Adaptive backstepping control using combined direct and indirect ?–modification adaptation

Y. Soukkou, S. Labiod

Abstract : In this paper, by using the dynamic surface control technique, an adaptive backstepping controller using combined direct and indirect ?-modification adaptation is proposed for a class of parametric strict-feedback systems. In this approach, a ?-modification parameter adaptation law that combines direct and indirect update laws is proposed. At first, the x-swapping identifier with a gradient-type update law is presented for a class of parametric strict-feedback nonlinear systems. Next, the main steps of the controller design for a class of nonlinear systems in parametric strict-feedback form are described. The closed-loop error dynamics is shown to be globally stable by using the Lyapunov stability approach. Finally, simulation results for a single-link flexible-joint robot manipulator are given to illustrate the tracking performance of the proposed adaptive control scheme.

Keywords : Backstepping control, direct and indirect adaptive control, adaptive dynamic surface control, Lyapunov stability, flexible joint manipulators