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On the Jitter Sensitivity of an Adaptive Digital Controller: A Computational Simulation Study

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Abstract

In many real-time control applications, the ability to accurately track a reference trajectory with stable, pre-specified closed-loop dynamics is highly desirable. For fixed gain control systems, the detrimental impact of jitter on performance has been relatively well studied. However, research that quantifies the possible impact of jitter on the performance and relative stability of adaptive control schemes is comparatively much rarer. With technology advances now making real-time adaptive control a viable option for high-speed applications, this situation requires further investigation. In this paper, the jitter sensitivity of a digital parameter adaptive tracking control system is studied using precise software-in-the-loop computational simulations. The results obtained indicated that the adaptive controller was significantly susceptible to jitter. In particular, key metrics such as the phase margin, gain margin, settling time, overshoot and root mean square parameter and tracking errors were all significantly impacted following the introduction of 5% jitter in the controller. The obtained data are thought to be the first detailed results of this kind and present useful insights into the practical complexities when innovating adaptive real-time tracking control systems and indicate that specialized controller implementations that minimize jitter should be employed and that further analysis is warranted.

Keywords: adaptive control, digital control, digital signal processing, timing jitter

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