

Decentralized Output Regulation of Large Scale Nonlinear Systems with Delay

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Abstract: This paper deals with output regulation of a class of large-scale nonlinear systems with delays. Each of the subsystems is in the output feedback form, with nonlinear functions of the subsystem output and the outputs of other subsystems. The system outputs are subject to unknown constant delays. Both the system dynamics and the measurements are subject to unknown disturbances generated from unknown linear exosystems. Decentralized control design approach is adopted to design local controllers using measurements or regulated errors in each subsystems. It is shown in this paper that delays in the outputs of subsystems do not affect the existence of desired feedforward control input, and the invariant manifolds and the desired feedforward inputs always exist if the nonlinear functions are polynomials. Through a special parameterization of an augmented exosystem, an internal model can be designed for each subsystem, without the involvements of the uncertain parameters. The uncertain parameters affected by the uncertainty of the exosystem are estimated using adaptive control laws, and adaptive coefficients in the control inputs are used to suppress other uncertainties. The proposed decentralized adaptive control strategy ensures the global stability of the entire system, and the convergence to zero of the regulated errors. An example is included to demonstrate the proposed control strategy.

Keywords: decentralized control; output regulation; nonlinear systems; time delay;

AMS Subject Classification: 93A14; 93D15; 93D21; 93D05; 93C10; 37C27;

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