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DESIGN OF A GENERALIZED MINIMUM VARIANCE CONTROL IN SAMPLED-DATA CONTROL SYSTEMS

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Abstract. *The present paper proposes a new method for designing the generalized minimum variance control (GMVC) in a sampled-data control system, in which a continuous-time plant is controlled using a discrete-time controller. In the conventional GMVC, sample behavior is optimized, but intersample behavior is not taken into account. However, intersample behavior as well as sample behavior can be improved using the proposed method. Simulation results demonstrate the effectiveness of the proposed method.*
Keywords: Generalized minimum variance control, Sampled-data system, Zero-order hold, Intersample ripple

1. **Introduction.** The present paper discusses the design of a sampled-data control system [1, 2, 3, 4], in which a continuous-time plant is controlled using a discrete-time controller with both a sampler and a holder. The sample-data control system takes into account not only sample behavior but also intersample behavior.

Generalized Minimum Variance Control (GMVC) [5, 6] in a discrete-time system has been proposed to compensate the dead time. In the design of GMVC, a discrete-time controller is derived for the purpose of minimizing a performance function, which includes a dead time forward-predicted plant output. Generalized minimum variance control emphasizes the behavior of dead time forward prediction because it is designed to consider dead time.

However, intersample behavior is likely to deteriorate even if the sampled behavior can be well controlled, because the performance function of GMVC is designed to evaluate sample behavior but not intersample behavior. A GMVC with a short sampling interval handles the problem better than a GMVC with a long sampling interval, but a discrete-time system with a short sampling interval has unstable zeros, even if the continuous-time system is a minimum-phase system. Hence, a GMVC in continuous-time has been designed to control continuous-time behavior [7]. However, if the plant is controlled using a digital computer that operates in discrete time, the control system should be designed as a sampled-data control system. However, a GMVC for the sampled-data system has not yet been proposed. Therefore, in the present paper, a method for designing a sampled-data GMVC, the performance function of which evaluates the variance of a generalized output including a continuous-time dead-time forward-predicted plant output, is proposed. In the proposed method, since a performance function that includes continuous-time behavior is minimized, intersample behavior can be improved by using a discrete-time controller. To derive the control law for the sampled-data GMVC, a continuous-time dead-time forward-predicted plant output, generated using a discrete-time controller and a holder, must be developed. Thus, in the present paper, a continuous-time predicted plant output and a discrete-time control law minimizing a continuous-time performance function are