



# Natural Time Analysis: The New View of Time : Precursory Seismic Electric Signals, Earthquakes and other Complex Time Series

Panayiotis A. Varotsos, Nicholas V. Sarlis, Efthimios S. Skordas



This book deals with the theory and the applications of a new time domain, termed natural time domain, that has been forwarded by the authors almost a decade ago (P.A. Varotsos, N.V. Sarlis and E.S. Skordas, Practica of Athens Academy 76, 294-321, 2001 Physical Review E 66, 011902, 2002). In particular, it has been found that novel dynamical features hidden behind time series in complex systems can emerge upon analyzing them in this new time domain, which conforms to the desire to reduce uncertainty and extract signal information as much as possible. The analysis in natural time enables the study of the dynamical evolution of a complex system and identifies when the system enters a critical stage. Hence, natural time plays a key role in predicting impending catastrophic events in general. Relevant examples of data analysis in this new time domain have been published during the last decade in a large variety of fields, e.g., Earth Sciences, Biology and Physics. The book explains in detail a series of such examples including the identification of the sudden cardiac death risk in Cardiology, the recognition of electric signals that precede earthquakes, the determination of the time of an impending major mainshock in Seismology, and the analysis of the avalanches of the penetration of magnetic flux into thin films of type II superconductors in Condensed Matter Physics. In general, this book is concerned with the time-series analysis of signals emitted from complex systems by means of the new time domain and provides advanced students and research workers in diverse fields with a sound grounding in the fundamentals of current research work on detecting (long-range) correlations in complex time series. Furthermore, the modern techniques of Statistical Physics in time series analysis, for example Hurst analysis, the detrended fluctuation analysis, the wavelet transform etc., are presented along with their advantages when natural time domain is employed.

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