

Investigation for Existence, Controllability \& Observability of a Fractional order Delay Dynamical System

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Abstract

Recently, several research articles have investigated the existence of solution of dynamical systems with fractional-order and as well as expounded controllability. Nevertheless, very little attention has been given to observability of such dynamical systems. In the present work, we explore the outcomes of controllability and observability regarding a differential system of fractional order with input delay. Laplace and inverse Laplace transforms along with the Mittag-Leffler matrix function are applied to the proposed dynamical system in Caputo's sense and obtain a general solution in the form of an integral equation. Then we set out conditions for the controllability of the underlying model, regarding the linear case. We then expound controllability conditions for the nonlinear case with the aid of fixed point theorem of Schaefer and the Arzola-Ascoli theorem. After converting the problem considered to a fixed point problem, we prove the observability of the linear case using the observability Grammian matrix. The necessary and sufficient conditions, for the nonlinear case, are investigated with the help of the Banach contraction mapping theorem. Finally, we add some examples to elaborate our work.

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