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SAMPLED-DATA $\mathcal{H}_\infty$-CONTROL FOR TIME-VARYING HYBRID SYSTEMS

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Abstract. This paper presents sampled-data $\mathcal{H}_\infty$-control of linear mixed continuous-time and discrete-time systems, including a mix of continuous-time and discrete-time performance signals and disturbances. However, neither continuous-time control signals nor continuous-time measurements are included. The sampling may well be multirate, i.e. different signals may be sampled by different rates, as long as a periodic pattern is repeated over the period, consisting of a number of sampling steps. In fact, the results are applicable even to arbitrary linear time-varying systems.

The sampled-data system is discretised such that the continuous-time performance is reflected in the discretised or "lifted" system. This lifted system is combined with discrete-time updates at the sampling instants to achieve the sampled-data controller. The "hold-states" case is presented as a special application, when there is also a hold circuit at the controller output. The continuous-time Riccati equations with discrete-time updates then can be replaced by *one discrete*-time static feedback and filter Riccati equation respectively, which also reflect the intersample behaviour.

Furthermore, convergence results between the discretised Riccati solutions and the corresponding continuous-time solutions are shown, when the sampling interval decreases towards zero. Simulations are shown when the results are applied to the control of a MIMO jet-engine model.

Keywords. Sampled-Data Systems, $\mathcal{H}_\infty$-Control, Multirate Control, Time-Varying Systems, Periodic Systems, Intersample Behaviour

1 Introduction

Sampled-data control means that a discrete-time controller is designed for a continuous-time plant, such that a continuous performance measure is fulfilled. It means that the intersample behaviour during the sampling periods is taken into account when the controller is designed. This is the most well-known example of a hybrid continuous- and discrete-time system, where outputs from the continuous plant are measured at discrete-time instants. $\mathcal{H}_\infty$-control of such systems, with a hold-circuit introduced at controller output, has been thoroughly investigated since the beginning of the 90s, see e.g. articles [5, 4, 2, 28, 27, 33, 14, 13, 19, 20] and books [6, 10, 11]. Recently a number of papers have dealt with optimal samplers and/or optimal hold-circuits, see e.g. [21, 22].