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ANTI-SWAY CONTROL FOR OVERHEAD CRANES USING NEURAL NETWORKS

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Abstract. *This paper presents an anti-sway control for overhead cranes using neural networks. To reduce the sway of a load after positioning to the greatest extent possible, we construct a trajectory for the position of the trolley. Radial basis function networks (RBFNs) are employed to generate the desired trolley position. Thereafter, a particle swarm optimization (PSO) is used as a learning algorithm in which the maximum swing angle after positioning is adopted as the objective function to be optimized. By moving the trolley along the trajectory thus generated, the sway angle can be suppressed. The performance of the proposed anti-sway control is confirmed by numerical simulations. Furthermore, the realization and effectiveness of the present approach are verified by experiment.*
Keywords: Crane system, Anti-sway control, Radial basis function networks, Particle swarm optimization

1. **Introduction.** Cranes are extensively used as transport systems in many industrial fields. To improve both the efficiency and the safety of cranes, their sway motion must be suppressed. Therefore, the vibration problems of cranes have been widely investigated by many researchers. Abdel-Rahman et al. [1] published an exhaustive literature review of the modeling and control of cranes in which a number of papers on gantry, rotary and boom cranes were reviewed. Open-loop controllers, such as input shaping and optimal control techniques, and closed-loop controllers, such as linear control, adaptive control, fuzzy logic control and nonlinear control techniques, have been summarized in the literature. More recently, Konishi et al. [2] applied a model predictive control scheme to a container crane by taking into account disturbances, in which the crane system along with a discrete binary input was expressed by using a mixed logical dynamical system. An adaptive fuzzy sliding mode controller for the regulation and tracking control of a 3-D overhead crane was proposed by Chang et al. [3]. They also presented a fuzzy-based friction-compensating algorithm to minimize the positioning error.

Neural networks are used in various fields such as recognition, classification and prediction and they are also adopted for the control of dynamical systems. Neural controllers based on process inverse dynamics were presented by Psaltis et al. [4] and Hunt et al. [5]. Narendra and Parthasarathy [6] and Levin and Narendra [7,8] developed neuro-controls using back-propagation learning algorithms. Balakrishnan and Weil [9] conducted a comprehensive review of the literature dealing with the control of dynamical systems.

As for the application of neural network controllers to mechanical systems, Moreno et al. [10] and Méndez et al. [11] proposed neural-network-based, self-tuning controllers for