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Special focus on advances in disturbance/uncertainty estimation and attenuation techniques with applications*

Disturbances and uncertainties exist in most engineering systems and always result in adverse effects on the control performances of closed-loop systems. The design and analysis of nonlinear control systems under disturbances is an active research topic in control systems societies. Many advanced disturbance/uncertainty estimation and attenuation (DUEA) techniques have been developed to deal with systems in the presence of various disturbances and parametric uncertainties, e.g., stochastic control, output regulator control, H_∞ control, sliding mode control, disturbance observer based control (DOBC), and active disturbance rejection control (ADRC). DUEA shows many promising properties for practical applications including "flexibility for implementation", "nominal performance recovery" and "prominent disturbance rejection ability". Consequently, DUEA will likely provide a source of efficient solutions for improving the control performance of complex nonlinear systems. In this context, this special topic focuses on advances in disturbance/uncertainty estimation and attenuation techniques with applications.

In the article "Nonlinear composite bilateral control framework for n-DOF teleoperation systems with disturbances", a new nonlinear composite bilateral control framework is proposed for n-degree-of-freedom (n-DOF) teleoperation systems with external disturbances. The proposed control framework fully considers the nonlinear dynamics of the n-DOF teleoperation systems. The method guarantees satisfactory position tracking performance and desired remote force haptic simultaneously for the n-DOF teleoperation systems.

In "Robust disturbance rejection for a fractional-order system based on equivalent-input-disturbance approach", a new disturbance rejection method based on the equivalent-input-disturbance approach is presented for uncertain fractional-order (FO) systems. A robust stability condition for the control system and the parameters of the controller are derived using an indirect Lyapunov method. The presented method effectively rejects disturbances and handles modeling uncertainties without requiring prior knowledge of the disturbance.

The article "On comparison of modified ADRCs for nonlinear uncertain systems with time delay" aims to rigorously investigate the performance of several modified ADRCs, including delayed designed ADRC (DD-ADRC), polynomial based predictive ADRC (PP-ADRC), Smith predictor based ADRC (SP-ADRC), and predictor observer based ADRC (PO-ADRC), such that the improvements of each method can be demonstrated. The capability to tackle time delay, the necessity of stable open loop, and the performance of rejecting uncertainties for these methods are thoroughly studied and compared.

The article "Guaranteeing almost fault-free tracking performance from transient to steady-state: a disturbance observer approach" proposes an output-feedback fault-tolerant controller (FTC) for a class of

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uncertain multi-input single-output systems under float and lock-in-place actuator faults using a high-gain disturbance observer (DOB). One appealing feature of the presented approach is to recover a fault-free tracking performance of a (pre-defined) nominal closed-loop system, during the entire time period including the transients due to abrupt actuator faults.

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