ABSTRACT

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Topic : Chaos Synchronization and Dynamical Analysis of Nonlinear Dynamical Systems

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Chaos can be described as confusion or disorder that occurs in events so that they appear erratic and unpredictable. As a typical nonlinear phenomenon, chaos holds some special properties as sensitive to initial conditions, dense periodic orbits and topologically mixing. Chaotic behavior exists widely in engineering, biology, economics and many other scientific disciplines. A significant development in chaos theory occurred when Lorenz discovered a 3-D chaotic system of a weather model. Subsequently, Rössler discovered a 3-D chaotic system in 1976, which is algebraically simpler than the Lorenz system. Chaotic behavior is a common feature of nonlinear dynamics and hyper-chaos in higher-dimensional nonlinear systems. Recently, hyper-chaos due to its attractive features like high security, high efficiency and high capacity has been deeply investigated in many application fields such as secure communications, lasers, nonlinear circuits and so on. Hyper-chaotic systems can be defined as a chaotic systems with more than one positive Lyapunov exponents i.e. the number of directions of spreading is greater than one, which results the system to show the behavior of high disorder and randomness. The first classical hyper-chaotic system is the well known hyper-chaotic Rössler system. After that, many hyper-chaotic systems have been developed and the applications of these models have been enhanced recently. Every day the number of articles that relates to this topic is increasing, and numerous articles have been devoted to explain the new high-dimensional chaotic systems having more complicated topological

structure . Since the seminal work of Pecora and Carroll, on the synchronization of chaotic systems, synchronization phenomenon has formed a new body of research activities which is at the fore front of recent application topics in nonlinear dynamics. As a result, enormous progress has been made in understanding various types and methods of synchronization. We are aware that chaos control of chaotic systems has also received a great attention due to its potential applications in physics, chemical reactor, biological networks, artificial neural networks, telecommunications etc. Basically, chaos controlling is the stabilization of an unstable periodic orbit or equilibria by means of tiny perturbations of the system. Since Ott, Grebogi, and Yorke firstly proposed the method of chaos control and after that many useful and powerful methods have been developed for sustained development of humanity. These may include optimal control, synchronization, adaptive control, sliding mode control etc. Keeping in view the above mentioned studies and their applications, we have designed two new 4-D hyper-chaotic systems and some basic analysis of new 4-D hyper-chaotic systems has been done by means of dissipation, equilibrium, stability, time series, phase portrait, Lyapunov exponents, Poincare map and bifurcation diagram. The optimal control method based on the Pontryagin minimum principle(PMP) has been studied for these considered systems. Also, the Active Control method has been employed to discuss the hybrid projective synchronization between the two identical new 4-D hyper-chaotic systems at different initial conditions. Further, we have extended our studies on more generalized fractional order chaotic systems . We have studied the adaptive sliding mode synchronization of commensurate fractional order Genesio-Tesi system with disturbance. Also, the hybrid projective synchronization for incommensurate, integer and commensurate fractional-order financial systems with unknown disturbance has been studied.