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Adaptive backstepping control using combined direct and indirect adaptation for a single-link flexible-joint robot

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Abstract: In this paper, a new tuning functions based adaptive backstepping controller using combined direct and indirect adaptation for a single-link flexible-joint robot is presented. In this approach, the parameter estimation is driven by a weighted combination of tracking and identification errors. At first, the x-swapping filter identifier with a gradient-type update law is presented for a class of parametric strict-feedback nonlinear systems. Then, the main steps of the controller design for a single-link flexible-joint robot manipulator model are described. The closed-loop error dynamics is shown to be globally stable by using the Lyapunov stability approach. Finally, simulation results are given to illustrate the tracking performance of a single-link flexible-joint robot manipulator with the proposed adaptive control scheme

Keywords : Backstepping control, direct and indirect adaptive control, combined adaptation, Lyapunov stability, flexible joint manipulators