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A DESIGN METHOD FOR ROBUST STABILIZING SIMPLE REPETITIVE CONTROLLERS FOR TIME-DELAY PLANTS

Kou Yamada, Yoshinori Ando, Iwanori Murakami
Masahiko Kobayashi and Nan Li

Department of Mechanical System Engineering
Gunma University
1-5-1 Tenjincho, Kiryu, Japan
{ yamada; ando; murakami }@me.gunma-u.ac.jp
{ m08m218; m06m474 }@gs.eng.gunma-u.ac.jp

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Abstract. *A simple repetitive controller was proposed by Yamada et al. It works as a modified repetitive controller. The transfer functions from the periodic reference input to the output, and from the disturbance to the output have a finite number of poles, and the input–output characteristics and the disturbance attenuation characteristics can be specified easily. However, this method cannot be applied to time-delay plants with uncertainty. We present a parameterization of all robust stabilizing simple repetitive controllers for time-delay plants with uncertainty.*

Keywords: Repetitive control, Uncertainty, Robust stability, Repetitive controller, Finite number of poles, Parameterization, Time delay

1. **Introduction.** A repetitive control system is a type of servomechanism for periodic reference inputs. That is, the repetitive control system follows the periodic reference input without steady state error, even if a periodic disturbance or uncertainty exists in the plant [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13]. It is difficult to design stabilizing controllers for the strictly proper plant, because a repetitive control system that follows any periodic reference input without steady state error is a neutral type of time-delay control system [11]. To design a repetitive control system that follows any periodic reference input without steady state error, the plant must be biproper [3, 4, 5, 6, 7, 8, 9, 10, 11]. In practice, the plant is strictly proper. Many design methods for repetitive control systems for strictly proper plants have been given [3, 4, 5, 6, 7, 8, 9, 10, 11]. These studies are divided into two types. One uses a low-pass filter [3, 4, 5, 6, 7, 8, 9, 10] and the other uses an attenuator [11]. The latter is difficult to design because it uses a state variable time delay in the repetitive controller [11]. The former has a simple structure and is easily designed. Therefore, the former type of repetitive control system is called the modified repetitive control system [3, 4, 5, 6, 7, 8, 9, 10].

Using the modified repetitive controllers in [3, 4, 5, 6, 7, 8, 9, 10], even if the plant does not include time delays, the transfer functions from the periodic reference input to the output and from the disturbance to the output have an infinite number of poles. This makes it difficult to specify the input–output characteristics and the disturbance attenuation characteristics. From the practical point of view, it is desirable that these characteristics should be easy to specify. Therefore, these transfer functions should have a finite number of poles. To overcome this problem, Yamada et al. proposed simple repetitive control systems such that the controller works as a modified repetitive controller and the transfer functions from the periodic reference input to the output and from the