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NEURAL NETWORK ROBUST CONTROL FOR A NONHOLONOMIC MOBILE ROBOT INCLUDING ACTUATOR DYNAMICS

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Abstract. *In this paper, a control strategy that integrates a kinematic controller and an adaptive wavelet neural network (AWNN) controller for nonholonomic mobile robots including actuator dynamics is presented. The AWNN control system adopts a wavelet neural network (WNN) with accurate approximation capability to represent the unknown dynamics of the robotic system. It also uses a robust term to confront the inevitable approximation errors due to the finite number of wavelet bases functions and to disturbances. Based on the Lyapunov stability theorem, an adaptive learning algorithm learns the parameters of weight, dilation, and translation of the WNN on line. The tracking stability of the closed loop system, the convergence of the WNN weight-updating process and boundedness of WNN weight estimation errors are all guaranteed. The effectiveness and superiority of the proposed controller are demonstrated by simulation and experiment studies.*
Keywords: Adaptive wavelet neural network, Robust tracking control, Lyapunov stability theorem, Mobile robot, Actuator dynamics

1. **Introduction.** A mobile robot that can move intelligently without human intervention has a broad range of applications [1, 2]. It constitutes a class of mechanical systems called nonholonomic mechanical systems characterized by kinematic constraints that are not integrable and cannot therefore be eliminated from the model equations. Nonholonomic behavior in robotic systems is particularly interesting, because it implies that the mechanism can be completely controlled with reduced number of actuators [3, 4].

Much research effort has been oriented to solving the problem of motion under nonholonomic constraints using the kinematic model of a mobile robot. With the aid of the linearization technique, local controllers were proposed in [5]. Based on the dynamic feedback linearization and the differential flatness concept, the dynamic controllers with