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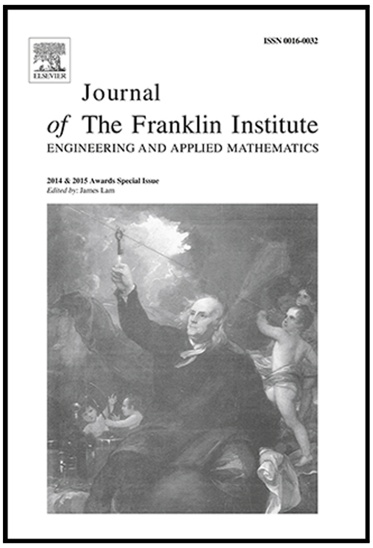

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DUAL BOUNDARY CONDITIONAL INTEGRAL BACKSTEPPING CONTROL OF A TWIN ROTOR MIMO SYSTEM

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Abstract

Conditional integration is a technique used to improve the transient performance of controllers with integral action. This paper proposes a novel modification of this technique and integral backstepping for the control of a Twin Rotor MIMO System (TRMS) to ensure efficient asymptotic output regulation of the system without degrading the transient response. The control objectives are to stabilize the helicopter-like system, reach a desired position and precisely track a given trajectory in the presence of significant cross couplings. The TRMS is decoupled into the vertical subsystem (VS) and the horizontal subsystem (HS) and an integral backstepping controller (IBC) is designed for each subsystem with the cross couplings considered as uncertainties. An adaptable integral gain law, which can be applied to any continuous control law, is then formulated to provide integral action conditionally within two (outer and inner) boundary layers, based on the output tracking error and reference signals. Simulation results show that the obtained dual boundary conditional integral backstepping control (DBCIBC) approach achieves robust output regulation in the presence of the system's uncertainties and external disturbances whilst maintaining a good transient response. Furthermore, comparisons with three available methods in the literature also indicate that the DBCIBC significantly improves performance in terms of error and control signal indices especially for the case of tracking a time varying reference input where the error index in the VS is reduced by over 50% on average.

Keywords: Backstepping, Conditional, Integral, Regulation, MIMO, TRMS