Hybrid control of a pneumatic artificial muscle (PAM) robot arm using an inverse NARX fuzzy model

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Abstract: We investigated the possibility of applying a hybrid feed-forward inverse nonlinear autoregressive with exogenous input (NARX) fuzzy model-PID controller to a nonlinear pneumatic artificial muscle (PAM) robot arm to improve its joint angle position output performance. The proposed hybrid inverse NARX fuzzy-PID controller is implemented to control a PAM robot arm that is subjected to nonlinear systematic features and load variations in real time. First the inverse NARX fuzzy model is modeled and identified by a modified genetic algorithm (MGA) based on input/output training data gathered experimentally from the PAM system. Second the performance of the optimized inverse NARX fuzzy model is experimentally demonstrated in a novel hybrid inverse NARX fuzzy-PID position controller of the PAM robot arm. The results of these experiments demonstrate the feasibility and benefits of the proposed control approach compared to traditional PID control strategies. Consequently, the good performance of the MGA-based inverse NARX fuzzy model in the proposed hybrid inverse NARX fuzzy-PID position control of the PAM robot arm is demonstrated. These results are also applied to model and to control other highly nonlinear systems. © 2010 Elsevier Ltd.

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