

Adaptive Switching Control Based On the Balance Equation

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Abstract: This paper presents an adaptive switching control strategy based on the Balance Equation. Previous work has described the development of the Balance Equation inspired by the PI/PID design rule in the framework of Internal Model Control. The linear algebraic relationship between the proportional and integral contributions of a PI controller revealed by the Balance Equation is utilized as the driving force for the adaptive switching among a set of candidate controllers. A performance index is calculated through the difference between the integral contribution given by the ideal controller and that given by a candidate controller. By minimizing this performance index, the adaptive switching strategy aims at finding the candidate controller that is closest to the ideal controller. For step changes in the set-point, as long as the candidate controller set covers the ideal controller, the adaptive control strategy can always switch to this controller in a timely fashion. Extensive simulation results have shown that the adaptive switching control strategy can always identify the best controller from the candidate controller set and achieve good set-point tracking performance even in the presence of significant variation in the process time constant. This adaptive control switching strategy serves as a good demonstration for the value of the Balance Equation, which can enable more new insight, better control performance, and stronger adaptation ability in wider applications.

Keywords: Adaptive Switching Control, Tracking, PI Control, Internal Model Control, Balance Equation.
