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TRACK-SEEKING CONTROL OF A HARD DISK DRIVE USING MULTIRATE GENERALIZED PREDICTIVE CONTROL TO IMPROVE INTERSAMPLE PERFORMANCE

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Abstract. *This paper proposes a new controller for track-seeking control of a head in a Hard Disk Drive (HDD). The sampling period of the head position is restricted, but the hold period of a control input can be changed to improve HDD system performance. Hence, this paper proposes a method for designing Generalized Predictive Control (GPC) in a multirate system, where the sampling period is longer than the hold period. In design of a standard GPC, intersample behavior is not evaluated because the controller is based on the optimization of the sample behavior. However, the intersample behavior has to be evaluated in the HDD system. Therefore, the proposed controller's derivation is based on an objective function that includes intersample behavior as well as sample behavior. The proposed method is applied to a benchmark problem and its effectiveness is demonstrated.*
Keywords: Hard disk drive, Generalized predictive control, Multirate system, Intersample behavior

1. **Introduction.** This paper discusses track-seeking control of a head in a Hard Disk Drive (HDD) system [1, 2]. The settling procedure of the track-seeking control is divided into main two steps; first, a head is moved to its target position as fast as possible (seek), second, it follows the target position for recording data onto a disk (following). This paper proposes a new design method for improving the seek control performance.

In track-seeking control of a head in an HDD system, intersample behavior as well as sample behavior must be accurately controlled. Hence, the authors have proposed a method for designing Generalized Predictive Control (GPC) [3] considering intersample behavior, and applied it to head positioning control [4]. This control method is designed for a single-rate system in which the sampling period of a plant output is equivalent to the hold period of a control input. If a head can be controlled for short-period, HDD performance will be improved. However, the sampling period of position signals among data tracks on a disk is fixed. Therefore, the sampling period cannot be arbitrarily changed since the capacity of user data on a disk cannot be decreased. On the other hand, the hold period of the control input can be shortened. Hence, the newly proposed controller is designed for a multirate system, where the sampling period of the plant output is an integer multiple of the hold period of the control input. In the multirate system, even if the sampled output converges to a reference input, ripples might emerge between sampled outputs [6, 7]. Thus, the conventional single-rate controller [4] is extended into