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# INFINITE CONTROLLABILITY AND INFINITE OBSERVABILITY OF GENERALIZED DYNAMICAL SYSTEMS

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**Abstract.** This paper considers the characteristics of infinite controllability (observability) for generalized dynamical system. Some new sufficient and necessary conditions for infinite controllability (observability) are formulated, which are the generalization of the results obtained in descriptor systems. At the same time, the concepts of infinite (centralized/decentralized) fixed modes are introduced, and the properties of infinite fixed modes are discussed. Two computational examples are given to illustrate the above results.
**Keywords.** Infinite controllability, infinite observability, generalized dynamical system, infinite centralized fixed modes, infinite decentralized fixed modes.

## 1 Introduction

Many researches have been focused on the linear time-invariant descriptor systems and linear time-varying descriptor systems in the past decades. Some valuable results have been obtained. For linear time-invariant descriptor system, considerable perfect theory is established [1, 2]. Since the early 1980s, people have begun to study linear time-varying descriptor systems. Numerous research work on such systems has been published. In the previous literature, several papers dealt with certain canonical forms [3, 4]. For linear time-varying singular systems, observability is first studied by Campbell and Terrell [5]. Furthermore, in Campbell, Nichols, and Terrell [6], controllability and observability have been treated. Based on an observability theory similar to the one presented in Campbell and Terrell [5], projection operators are constructed in Terrell [7] to decompose the system into unobservable subspace and observable complement. None of the work regarding observability and controllability has discussed impulsive behavior. Cobb [8] has unified a variety of seemingly different controllability and observability definitions proposed in the literature prior to his paper. Wang [9] has discussed impulse observability and impulse controllability for linear time-varying singular systems. However, there has been little work on generalized dynamical systems which is widely applied in electronic network. In the field, Verghese [10, 11] has studied impulsive behavior and infinite frequency behavior of generalized