Apply intelligent control to linear ultrasonic motor drive

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ABSTRACT

This thesis develops a Takagi-Sugeno-Kang-type self-organizing recurrent-neural-fuzzy network(T-SORNFN) for the trajectory tracking control of linear ultrasonic motor drive. Without a priori Knowledge, the T-SORNFN is constructed to model the inverse dynamics of a linear ultrasonic motor drive by a set of recurrent fuzzy rules built online through concurrent structure and parameter learning. The fuzzy rules in the T-SORNFN can be either generated or eliminated to obtain a suitable-sized network structure, and a recursive recurrent learning laws of network parameters are derived based on the supervised gradient descent method to achieve fast-learning converge. Based on the Lyapunov stability approach, the converge of the T-SORNFN is guaranteed by choosing varied learning rates. Further more ,an inverse-control architecture that incorporates T-SORNFN and a PD controller is used to control the linear ultrasonic motor drive in a changing environment. A recursive least-squares(RLS) algorithm is utilized for online fine-tuning the consequent parameters in T-SORNFN to obtain a more precision model. The experimental setup is comprised by a host PC, a servocontrol board, a ultrasonic motor driver and a linear ultrasonic motor. Simulated and experimental results of a linear ultrasonic motor are provided to verify the effectiveness of the proposed control system.

Keywords : Recurrent neural fuzzy network, Linear ultrasonic motor, Lyapunov stability ,Recursive least square.

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