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STABILIZATION OF DISCRETE FAULT TOLERANT CONTROL SYSTEMS WITH PARAMETER UNCERTAINTIES

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Abstract. *The stochastic behavior of DTFTCS with norm bounded parameter uncertainties in noisy environments is studied. The uncertainties are assumed to be unknown but bounded. Second moment stability for the uncertain DTFTCS driven by a state feedback control law is to be investigated. Sufficient conditions that guarantee the second moment stability and achieve a minimum of δ-level of disturbance rejection are to be derived. An H_∞ stabilizing fault tolerant control law will be synthesized as a feasible solution for a set of linear matrix inequalities (LMIs) which allow the utilization of linear optimization tools. The results are verified by a numerical example.*
Keywords: Fault tolerant control systems with Markovian parameters (FTCSMP), Stochastic stability, Norm bounded uncertainties, Linear matrix inequality (LMI)

1. **Introduction.** Fault Tolerant Control Systems with Markovian Parameters (FTCSMP) belong to a class of hybrid stochastic systems specifically designed for safety-critical applications to achieve high levels of system survivability and reliability under normal and faulty operating conditions. FTCSMP model was originally developed to deal with constraints related to the integration of the FDI process and the control reconfiguration mechanism in one unified framework [9]. In FTCSMP two separate random processes with different state spaces are defined: one to model system component failures and the second to model the non-deterministic decisions of the FDI process. This unique modeling broaden the applicability of the FTCSMP model to accommodate several practical issues and physical limitations. Several researchers were attracted to research in FTCSMP and significant contributions were made in relation to stability properties in noisy environments with detection errors and delays, with parameter uncertainties and with actuator saturation, and the design of a fault tolerant controller and H_∞ control. A comprehensive review of the stochastic stability and stabilization of continuous FTCSMP using Lyapunov function approach can be found in [4]. Lately, the analysis of stochastic stability and H_∞ stabilization of continuous AFTCS was revisited in [1] using convex programming framework, integral quadratic constraints were defined for FTCSMP and a stabilizing controller was synthesized in [8], the utilization of sliding mode variable structure control [11].

The class of discrete time fault tolerant control systems (DTFTCS) drove less attraction than the continuous contour part. The difficulty to characterize the stochastic behavior of DTFTCS is due to the complexity of the model and tools needed to complete the studies [7]. Just recently, [5] developed a general framework for DTFTCS and proposed a unique approach to synthesize a fault tolerant controller, the issue of time delays in the state dynamics for DTFTCS was researched in [6].