J Stat Phys (2008) 130: 203–204
DOI 10.1007/s10955-007-9441-7

Michael F. Barnsley: Superfractals

Cambridge University Press, 2006

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Received: 7 September 2007 / Accepted: 14 September 2007 / Published online: 3 October 2007

Nature abounds with examples of fractal patterns—images and phenomena that exhibit self similarity over a wide range of length scales. Michael Barnsley has devoted a large part of his career figuring out ways to model these patterns by means of fractal geometry. The absolute authority on applications of fractals to image compression, he holds several patents on the subject and heads *Iterated Systems Inc.*, the business he had founded in 1987 to exploit these ideas. Most of us are acquainted with Barnsley's work thanks to his oft cited book *Fractals Everywhere*. In *Superfractals* he further develops the theory and introduces new concepts, culminating with *superfractals*, that let one describe whole collections of random variations of a natural image (a mountain scape, a tree, or fern) by means of *iterated function systems* (IFS), thus formally connecting between deterministic and random fractals.

The first half of the book (Chaps. 1 and 2) covers mostly familiar background material; points and spaces, metric, measures, fractal dimension, mappings and transformations, with the addition of *code spaces*—spaces of point addresses—that endow IFS with tremendous flexibility and constitute a major theme of the book. The second half explores new ideas, such as *orbital pictures* that result from IFS semigroups applied to pictures and sets (Chap. 3), fractal homeomorphisms and *fractal tops*, that assign unique addresses to set attractors even in overlapping cases (Chap. 4), and *superfractals*, that result from application of different IFS using the new concept of V*-variability* (Chap. 5).

The book is written in a mathematical style, with emphasis on applications. Each new idea is preceded by an intuitive discussion, often accompanied by examples, and always by gorgeous artwork. The explanations and arguments are very clear and easy to follow, even for someone not accustomed to mathematical texts. Barnsley remarks that it is imperative to read the book sequentially from its beginning to absorb the necessary concepts and notation for the understanding of the material in later chapters, however Chap. 5 on *superfractals* is particularly well written, and I find that the detailed account (in Sect. 5.2) of the computational experiments that led the author and his colleagues to their discovery helps

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one jumping directly into the subject with minimal fuss. Exercises scattered throughout the book are very helpful in grasping the material. If there is any change I'd like to see in the second edition is the inclusion of an answers key with solutions and hints, as in *Fractals Everywhere*. The work has immediate applications to computer graphics and signal processing. The mathematical formalism presented makes a significant contribution to the field of fractal geometry and hints at broader future developments.