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Title of the Thesis: Chaotic Systems and Synchronization

Abstract

Chaos theory and synchronization play an important role in the development of dynamical systems nonlinear. It is such a very fascinating research field that it has been thoroughly studied during the last few decades. Presently chaos has taken its route in almost all the disciplines. There are enough evidence and practical goals for investigating the chaos control and synchronization.

The present thesis chapters described as under:

Chapter-1(Introduction), This chapter is introductory, deals with a brief survey of some historical aspects and basic definitions, formulae and results relevant to the chaos control methods and chaos synchronization schemes. Most of these results are available in standard references on the subject, but we have included them to make the thesis self-contained.

Chapter-2 (Adaptive hybrid complex projective combination–combination synchronization in non-identical hyperchaotic complex systems). This chapter is devoted to the study of an adaptive hybrid complex projective combination-combination synchronization method to synchronize the hyperchaotic (HC) complex Lorenz system and HC complex Lu system. The adaptive control laws and parameter update laws are derived using Lyapunov stability theory. During these studies, the coupled HC complex systems (master and slave systems) evolve in a distinct direction with a constant intersection phase angle. Using MATLAB simulations are performed to illustrate the validity and effectiveness of the proposed scheme.

Chapter-3 (Sliding Mode Disturbance Observer Control Based on Adaptive Hybrid Projective Compound Combination Synchronization in Fractional-Order Chaotic Systems). In this chapter, we have investigated the hybrid projective compound combination synchronization (HPCCS) in a class of commensurate fractional-order chaotic Genesio–Tesi system with unknown disturbance. To deal with the problem of bounded disturbance, the nonlinear HPCCS is proposed for the fractional-order chaotic system. Further, choosing the appropriate control gain parameters, the nonlinear fractional-order disturbance observer can approximate the disturbance efficiently. Based on the sliding mode control (SMC) method, a simple sliding mode surface has been introduced. Using the Lyapunov stability theory, the designed adaptive SMC method establishes the synchronization of the three master and two chaotic slave systems are expeditiously.

Chapter-4 (Combination Projective Synchronization in Fractional-Order Chaotic System with Disturbance and Uncertainty). In this chapter, we have studied combination projective synchronization (CPS). In CPS, matrix projective combination synchronization (MPCS) and inverse matrix projective combination synchronization (IMPCS) has been investigated between non-identical fractional-order complex chaotic systems which are subjected to uncertainty and external disturbance. Matrix projective synchronization (MPS) and inverse matrix projective synchronization is obtained for the scaling factor to be using a constant matrix, which gives the assurance of high security in secure communication and image encryption.

Chapter-5 (Modulus Synchronization in Non-identical Hyperchaotic Complex Systems and Hyperchaotic Real System Using Adaptive Control). In this chapter, we discuss a new modulus combination–combination synchronization (MCCS) scheme using the adaptive control technique. MCCS scheme is performed between complex hyperchaotic (HC) systems and real hyperchaotic (HC) systems. The HC complex Lorenz and Lu are taken as master systems, and the HC Chen system and Newton–Leipnik are taken as slave systems. Based on the Lyapunov stabilitytheory, adaptive control and parameter update law are obtained from making the MCCS