

# Scaling exponents reveal properties of data generating processes

Sixth International Conference  
on Noise in Physical Systems

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## FOREWORD

The study of fluctuations (or noise) in a physical system provides insights, not available by any other technique, into the microscopic dynamic behavior of that system. Besides being a source of information, noise can also be a source of irritation, in that it limits the performance of numerous devices. The study of noise is of prime importance for the testing of physical theories as well as for the development of improved physical measurements and improved performance of devices. Therefore, the Conference has as one of its goals an improved understanding of noise in devices and its influence on the error budget of a measurement. Indeed, progress in relieving or minimizing noise in some devices was reported (e.g., the relationship of "burst noise" to the metallurgical condition of the sample).

Strong emphasis was given in this Conference to new topics for which the noise spectra proved to be particularly helpful in characterizing the underlying system dynamics. Papers discussed, for example, the transition from periodic to chaotic behavior in chemical systems and turbulent fluid flow, entropy generation in the computer process, the existence and implications of quantum mechanical noise, and noise spectra occurring in electrochemical processes.

Judging from the number of contributions and the intensity of the discussions following their presentations, the topic of  $1/f$  noise remains as a very interesting one. It has resisted most, if not all theoretical attempts to explain it. An invited paper by T. Musha gave even more evidence to its ubiquity in nature. One of the most interesting developments here has been the connection between  $1/f$  noise and human comfort. Extending beyond the observation that noise exhibiting a  $1/f$  spectrum is pleasing to the listener, clinical evidence now suggests that electronic alleviation of pain in humans is improved when the electrical shocks are given a  $1/f$  component.

# Scaling phenomena: Time scales



## **1/f Noise in Human Cognition**

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When a person attempts to produce from memory a given spatial or temporal interval, there is inevitably some error associated with the estimate. The time course of this error was measured in a series of experiments where subjects repeatedly attempted to replicate given target intervals. Sequences of the errors in both spatial and temporal replications were found to fluctuate as  $1/f$  noises.  $1/f$  noise is encountered in a wide variety of physical systems and is theorized to be a characteristic signature of complexity.

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