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Topic of Title : Fuzzy Modeling and Synchronization of Nonlinear Dynamical Systems

ABSTRACT

Fuzzy modeling and synchronization of nonlinear dynamical systems may appear two totally different areas with simply marginal interesting connections to each other. We have brought together the appearing uncorrelated concepts, fuzzy logic and chaos synchronization theory. It is primarily motivated by the ideas of soft computing (SC), initiated by Lotfi A. Zadeh, the founder of fuzzy logic.

Fuzzy models based on the Takagi-Sugeno (T-S) method of reasoning integrate the ability of linguistic models for qualitative knowledge representation with great potential for expressing quantitative information. Because of the linear dependence of each rule on the input variables of the underlying system, the T-S method is capable of acting as an interpolating supervisor of multiple linear controllers that are to be applied, under different operating conditions of a dynamic nonlinear system. Fuzzy logic and chaos theory have entered into the ken of science. The study on their interactions has been carried out for more than two decades, at least with respect to the following aspects: fuzzy control of chaos, adaptive fuzzy systems from chaotic time series, theoretical relations between fuzzy logic and chaos theory, fuzzy modeling of chaotic systems with assigned properties, chaotifying Takagi-Sugeno (TS) fuzzy models, and fuzzy chaos- based

cryptography. Fuzzy logic was originally introduced by Lotfi Zadeh in 1965 in his seminal paper "Fuzzy sets".

Fuzzy models based on the T-S method of reasoning integrate the ability of linguistic models for qualitative knowledge representation with great potential for expressing quantitative information. In addition, this type of fuzzy models permits a relatively easy application of various powerful learning techniques for system identification from data and controller design. Fuzzy set theory resembles human reasoning using approximate information and inaccurate data to generate decisions under uncertain environments. It is designed to represent uncertainty and vagueness mathematically, and to provide formalized tools for dealing with imprecision in real-world problems. The first evidence of physical chaos was Edward Lorenz’s discovery in 1963. Although the study of chaos can be traced back to hundreds of years ago to some philosophical pondering and to the work of the French mathematician Jules Henri Poincar’e at the beginning of the last century. As chaos theory is also a qualitative study of unstable aperiodic behavior in deterministic nonlinear dynamical systems. Researches reveal that it is due to the drastically evolving and changing chaotic dynamics that the human brain can process massive information instantly. "The controlled chaos of the brain is more than an accidental by-product of the brain complexity, including its myriad connections, but rather, it may be the chief property that makes the brain different from an artificial-intelligence machine". By using the various types of chaos synchronization methodologies to perform the synchronization between identical and nonidentical chaotic and hyper chaotic systems, the computational techniques are performed by using MATHEMATICA and MATLAB softwares.