



Nonlinear Physical Systems: Spectral Analysis, Stability and Bifurcations

Oleg N. Kirillov, Dmitry E. Pelinovsky

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Bringing together 18 chapters written by leading experts in dynamical systems, operator theory, partial differential equations, and solid and fluid mechanics, this book presents state-of-the-art approaches to a wide spectrum of new and challenging stability problems.

Nonlinear Physical Systems: Spectral Analysis, Stability and Bifurcations focuses on problems of spectral analysis, stability and bifurcations arising in the nonlinear partial differential equations of modern physics. Bifurcations and stability of solitary waves, geometrical optics stability analysis in hydro- and magnetohydrodynamics, and dissipation-induced instabilities are treated with the use of the theory of Krein and Pontryagin space, index theory, the theory of multi-parameter eigenvalue problems and modern asymptotic and perturbative approaches.

Each chapter contains mechanical and physical examples, and the combination of advanced material and more tutorial elements makes this book attractive for both experts and non-specialists keen to expand their knowledge on modern methods and trends in stability theory.

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1. Surprising Instabilities of Simple Elastic Structures, Davide Bigoni, Diego Misseroni, Giovanni Noselli and Daniele Zaccaria.
2. WKB Solutions Near an Unstable Equilibrium and Applications, Jean-François Bony, Setsuro Fujiié, Thierry Ramond and Maher Zerzeri, partially supported by French ANR project NOSEVOL.
3. The Sign Exchange Bifurcation in a Family of Linear Hamiltonian Systems, Richard Cushman, Johnathan Robbins and Dimitrii Sadovskii.
4. Dissipation Effect on Local and Global Fluid-Elastic Instabilities, Olivier Doaré.
5. Tunneling, Librations and Normal Forms in a Quantum Double Well with a Magnetic Field, Sergey Yu. Dobrokhotov and Anatoly Yu. Anikin.
6. Stability of Dipole Gap Solitons in Two-Dimensional Lattice Potentials, Nir Dror and Boris A. Malomed.
7. Representation of Wave Energy of a Rotating Flow in Terms of the Dispersion Relation, Yasuhide Fukumoto, Makoto Hirota and Youichi Mie.
8. Determining the Stability Domain of Perturbed Four-Dimensional Systems in 1:1 Resonance, Igor Hoveijn and Oleg N. Kirillov.
9. Index Theorems for Polynomial Pencils, Richard Kollár and Radomír Bosák.
10. Investigating Stability and Finding New Solutions in Conservative Fluid Flows Through Bifurcation Approaches, Paolo Luzzatto-Fegiz and Charles H.K. Williamson.
11. Evolution Equations for Finite Amplitude Waves in Parallel Shear Flows, Sherwin A. Maslowe.
12. Continuum Hamiltonian Hopf Bifurcation I, Philip J. Morrison and George I. Hagstrom.
13. Continuum Hamiltonian Hopf Bifurcation II, George I. Hagstrom and Philip J. Morrison.
14. Energy Stability Analysis for a Hybrid Fluid-Kinetic Plasma Model, Philip J. Morrison, Emanuele Tassi and Cesare Tronci.
15. Accurate Estimates for the Exponential Decay of Semigroups with Non-Self-Adjoint Generators, Francis Nier.
16. Stability Optimization for Polynomials and Matrices, Michael L. Overton.
17. Spectral Stability of Nonlinear Waves in KdV-Type Evolution Equations, Dmitry E. Pelinovsky.

18. Unfreezing Casimir Invariants: Singular Perturbations Giving Rise to Forbidden Instabilities, Zensho Yoshida and Philip J. Morrison.

About the Authors

Oleg N. Kirillov has been a Research Fellow at the Magneto-Hydrodynamics Division of the Helmholtz-Zentrum Dresden-Rossendorf in Germany since 2011. His research interests include non-conservative stability problems of structural mechanics and physics, perturbation theory of non-self-adjoint boundary eigenvalue problems, magnetohydrodynamics, friction-induced oscillations, dissipation-induced instabilities and non-Hermitian problems of optics and microwave physics. Since 2013 he has served as an Associate Editor for the journal *Frontiers in Mathematical Physics*.

Dmitry E. Pelinovsky has been Professor at McMaster University in Canada since 2000. His research profile includes work with nonlinear partial differential equations, discrete dynamical systems, spectral theory, integrable systems, and numerical analysis. He served as the guest editor of the special issue of the journals *Chaos* in 2005 and *Applicable Analysis* in 2010. He is an Associate Editor of the journal *Communications in Nonlinear Science and Numerical Simulations*.

This book is devoted to the problems of spectral analysis, stability and bifurcations arising from the nonlinear partial differential equations of modern physics. Leading experts in dynamical systems, operator theory, partial differential equations, and solid and fluid mechanics present state-of-the-art approaches to a wide spectrum of new challenging stability problems. Bifurcations and stability of solitary waves, geometrical optics stability analysis in hydro- and magnetohydrodynamics and dissipation-induced instabilities will be treated with the use of the theory of Krein and Pontryagin space, index theory, the theory of multi-parameter eigenvalue problems and modern asymptotic and perturbative approaches. All chapters contain mechanical and physical examples and combine both tutorial and advanced sections, making them attractive both to experts in the field and non-specialists interested in knowing more about modern methods and trends in stability theory.

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