Hybrid Synchronization of the Generalized Lotka-Volterra Three-Species Biological Systems via Adaptive Control

Sundarapandian Vaidyanathan

R & D Centre, Vel Tech University, Avadi, Chennai, Tamil Nadu, India

Abstract: Since the recent research has shown the importance of biological control in many biological systems appearing in nature, this research paper investigates research in the dynamic and chaotic analysis of the generalized Lotka-Volterra three-species biological system, which was studied by Samardzija and Greller (1988). The generalized Lotka-Voterra biological system consists of two predator and one prey populations. This paper depicts the phase portraits of the 3-D generalized Lotka-Volttera system when the system undergoes chaotic behaviour. The hybrid synchronization of *master* and *slave* chaotic systems deals with the coexistence of both complete synchronization and anti-synchronization in the synchronizing of states of the master and slave systems. Next, this paper derives adaptive biological control law for achieving global and exponential hybrid chaos synchronization ofthe states of the generalized Lotka-Volterra three-species biological systems with unknown parameters. All the main results are proved using Lyapunov stability theory. Also, numerical simulations have been plotted using MATLAB to illustrate the main results for the three-species generalized Lotka-Volterra biological system and its adaptive hybrid synchronization.
Keywords: Chaos, chaotic systems, chaos synchronization, chaos control, hybrid synchronization, biology, biological system, Lotka-Volterra system, etc.

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