Stochastic Controllability of Fractional Linear Systems

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Controllability plays an important role both in deterministic and stochastic control theory. In the literature there are many different definitions of controllability, both for linear and nonlinear dynamical systems, which strongly depend on class of dynamical control systems and the set of admissible controls.

However, it should be stressed, that the most literature in this direction has been mainly concerned with deterministic controllability problems for finite-dimensional linear dynamical systems with standard derivative in the differential state equation.

Controllability concepts for stochastic control systems have been recently discussed only in a rather few number of publications.

In the present paper we shall study stochastic controllability problems for fractional linear dynamical systems, which are natural generalizations of controllability concepts well known in the theory of infinite dimensional control systems. It will be proved that under suitable assumptions controllability of a deterministic fractional linear associated dynamical system is equivalent to stochastic exact controllability and stochastic approximate controllability of the original fractional linear stochastic dynamical system. This is a generalization to fractional case some previous results concerning stochastic controllability of linear dynamical systems.

The paper is organized as follows: section 2 contains mathematical model of linear, fractional stationary stochastic dynamical system. In section 3 using results and methods taken directly from deterministic controllability problems, necessary and sufficient conditions for exact and approximate stochastic controllability are formulated and proved. Finally, section 4 contains concluding remarks.