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RELATION BETWEEN MODEL FEEDBACK CONTROL SYSTEMS AND THE PARAMETERIZATION OF MIMO PLANTS

Kou Yamada, Hideharu Yamamoto and Nan Li

Department of Mechanical System Engineering
Gunma University
1-5-1 Tenjincho, Kiryu, Japan
yamada@me.gunma-u.ac.jp; { m07m251; m06m474 }@gs.eng.gunma-u.ac.jp

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Abstract. *We examine model feedback control systems. The model feedback control proposed by Narikiyo and Izumi is simple and can simplify the shaping of the sensitivity function and the complementary sensitivity function. It has been used in many applications such as the trajectory control of robot manipulators and serially connected tanks of fluids. The control structure of the model feedback control system is limited, and nothing has been reported about whether model feedback control can represent all of the stabilizing controllers for multiple-input/multiple-output plants. We give a solution to this question.*
Keywords: Model feedback control system, Parameterization, Minimum-phase system, Sensitivity function, Robust stability

1. **Introduction.** We examine the relation between model feedback control systems (MFCSs) and the parameterization of all stabilizing controllers for multiple-input/multiple-output (MIMO) plants. The MFCS was first proposed by Narikiyo and Izumi [1]. It has characteristics that simplify the shaping of the sensitivity function and the complementary sensitivity function, and has been applied to trajectory control of robot manipulators [1], serially connected water tanks [2, 3], and other systems. The MFCS is considered as a kind of passive adaptive control system [4, 5, 6, 7, 8, 9, 10, 11]. Passive adaptive control systems restrain the influence of uncertainty in the plant without identification or adjustment capabilities. That is, the passive adaptive control system is similar to the infinite-gain margin problem [12, 13, 14] or a low-sensitivity control system with robust stability [15, 16].

The basic control structure of the MFCS is similar to that of disturbance–response feedback [17] and the disturbance observer [18, 19]. Disturbance observer techniques have been applied to many control systems [18, 19]. Therefore, the usefulness of the MFCS is obvious.

Because the control structure of the MFCS is limited, it is quite possible that it cannot represent all the stabilizing controllers for a plant. Generally, if a class of controllers is small, achievable control performance tends to be conservative. If the MFCS can represent all the stabilizing controllers for a plant, then its structure is more useful and important than if all stabilizing controllers could not be thus represented. From such a viewpoint, Yamada et al. [20] examined the relation between MFCSs and the parameterization of all stabilizing controllers for single-input/single-output minimum-phase plants. That study clarified that MFCSs can represent all stabilizing controllers for single-input/single-output minimum-phase plants. Therefore, even if MFCSs are used for single-input/single-output plants, achievable control performance is not limited [20].