

Preface

It has been known since antiquity that Nature is full of wonderful geometric structures (cellular, helical, vertex, crystalline etc), and some remarkable purely mathematical structures have been discovered in the last century (resonance structures, strange attractors, fractals). Besides being of great scientific interest, these structures often possess a very beautiful visual form. In recent years the structures have been the object of an extensive research activity in various fields of Science. The dynamical theory of formogenesis is widely discussed in the literature.

This book attempts to provide both the visual presentation and theoretical analysis of the structures arising in nonlinear dynamical systems. The WinSet program (developed by the authors) is used to generate the images of many invariant structures related to a variety of phenomena of nonlinear dynamics. The images of structures dealt with in the book may be referred to as "fractal design" or "esthetic chaos".

The book consists of two parts. Part I is intended for a wide readership and is concerned with the WinSet software for the visualization of invariant sets of classical nonlinear dynamical systems. The features of the program are described, and the standard (built-in) maps, differential equations and fractals are listed, for which WinSet can draw the invariant sets. The program functions in Windows 95 environment and can be used for computer-aided design.

Part II presents the mathematical investigation of invariant sets in low-dimensional dynamical systems and diffusion equations, and explains how the invariant structures appear and requires a sound mathematical knowledge.

Chapters 1, 4–7 were written by A. Morozov (except Section 4.4.1 and Section 4.4.2 written by T. Dragunov), Chapter 2 — by O. Malysheva and T. Dragunov, Chapter 3 — by S. Boykova, Chapter 8 — by A. Morozov and O. Malysheva. Writing and debugging of the WinSet source code in Delphi-3 was mainly done by T. Dragunov, while some modules were written by the other authors. The compiler for user-defined systems was written by S. Boykova and T. Dragunov.

WinSet grew out of the program called Mader developed by Morozov in early 90-s.

The book is based on the monograph "Invariant Sets of Dynamical Systems for Windows" published in Russia in 1998, written by the same authors [68]. The Chapter 8 has been added especially for the English edition. Besides, Chapters 1–3 have been revised, and the new version of the WinSet application has been created.

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