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Delay Margin Achievable by PID Control

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Reception starts at 4:15pm

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Abstract

Delay margin is a fundamental measure of robust stabilization against uncertain, variable time delays and it addresses a central issue in the study of feedback stabilization of time-delay systems: What is the largest range of delay so that there exists a single LTI controller that can stabilize the delay plant within that range? The PID delay margin, the delay margin achievable by the subclass of LTI PID controllers, has also been known to pose a grave challenge. By far, no analytical characterization and exact computation of PID delay margin have been available for second-order delay systems, and the existing methods rely fully on brute-force search. The problem, however, is now completely resolved. Our contribution is threefold. First, we show that the delay margin of second-order systems achievable by PID control coincides with that by PD controllers. Second, we show that the proportional control in a PID controller contributes no effort to increase the delay margin. Finally, we show that the PID delay margin can be computed by solving a unimodal problem, that is, a univariate optimization problem that admits a unique maximum and hence constitutes a convex optimization problem in one variable. The problem can thus be solved efficiently and in high precision by convex optimization, or any gradient-based or bisection methods.

About the Speaker

Jianqi Chen received the B.S. degrees from Zhejiang University in 2014. He is now pursuing the PhD degree at the Department of Electronic Engineering, City University of Hong Kong. His research interests include the time-delay systems, networked control systems, and cyber-physical systems.