

Radboud University Nijmegen





Behavioral Science Institute

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“Turbulence is the most important unsolved problem of classical physics”

- Richard Feynman (1918 - 1988)

Learn for

turning



“I am an old man now, and when I die and go to heaven there are two matters on which I hope for enlightenment:

*One is quantum electrodynamics,
and the other is the turbulent motion of fluids.*

And about the former I am rather optimistic.”

- Horace Lamb (1849 - 1934)

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Turbulent



Laminar

Deterministic Chaos



The Art of Modeling Dynamic Systems

Table 12-1. Summary of the Hierarchy of Dynamic Systems.

Type	Constraints	Description
Zero	Absolute	Constant state
I	Analytic integrals	Solvable dynamic system
II	Approximate analytic integrals	Amenable to perturbation theory
III	Quasi-deterministic; smooth but erratic trajectory	Chaotic dynamic system
IV	Rigorously defined only by averages over time or state space	Turbulent/stochastic

Table 12-2. A few examples of the types of dynamic systems.

Type	Examples
Zero	Images, gravity models, structures
I	Gear trains, 2-body problem, physical pendulum
II	Satellite orbits, lunar and planetary theories
III	Climatology, Lorenz equations, discrete logistic equation
IV	Quantum mechanics, turbulent flow, statistical mechanics

A Classification Scheme for Dynamic Systems 169

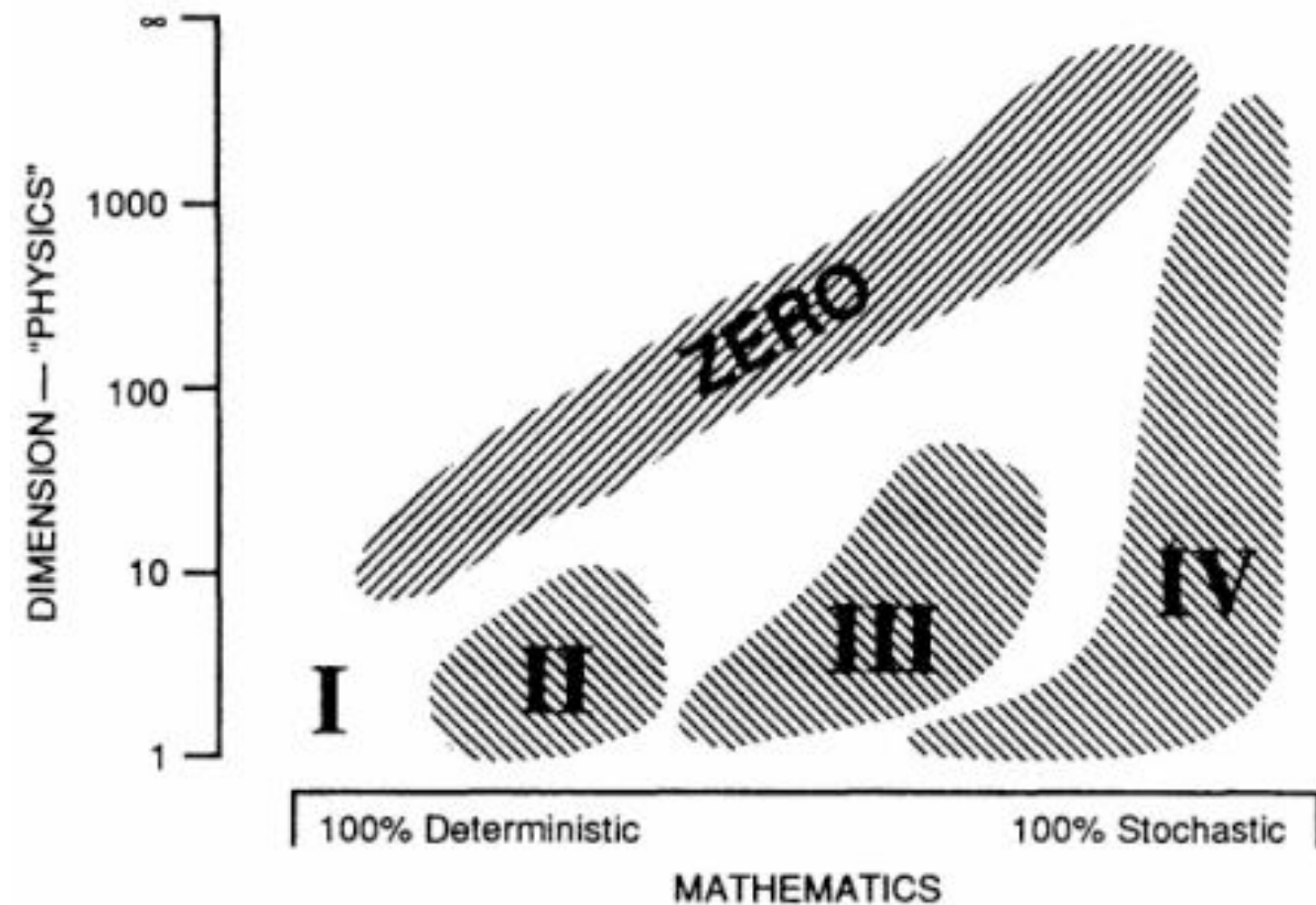


Figure 12-1. Schematic representation of the Hierarchy of Dynamic Systems.