

A Data-Driven PID Controller for Flexible Joint Manipulator using Normalized Simultaneous Perturbation Stochastic Approximation

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Abstract:

This paper presents a data-driven PID control scheme based on Normalized Simultaneous Perturbation Stochastic Approximation (SPSA). Initially, an unstable convergence of conventional SPSA is illustrated, which motivate us to introduce its improved version. Here, the conventional SPSA is modified by introducing a normalized gradient approximation to update the design variable. To be more specific, each measurement of the objective function from the perturbations is normalized to the maximum objective function measurement at the current iteration. As a result, this improvement is expected to avoid the updated control parameter from producing an unstable control performance. The effectiveness of the normalized SPSA is tested to datadriven PID control scheme of flexible joint plant. The simulation results are presented in terms of the convergence responses and control performances. The outcome of this paper shows that the data-driven controller tuning using the normalized SPSA is able to provide stable and better control performances as compared to the existing modified SPSA.

Keywords - Data-driven; Improved stochastic approximation; PID controller tuning.