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Book Review: Noise and Chaos in Nonlinear Dynamical Systems

Noise and Chaos in Nonlinear Dynamical Systems (Proceedings of the Nato Advanced Research Workshop on Noise and Chaos in Nonlinear Dynamical Systems, Institute for Scientific Interchange, Turin, Italy, March 7–11, 1990), F. Moss, L. A. Lugiato, and W. Schleich, eds., Cambridge University Press, Cambridge, 1990.

There are so many conferences in each given field these days that one can (and probably, somebody has tried) to spend all the year just dashing madly from one conference to another.

In exchange for the registration fee, and depending on grants available, the organizers of conferences repay the participants by publishing *Proceedings* of these conferences. The simplest way to produce a *Proceedings* is similar to the recipe for Irish stew described by Jerome K. Jerome (to put in everything available): a wide range of topics, random articles written by those who attended the conference, different types of prints, figures, formulas, sometimes inserted by hand, and corrections, etc. Afterward, these *Proceedings* fill the shelves of libraries, and are rarely read.

The participants of the conference are in a better position than the readers; they are able to ask questions, to speak with the lecturers, and to participate in discussions (the only thing outsiders know about the discussions is revealed from the editor's preface for the *Proceedings* reviewed: "the participants gave rise to extremely lovely discussions").

The *Proceedings* under review also belongs to this type of publication, with one essential difference, namely, the articles are written by top-rank scientists regarded as leaders in their fields. Only this latter circumstance allows me to recommend these *Proceedings* to potential readers.

The 16 invited lectures presented in the *Proceedings* might be conveniently divided into the following topics:

I. *Quantum Theory of Measurements.* W. Lamb suggests simple harmonic oscillator models both for a given system and a measuring device

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("meter") assuming that the meter's coordinate can be measured. The appropriate equations have been solved numerically, showing the derivations of quantum measurements from the classical result.

II. *(Deterministic) Chaos Versus (Random) Noise.* G. Nicolis shows how to map some chaotic systems into a stochastic process.

III. *Chaotic Dynamics.* P. Cvitanovic calculates the averages over chaotic phase space as a perturbation series in a few fundamental cycles using as a small parameter the deviation of a longer cycle from its approximation by shorter cycles. G. Zaslavsky reviews some results obtained at the Space Research Institute, USSR, concerning diffusion dynamics and space patterns in degenerate (the action is identically equal to zero) Hamiltonian dynamics as compared with the Arnold diffusion in the KAM theory.

IV. *Colored Noise.* The path integral approach is described by M. San Miguel *et al.*, while R. Fox presents algorithms for numerical simulations of the colored noise.

V. *Applications of Chaotic Dynamics to:*

(a) *Nonlinear Optics.* S. Haroche studies the radiative properties of a single atom confined in a cavity with metallic boundaries. F. De Olivera *et al.* consider the statistical properties of squeezed light, while the connection between squeezing and instabilities is studied by C. Fabre *et al.* M. Scully considers a quantum beat laser as one of the systems which can lase even without population inversion. Including the transverse effects in the Maxwell–Bloch equations and solving them numerically for cylindrical symmetry, L. Lugiato *et al.* obtain the spatial patterns and their spontaneous symmetry breaking in lasers. F. Arecchi reports an experimental study of transient statistical dynamics of lasers.

(b) *Fluid Dynamics.* H. Brand and R Deissler review the theoretical and experimental stages of the confined states which appear, for example, in convection in binary liquid mixtures. S. Grossman presents a mean-field-like theory which allows one to obtain the Kolmogorov spectrum of turbulence from the nonlinear Navier–Stokes equation.

(c) *Chemical Reactions.* K. Lindenberg *et al.* present an extensive review of the peculiar kinetics of $A + B \rightarrow 0$ diffusion-limited reactions which proceed with anomalous reaction rate laws and end up in a non-homogeneous spatial distribution of species.

(d) *Quantum Tunneling.* P. Hanggi considers the influence of incoherent quantum tunneling processes on the stability of metastable states in the presence of dissipation.

In summary, I believe that scientists working in the field of chaotic dynamics will find some useful material in this *Proceedings.*

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