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Classical and Quantum Nonlinear Dynamics, Frühjahrsemester 2024

Preliminary outline

I. Flows on the line
I.1 Introduction: A geometric way of thinking
I.2 Linear stability analysis
I.3 Existence an uniqueness of solutions
I.4 Bifurcations
I.5 Flows on the circle (self reading)

II. Two-dimensional flows
II.1 Linear systems
II.2 Phase plane; linearization
II.3 Index theory (self reading)
II.4 Limit cycles
II.5 Bifurcations revisited

III. Chaos
III.1 Lorenz equations
III.2 One-dimensional maps

IV. Synchronization
IV.1 Basic concepts
IV.2 Locking of one oscillator to an external harmonic signal
IV.3 Mutual synchronization of two oscillators
IV.4 Many oscillators: The Kuramoto model

V. Parametrically-pumped oscillators
V.1 Mathieu equation; Floquet theory
V.2 The nonlinear parametric resonator
V.3 Coupled parametric resonators

VI. Quantum nonlinear dynamics
VI.1 From closed to open quantum systems
VI.2 The quantum parametric oscillator
VI.3 Quantum synchronization
VI.4 Quantum chaos