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Professor
Ph.D. Princeton, 1966

Our research is primarily in applications of contemporary developments in dynamical systems and nonlinear dynamics to problems of physical interest in fluid and plasma physics. The particular problems we are working on include:

Nonlinear stability of fluid flows in geophysical settings. We have developed a method for separating modes of an inviscid flow with significantly different time scales while retaining the Hamiltonian structure of the dynamics. This has been applied to the description of quasi-geostrophic flows in the ocean and atmosphere. This method also promises the ability to analyze the time scales in which nonlinear instabilities develop in physical systems. We are now applying this to the description of other flows with separated time scales such as waves on interfaces and wave motions internal to stratified fluids.

Using notions of nonlinear dynamics, we are investigating the manner in which friction is exhibited by parts of a Hamiltonian system which develop on separated time scales. Characterizing the flow of information from one subsystem to another by the Liapunov exponents natural to chaotic motions and by correlation functions in phase space, we are able to determine on what time scales a system may look dissipative and possess strange attractors even though it is part of an overall Hamiltonian system.

We are also beginning to investigate the spatial and temporal scales associated with nonlinear instabilities in a continuum system such as a fluid or plasma. This is an entirely new direction in the study on nonlinear instability and promises to have direct implications on experiments done here at UCSD and elsewhere which seek characteristics of these instabilities.

Selected Publications:

The Analysis of Observed Chaotic Data in Physical Systems. With R. Brown, J. Sidorowich and L. Tsimring. Rev. of Mod. Phys. 65, 1331 (1993).

Analysis of High Reynolds Number Flows over a Buoyant Axisymmetric Body. With J. Cembrela, T. Frison, T. Galib and R. Katz. Phys. Rev. E 49, 4003 (1994).

Nonlinear Systems. *Encyclopedia of Applied Physics,* Ed. G.L. Trigg, published by VCH Publishers in collaboration with the American Institute of Physics, the German Physical Society, the Japan Society of Applied Physics, and the Physical Society of Japan. To appear in 1994.