

Preface

This text is based on various courses taught, over many years, by the authors at the University of Bath. The intention is a rigorous – and essentially self-contained – treatment of initial-value problems for ordinary differential equations. The material is presented at a technical level accessible by final year undergraduate students of mathematics and appropriate also for students in the early stages of postgraduate study, both in mathematics and mathematically-oriented engineering. Only a basic grounding in linear algebra (e.g. finite-dimensional vector spaces, norms, inner products, linear transformations and matrices, Jordan form) and analysis (e.g. uniform continuity, uniform convergence, compactness in a finite-dimensional setting, elementary differential and integral calculus) is assumed: the typical UK undergraduate attains this level of mathematical maturity by the end of his/her second year of study in mathematics. In an appendix, these basics are assembled to provide the mathematical framework underpinning the book. In the main body of the text, diverse results are presented pertaining to existence and uniqueness of solutions of initial-value problems, continuous dependence on initial data, flows, qualitative behaviour of solutions, limit sets, stability theory, invariance principles, introductory control theory, stabilization by feedback. The latter aspects, namely the coverage of control theoretic concepts, is a distinguishing feature. This thread runs from essentially classical linear control theory, through developments in absolute stability of feedback systems, and terminates with an introductory account of more recent notions of feedback stabilizability and input-to-state stability. The book has no pretensions to comprehensiveness. On the one hand, the permeating thread of control reflects a bias towards synthesis: the bringing of stable behaviour to potentially or inherently unstable processes through appropriate choice of inputs. On the other hand, the book does not contain material relating to the theory of bifurcations or chaos (these topics are treated in numerous other texts on ordinary differential equations).

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Hartmut Logemann & Eugene P. Ryan
Bath
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