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	Nota di contenuto	Introduction -- Introduction to Dynamical Systems Theory -- Bifurcation to Limit Cycle Oscillations in Laminar Thermoacoustic Systems -- Thermoacoustic Instability: Beyond Limit Cycle Oscillations -- Thermoacoustic Instability is Self-Organization in a Complex System -- Intermittency - A State Precedes Thermoacoustic Blowout in Turbulent Combustors -- Spatiotemporal Dynamics of Flow, Flame, and Acoustic Fields during the Onset of Thermoacoustic Instability -- Synchronization of Self-excited Acoustics and Turbulent Reacting Flow Dynamics -- Model for Intermittency Route to Thermoacoustic Instability -- Multifractal Analysis of a Turbulent Thermoacoustic System -- Complex Network Approach to Thermoacoustic Systems -- Early Warning and Mitigation Strategies for Thermoacoustic Instability -- Oscillatory Instabilities in Other Fluid Systems -- Summary and

Perspective.

Sommario/riassunto

This book systematically presents the consolidated findings of the phenomenon of self-organization observed during the onset of thermoacoustic instability using approaches from dynamical systems and complex systems theory. Over the last decade, several complex dynamical states beyond limit cycle oscillations such as quasiperiodicity, frequency-locking, period-n, chaos, strange non-chaos, and intermittency have been discovered in thermoacoustic systems operated in laminar and turbulent flow regimes. During the onset of thermoacoustic instability in turbulent systems, an ordered acoustic field and large coherent vortices emerge from the background of turbulent combustion. This emergence of order from disorder in both temporal and spatiotemporal dynamics is explored in the contexts of synchronization, pattern formation, collective interaction, multifractality, and complex networks. For the past six decades, the spontaneous emergence of large amplitude, self-sustained, tonaloscillations in confined combustion systems, characterized as thermoacoustic instability, has remained one of the most challenging areas of research. The presence of such instabilities continues to hinder the development and deployment of high-performance combustion systems used in power generation and propulsion applications. Even with the advent of sophisticated measurement techniques to aid experimental investigations and vast improvements in computational power necessary to capture flow physics in high fidelity simulations, conventional reductionist approaches have not succeeded in explaining the plethora of dynamical behaviors and the associated complexities that arise in practical combustion systems. As a result, models and theories based on such approaches are limited in their application to mitigate or evade thermoacoustic instabilities, which continue to be among the biggest concerns for engine manufacturers today. This book helps to overcome these limitations by providing appropriate methodologies to deal with nonlinear thermoacoustic oscillations, and by developing control strategies that can mitigate and forewarn thermoacoustic instabilities. The book is also beneficial to scientists and engineers studying the occurrence of several other instabilities, such as flow-induced vibrations, compressor surge, aeroacoustics and aeroelastic instabilities in diverse fluid-mechanical environments, to graduate students who intend to apply dynamical systems and complex systems approach to their areas of research, and to physicists who look for experimental applications of their theoretical findings on nonlinear and complex systems.