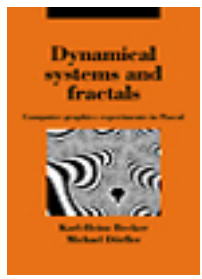

Dynamical Systems and Fractals

Computer Graphics Experiments with Pascal

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Book DOI: http://dx.doi.org/10.1017/CBO9780511663031

Online ISBN: 9780511663031

Hardback ISBN: 9780521360258

Paperback ISBN: 9780521369107

Chapter

Preface to the German Edition pp. xi-xii

Chapter DOI: http://dx.doi.org/10.1017/CBO9780511663031.002

Cambridge University Press

Preface to the German Edition

Today the 'theory of complex dynamical systems' is often referred to as a revolution, illuminating all of science. Computer-graphical methods and experiments today define the methodology of a new branch of mathematics: 'experimental mathematics'. Its content is above all the theory of complex dynamical systems. 'Experimental' here refers primarily to computers and computer graphics. In contrast to the experiments are 'mathematical cross-connections', analysed with the aid of computers, whose examples were discovered using computer-graphical methods. The mysterious structure of these computer graphics conceals secrets which still remain unknown, and lie at the frontiers of thought in several areas of science. If what we now know amounts to a revolution, then we must expect further revolutions to occur.

- The groundwork must therefore be prepared, and
- people must be found who can communicate the new knowledge.

We believe that the current favourable research situation has been created by the growing power and cheapness of computers. More and more they are being used as research tools. But science's achievement has always been to do what can be done. Here we should mention the name of Benoi§t B. Mandelbrot, a scientific outsider who worked for many years to develop the fundamental mathematical concept of a fractal and to bring it to life.

Other research teams have developed special graphical techniques. At the University of Bremen fruitful interaction of mathematicians and physicists has led to results which have been presented to a wide public. In this context the unprecedented popular writings of the group working under Professors Heinz-Otto Peitgen and Peter H. Richter must be mentioned. They brought computer graphics to an interested public in many fantastic exhibitions. The questions formulated were explained non-technically in the accompanying programmes and exhibition catalogues and were thus made accessible to laymen. They recognised a further challenge, to emerge from the 'Ivory Tower' of science, so that scientific reports and congresses were arranged not only in the university. More broadly, the research group presented its results in the magazine *Geo*, on ZDF television programmes, and in worldwide exhibitions arranged by the Goethe Institute. We know of no other instance where the bridge from the foremost frontier of research to a wide lay public has been built in such a short time. In our own way we hope to extend that effort in this book. We hope, while dealing with the discoveries of the research group, to open for many readers the path to their own experiments. Perhaps in this way we can lead them towards a deeper understanding of the problems connected with mathematical feedback.

Our book is intended for everyone who has a computer system at their disposal and who enjoys experimenting with computer graphics. The necessary mathematical formulas are so simple that they can easily be understood or used in simple ways. The reader will rapidly be brought into contact with a frontier of today's scientific research, in which

hardly any insight would be possible without the use of computer systems and graphical data processing.

This book divides into two main parts. In the first part (Chapters 1-10), the reader is introduced to interesting problems and sometimes a solution in the form of a program fragment. A large number of exercises lead to individual experimental work and independent study. The first part closes with a survey of 'possible' applications of this new theory.

In the second part (from Chapter 11 onwards) the modular concept of our program fragments is introduced in connection with selected problem solutions. In particular, readers who have never before worked with Pascal will find in Chapter 11 - and indeed throughout the entire book - a great number of program fragments, with whose aid independent computer experimentation can be carried out. Chapter 12 provides reference programs and special tips for dealing with graphics in different operating systems and programming languages. The contents apply to MS-DOS systems with Turbo Pascal and UNIX 4.2 BSD systems, with hints on Berkeley Pascal and C. Further example programs, which show how the graphics routines fit together, are given for Macintosh systems (Turbo Pascal, Lightspeed Pascal, Lightspeed C), the Atari (ST Pascal Plus), the Apple IIe (UCSD Pascal), and the Apple IIGS (TML Pascal).

We are grateful to the Bremen research group and the Vieweg Company for extensive advice and assistance. And, not least, to our readers. Your letters and hints have convinced us to rewrite the first edition so much that the result is virtually a new book - which, we hope, is more beautiful, better, more detailed, and has many new ideas for computer graphics experiments.

Bremen *Karl-Heinz Becker* *Michael Dörfler*