HARVEY MUDD COLLEGE

Department of Engineering
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Galileo McAlister, 4:15pm

Overview of Chaos and Its Information Applications

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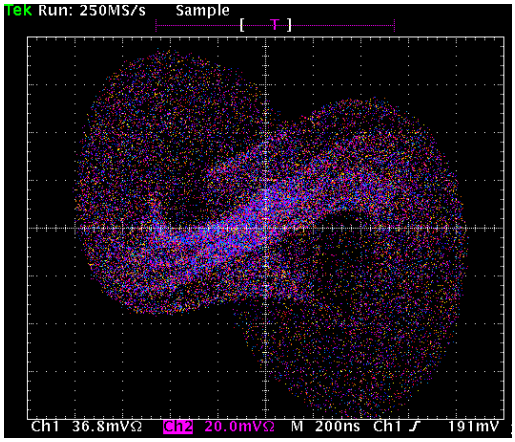

The evolution of the new discipline of nonlinear engineering is taking place along two main fronts: the first addressing higher-order effects that have become more important in current designs because of increased demands on performance under ever-more stringent application environments, while the second more radical activity has focused on the explicit harnessing of nonlinear effects through whole new designs. For the latter scenario, the most studied nonlinear effect is that of the complex, random-like behavior called "chaos," which is now being applied to such diverse areas as communications, signal processing, fluid mechanics, and physiology. The field of nonlinear engineering is still evolving on many fronts, with many international and interdisciplinary contributors. Although several important applications have been developed and demonstrated, the field is still essentially unexplored and rich with many opportunities for important practical applications to real-world problems.

This presentation will begin with the emergence of nonlinear engineering, followed by the basics of nonlinear dynamics, chaos, and chaotic synchronization. Next, the application of chaos to RF communications will be surveyed, including an ongoing effort at The Aerospace Corporation to develop and demonstrate a high frequency, chaos-based communications system. Following this, a wide ranging, representative overview and assessment of other communications, signal processing and sensor applications will be covered, including several areas that have disruptive potential for performance improvement. Time permitting, the closely related concept of fractals will be illuminated and illustrated, followed similarly by a brief survey of its intriguing applications to engineering and virtual media. The presentation will conclude with a live chaotic circuit demonstration that serves to illuminate some of the nonlinear effects discussed in the talk.

Bio: Dr. Christopher P. Silva received the B.S., M.S., and Ph.D. degrees, all in electrical engineering, in 1982, 1985, and 1993, respectively, from the University of California at Berkeley. His graduate research focused on the analytical detection of chaotic dynamics in nonlinear circuits, including the well-known double-scroll chaotic circuit and analog phase-locked loops.

He joined the Electronics Research Laboratory of The Aerospace Corporation in 1989 and is currently a Senior Engineering Specialist in the Communication Electronics Department, Communications and Networking Division. He has been involved with several internally funded research projects addressing nonlinear microwave CAD, private/secure communications and radar by means of chaos, nonlinear stability analysis of microwave circuits, and the measurement, modeling and compensation of nonlinear, high data rate satellite communications channels. He has given many invited talks at conferences, society meetings, universities, industry, and laboratories on the applications of nonlinear techniques to communications and signal processing, along with corresponding publications in various venues.

Dr. Silva is a Fellow of the IEEE, a Senior Member of the AIAA, and a member of AMS and SIAM.