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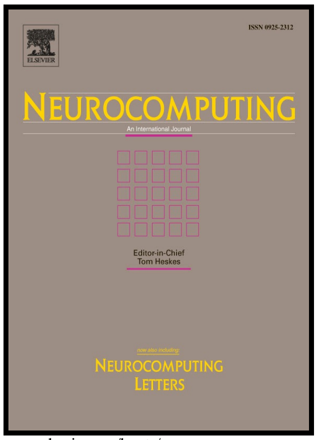

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Design of an intelligent optimal neural network-based tracking controller for nonholonomic mobile robot systems

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Abstract

This paper addresses the trajectory-tracking control problem of mobile robot systems with nonholonomic constraints, in the presence of time-varying parametric uncertainties and external disturbances. This necessitates an accurate controller to meet as much control objectives, as possible. Therefore, this paper deals with an artificial intelligence control technique to design a robust controller to meet the control objectives. The design of the intelligent controller is based on the optimal control theory, the adaptive neural network system, and the robust control technique. The trajectory-tracking problem is solved using the optimal control methodology. Since the nonholonomic wheeled mobile robot is strongly nonlinear, the neural network system is applied to approximate the nonlinear function in the optimal control law. The robust controller, for his part, is then applied to adaptively estimate an unknown upper bound of the time-varying parametric uncertainties, external disturbances and approximation error of the neural network system. The stability of the closed-loop robot system is proven using the optimal control theory and Lyapunov stability analysis. The results of the simulation studies on three typical nonholonomic mobile robots are provided to demonstrate the effectiveness of the proposed controller. In addition, a comparative study with a recent robust adaptive controller shows that our proposed intelligent controller gives better results, in the sense that the output trajectory converges to the steady state faster with smaller tracking error.

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