ADVANCED FRACTIONAL ORDER MODELING AND CONTROL OF DYNAMICS OF COMPLEX SYSTEMS: RECENT RESULTS

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ABSTRACT

In this presentation, we provide some applications of memristors and mem-systems with a particular focus on electromechanical systems and analogies that holds great promise for advanced modeling and control of complex objects and processes. In science and engineering, the ideas and concepts developed in one branch of science and engineering are often transferred to other branches. In addition to the analogy between mechanical and electrical systems, it was observed that phenomena from other physical domains exhibit similar properties, [1]. Representative example is nonlinear element -memristor which was postulated by Chua in 1971 [1] by analyzing mathematical relations between pairs of fundamental circuit variables. Besides, the relation between current and voltage which defines a memristive system, the relation between charge and voltage also specifies a memcapacitive system, and the flux-current relation gives rise to a meminductive system [2]. Here, we give a short review of available mem-systems integer order. In addition, important property of fractional operators is that they capture the history of all past events which means that fractional order systems [3] have intrinsically a memory of the previous dynamical evolution. Particularly, we present the connection between fractional order differintegral operators and behavior of the mem-systems which can be used for modeling dynamics of complex systems. Several potential applications of electromechanical analogies of integer and fractional order are discussed. Further, we investigate and suggest an open-closed-loop P/PDalpha type iterative learning control (ILC) [4] of fractional order singular complex system [5]. Particularly, we discuss fractional order linear singular systems in pseudo state space form. Sufficient conditions for the convergence in time domain of the proposed fractional order ILC for a class of fractional order singular system are given by the corresponding theorem together with its proof. Finally, numerical example is presented to illustrate the effectiveness of the proposed open-closed ILC scheme of fractional order for a class of fractional order singular complex system.

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