# Cambridge Scientific Publishers

An International Book Series

# Stability, Oscillations and Optimization of Systems



Modern stability theory, oscillations and optimization of nonlinear systems developed in respond to the practical problems of celestial mechanics and engineering has become an integral part of human activity at the end of XX century.

If, for a process or a phenomenon, for example, atom oscillations or a supernova explosion, a mathematical model is constructed in the form of a system of differential equations, the investigation of the latter is possible either by a direct (numerical as a rule) integration of the equations or by its analysis by qualitative methods.

In XX century the fundamental works by Euler (1707 – 1783), Lagrange (1736 – 1813), Poincaré (1854 – 1912), Lyapunov (1857 – 1918) and others have been thoroughly developed and applied in stability and oscillations investigation of nature phenomena and solution of many problems of technical progress.

In particular, the problems of piloted space flights and those of astrodynamics were solved due to modern achievements of stability theory and motion control. The Poincaré and Lyapunov methods of qualitative investigation of solutions to nonlinear systems of differential equations in macro-world study have been refined to a great extend though not completed. On the other hand modeling and establishing stability conditions for micro-processes are still on the stage of accumulating ideas and facts and forming the principles. One of the examples is the fact that the stability problem of thermonuclear synthesis has not been solved yet.

Obviously, this is one of the areas for application of stability and control theory in XXI century. For the development of efficient methods and algorithms in this area the interaction and spreading of the ideas and results of various mathematical theories will be necessary as well as the co-operation of scientists specializing in different fields.

The mathematical theory of optimal control (of moving objects, water resources, global process in world economy, etc.) is being developed in terms of basic ideas and results obtained in 1956 – 1961 and formulated in the Pontryagin's principle of optimality and Bellman's principle of dynamical programming. Considering manufacturing and production engineering activities, due to the difficulties of description of discrete events and hybrid processes, various heuristic and soft computing approaches have been developed for solving optimization problems. The efforts of many scholars and engineers in the framework of these ideas resulted in the efficient methods of control for many concrete systems and technological processes.

Thus, the development of classical ideas and results of stability and control theory remains the principle direction for the scholars and experts at modern stage of the mathematical theories. This fact will be demonstrated in the International Series **Stability, Oscillations and Optimization of Systems** by Cambridge Scientific Publishers Ltd.

**Stability, Oscillations and Optimization of Systems** provides a medium for the publication of high quality original monographs in the following areas:

**Development of the theory and methods of stability analysis**:

A. Stability Theory (ordinary differential equations, partial differential equations, stochastic differential equations, functional differential equations, integral equations, difference equations, etc.)
B. Dynamical Systems and Ergodic Theory (bifurcations and singularity, critical point theory, polystability, etc.)

**Development of methods of the theory of nonlinear oscillations:**
A. Analytical methods.
B. Qualitative methods.
C. Topological methods.
D. Numerical and computational methods, etc.

**Development of the theory and methods of optimization of systems:**
A. Optimal control of systems involving ODE, PDE, integral equations, equations with retarded argument, etc.
B. Minimax problems and nonsmooth analysis.
C. Necessary and sufficient conditions for optimality.
D. Hamilton-Jacobi theories.
E. Methods of successive approximations, etc.
F. Heuristics and metaheuristics for the optimization of ill defined and complex systems.

**Applications:**
A. Physical sciences (classical mechanics, including fluid and solid mechanics, quantum and statistical mechanics, plasma physics, astrophysics, etc.).
B. Engineering (mechanical engineering, aeronautical engineering, electrical engineering, chemical engineering).
C. Mathematical biology and life sciences (molecular biology, population dynamics, theoretical ecology).
D. Complex systems (synchronization, information and self-organization, collective dynamics, spatiotemporal chaos, biological and neural networks).
E. Manufacturing and production engineering.
F. Social sciences (economics, philosophy, sociology).

In the forthcoming publications of the series the readers will find fundamental results and survey papers by the experts from the worldwide which sum up the results of investigations in many directions of stability and control theory including uncertain and hybrid systems and systems with chaotic behavior of trajectories.

It is in this spirit that we see the importance of the **Stability, Oscillations and Optimization of Systems** series, and we are immensely thankful to Cambridge Scientific Publishers, Ltd. for their interest and cooperation in publishing this series.