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DESIGN METHOD FOR PID CONTROLLER IN MULTIRATE SYSTEM

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Abstract. A PID controller in a multirate system is designed such that the sampling interval of a plant output (lT_s, l:positive integer) is longer than the update interval of a control input (T_s). The control performance of the proposed multirate PID controller is superior to that of a PID controller designed for a slow-rate single-rate system, where both the update interval and the sampling interval are lT_s. Using the proposed multirate PID controller based on Generalized Predictive Control (GPC), a plant output converges to a reference input without ripples between sampled outputs. Furthermore, the future reference trajectory of GPC can be employed in the proposed design method, and it is clarified that the design parameter of the future reference trajectory influences only integral time in a multirate PID controller. Numerical examples demonstrate the effectiveness of the proposed design method.

Keywords. PID control, multirate system, generalized predictive control, integral action, intersample ripple.

1 Introduction

Proportional-Integral-Derivative (PID) control is a very useful and easy control method. Because its structure is simple and the meaning of the design parameters, referred to as PID parameters, is clear [2]. PID control performance is adjusted by tuning the PID parameters. However, it is rather difficult to find optimal parameters. Hence, numerous methods have been proposed for designing PID parameters [2, 11, 12, 14, 15]. These methods comprise two main classes [13]. In the first, the parameters are designed to satisfy given control specifications, such as phase and amplitude margins. The second is based on comparison and approximation of controllers designed by other methods by a PID controller. In the present paper, PID parameters are designed on the basis of generalized predictive control (GPC). The control performance of GPC is achieved by a PID controller with a simple control structure, so the obtained controller can be understood intuitively and existing PID controllers will be available in the future.

GPC [6] has been widely studied theoretically and used in industrial applications. It has been discussed in discrete time, but a real controlled plant