Book review

Introduction to the Modern Theory of Dynamical Systems by Anatole Katov and Boris Hasselblatt, Cambridge University Press, 1995.

I suspect that most readers, upon seeing the title of this book, would expect something quite different. The very broad title would lead one to believe that this is a work covering the behavior of mechanical, electrical, fluid and thermal systems, operational methods of linear systems analysis and time and frequency domain methods. The exact choice of topics would vary depending on the experience and goal of the authors. This book, however, provides the mathematical background needed for only some areas that fall into the category of dynamical systems. It consists of propositions, proofs, theorems, corollaries, lemmas and definitions, with nary an application in sight. The authors believe that "... the theory of dynamical systems is a major mathematical discipline closely intertwined with most of the main areas of mathematics". The net result is a book that only a mathematician could love.

The book consists of four parts with a total of 20 chapters, a Supplement and an Appendix. Part one, entitled "Examples and fundamental concepts", has chapters dealing with examples (maps with stable asymptotic behavior, linear maps, rotation of the circle, translation of the torus, linear flow on the torus, gradient flow, expanding maps, hyperbolic toral automorphisms and symbolic dynamical systems); equivalence, classification and invariants; principal classes of asymptotic topological invariants; statistical behavior of orbits and introduction to ergodic theory; systems with smooth invariants and more examples. This latter chapter covers Newtonian systems, Lagrangian mechanics, geodesic flow, Hamiltonian systems and contact systems in 35 pages.

Part two consists of four chapters covering local analysis and orbit growth. Part three covers low-dimensional phenomena. Part four considers hyperbolic dynamical systems. According to the authors, "... the main theme of the second part is the interplay between local analysis near individual (e.g., periodic) orbits and the global complexity of the orbit structure". Parts three and four expand on the "examples" introduced in Part one in great detail.

The book is Volume 54 of the *Encyclopedia of Mathematics and its Applications* by Cambridge University Press. This series "... is devoted to significant themes or topics that have a wide application in mathematics or mathematical science and for which a detailed development of the abstract theory is less important than a thorough and concrete exploration of the implications and applications". One has to wonder then why this book was included since it does the exact opposite. It also serves to illustrate the significant language gap between mathematicians and engineers, especially regarding such words as "applied", "examples" and "practical".

If you love mathematical rigor and orbital dynamics, this book should be in your library. It has its place as a reference text in that area of study. That is the limit of what it has to offer. It is definitely not a broad-based coverage of dynamical systems and it is at the opposite extreme of what an engineer would call a "practical" or "applied" book. The title is far too broad, probably an attempt to reach an audience that would not otherwise buy it. What the authors do, they do well. The book is a very good, comprehensive reference on the mathematical foundations of orbital mechanics. Other dynamic systems are mentioned only in passing. The coverage requires a good background in mathematics. Hence, the book will be inaccessible to most graduates of a standard U.S. engineering program since they will lack the mathematical sophistication needed until completion of at least a first graduate degree.

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