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Model-Based Control for Piezoelectric-Actuated Systems Using Inverse Prandtl-Ishlinskii Model and Particle Swarm Optimization

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Abstract : In this paper feedforward controller is designed to eliminate nonlinear hysteresis behaviors of a piezoelectric stack actuator (PSA) driven system. The control design is based on inverse Prandtl-Ishlinskii (P-I) hysteresis model identified using particle swarm optimization (PSO) technique. Based on the identified P-I model, both the inverse P-I hysteresis model and feedforward controller can be determined. Experimental results obtained using the inverse P-I feedforward control are compared with their counterparts using hysteresis estimates obtained from the identified Bouc-Wen model. Effectiveness of the proposed feedforward control scheme is demonstrated. To improve control performance feedback compensation using traditional PID scheme is adopted to integrate with the feedforward controller.

Keywords : the Bouc-Wen hysteresis model, particle swarm optimization, Prandtl-Ishlinskii model, automation engineering
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