the control method. The vibration isolation effect observed in the steel plate was confirmed by experimentation and simulation.

Keywords: Steel plate, electromagnetic levitation, vibration isolation, rigid body, PD control

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