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STABILITY AND STABILIZATION FOR SAMPLED-DATA SYSTEMS WITH PROBABILISTIC SAMPLING

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Abstract. *In this paper, the problems of exponential stability analysis and stabilization are investigated for sampled-data systems with probabilistic sampling. By introducing a stochastic variable satisfying a Bernoulli distribution, the probabilistic sampling system is transformed into a continuous time-delay system with stochastic parameters. A Lyapunov functional approach is developed to establish the mean-square exponential stability of the closed-loop system. Based on this, the design procedure for stabilization controllers is proposed by means of linear matrix inequalities (LMIs), which can be solved efficiently by available software. Finally, an example is given to demonstrate the effectiveness of the proposed controller design methodology.*

Keywords: Sampled-data systems, Exponential stability, Stabilization, Probabilistic sampling

1. **Introduction.** Due to the wide-spread use of digital controllers to control continuous-time systems [17, 19], the study of sampled-data control systems has long been an important part of control science. By sampled-data systems, we refer to those systems containing both continuous-time and discrete-time signals and components. These hybrid systems frequently form an idealized model of computer control in a number of engineer applications such as chemical process, aircraft control and automobile traffic control. There have been a great number of research results concerning sampled-data systems scattered in the literature in the past several years. To mention a few, Francis and Georgiou focused on the stability theory of hybrid systems and constructive state-space techniques for assigning zeros using periodic digital control in [4]. Chen and Francis presented a comprehensive study on the modern sampled-data systems in [2]. Optimal damping of harmonic disturbances of known frequencies was studied for sampled-data systems in [16]. In [5], Fridman employed the input-delay approach to investigate robust sampled-data stabilization of linear systems. Issues dealing with H_∞ control and robustness of uncertain systems were investigated in [3]. In [14], the author considered the H_∞ filtering problem for a class of uncertain continuous-time systems under sampled measurements. In [8], the problem of sampled-data control for networked control systems was considered.

Among the aforementioned results, the discrete controllers are mostly designed under the condition of single sampling [1, 21]. However, the available data for signal processing and control are not always equidistant in some applications. This also motivates the study of time-varying sampling. A typical example of such systems can be found in networked