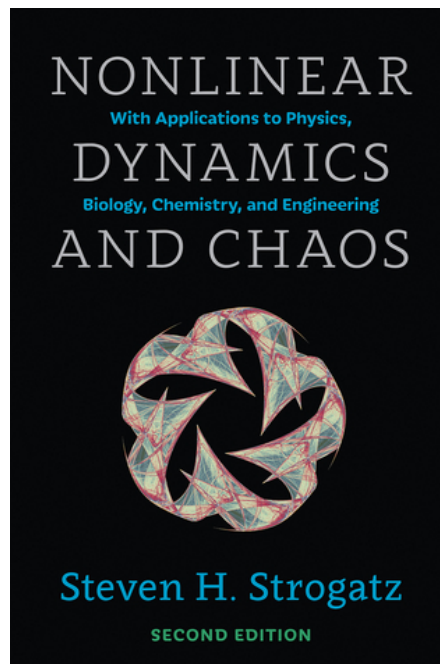




Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering

Steven H. Strogatz

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This textbook is aimed at newcomers to nonlinear dynamics and chaos, especially students taking a first course in the subject. The presentation stresses analytical methods, concrete examples, and geometric intuition. The theory is developed systematically, starting with first-order differential equations and their bifurcations, followed by phase plane analysis, limit cycles and their bifurcations, and culminating with the Lorenz equations, chaos, iterated maps, period doubling, renormalization, fractals, and strange attractors.

A unique feature of the book is its emphasis on applications. These include mechanical vibrations, lasers, biological rhythms, superconducting circuits, insect outbreaks, chemical oscillators, genetic control systems, chaotic waterwheels, and even a technique for using chaos to send secret messages. In each case, the scientific background is explained at an elementary level and closely integrated with mathematical theory.

In the twenty years since the first edition of this book appeared, the ideas and techniques of nonlinear dynamics and chaos have found application to such exciting new fields as systems biology, evolutionary game theory, and sociophysics. This second edition includes new exercises on these cutting-edge developments, on topics as varied as the curiosities of visual perception and the tumultuous love dynamics in *Gone With the Wind*.

Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering Details

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From Reader Review Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering for online ebook

Santiago Ortiz says

I'm just starting the book, but I already know this is a ★★★★★. This book is a window to Nature. The ratio between deepness and accessibility is amazing, thanks to the well written and clear texts and, specially, the smart and beautiful geometric explanations and qualitative solutions.

123...N says

Nonlinear Dynamics and Chaos by Strogatz is an introduction to the qualitative study of systems of first degree differential equations. Topics included through the first six chapters (which is as far as I have currently read) are bifurcations, stability of fixed points, linearization about fixed points, and many others. The writing is more conversational than a normal textbook which makes it less painful to read but also has some drawbacks.

Cons: The book is harder to use as a reference than typical textbooks because definitions and theorems are not boxed and set aside from the rest of the text (though I should note the first time a word is used it is usually in bold text). This can be a problem because the jargon is rather involved. Formal definitions are sometimes not given. Theorems are not accompanied by a proof (though for some of the theorems that is probably a good thing). There is no index of symbols (though to be fair the book has pretty standard notation). The pace is fairly brisk.

Pros: A strength of the book is the number of interesting applications provided. Instead of a plain math problem the examples often involve a model of a situation from biology or physics. Overall a very readable math book with interesting examples that stresses developing geometrical intuition and the ability to apply the math above a theoretical and rigorous development of the material. A solid background in calculus is all that is really needed to understand the book, though a having a smattering of linear algebra would be useful at certain points. There is an associated lecture series by the author on youtube.

Would Recommend: for people who need a refresher on the subject. People who are familiar with the math but are looking for applications.

Would Recommend With Reservations: to people who are new to the subject (the book is well written but the quick pace, difficulty to reference, and lack of rigor can cause problems).

Would Not Recommend: for someone looking for a rigorous and theoretical approach to the subject.

Mangoo says

Excellent mathematical introduction to the dynamics of non-linear systems. The text style is rather informal, and very clear, and many of the concepts and results presented are exposed in an intuitive way. Beginning

from uni-dimensional systems and reaching to chaos and strange attractors, there's that typical progressive crescendo in complexity which makes the reading worth and sticking. The book also contains a lot of examples taken from several disciplines (physics, chemistry, population dynamics, biology, and so on) and many exercises at the end of chapters.

Highly recommended.

Joe says

This is the definitive textbook about nonlinear dynamics, chaos, and complexity sciences. Be forewarned, there's math - but math is the language of science and everything here is essential and approachable. Not only is this a great introduction, it also makes a solid reference work for later use. Professor Strogatz also has a free companion YouTube series that follows along with the book. Highly recommended.

Johannes says

This is *the book* for nonlinear dynamics. Strogatz's writing is not only easy to follow, but is also pleasant, conversational, and at times even a bit whimsical. The book opens with very simple material, and while it eventually touches on some fairly advanced ideas (eg renormalization), it builds up to that point very carefully, so the student should never feel overwhelmed. The examples and problems are drawn from a wide range of fields, so students from disciplines besides math and physics should see some connection to their own interests.

Some people criticize the book's scope, claiming that it is too limited, but specialized topics such as pattern formation and network dynamics are better reserved for a more advanced course.

An excellent complement to the book is the set of lecture notes written by Michael Cross and available on his website: Chaos on the Web.

Kyle says

Fixed points, their equilibrium, bifurcation parameters, non-dimensionalization, linearization, romeo and juliet

Stefano Finazzo says

Um exemplo de como se escrever um livro didático... realmente didático.

Strogatz mostra o básico de sistemas dinâmicos começando do realmente básico, exigindo um mínimo de requisitos - um módico de conhecimentos de cálculo já é mais que suficiente. E leva o leitor bem longe, sem nunca deixá-lo abandonar a trilha - e exibindo a paisagem majestosa pelo meio do caminho.

O tom é informal (e cheio de troças e piadinhas); o rigor matemático é secundário à legibilidade e à intuição. Em todo capítulo há aplicações para o mundo real - algumas bem pouco triviais. Em qualquer assunto, numa

primeira exposição, é muito melhor saber por que as coisas são verdadeiras do que ter uma prova de que são, como dizem por aí.

Sobre os tópicos: Strogatz começa com uma exposição introdutória, mas relativamente completa, de fluxos na reta e no plano. O cume dessa primeira parte é a discussão sobre ciclos limites e bifurcações. Depois inicia a segunda parte sobre caos e fractais, que é apresentada de uma forma mais esquemática, ainda mais introdutória - o objetivo é mais despertar o gostinho da coisa que ser uma referência completa.

Alias, despertar o gosto pela coisa é o principal trunfo de Strogatz - missão na qual ele é bem sucedido - com láureas.

Ajuda um pouquinho que o tópico do livro favorece a apresentação de figuras de encher os olhos...

Robert says

I found this to be an excellent introduction to the subject, with clear explanations and extremely good organisation of the material. Examples build on each other in a logical fashion and make the pure mathematics concrete by using genuine scientific applications. The subject itself is fascinating and surprisingly mathematically tractable. The early chapters could be handled by anyone with A-level mathematics. Infrequent references to esoteric subjects like point-set topology are made for the sake of rigour but in fact can be totally ignored without loss of practical understanding of the techniques. Those needing more advanced material in any particular area will find adequate references.

Great stuff!

Stuart Woolf says

4.5 stars.

This is probably the best math book I've ever read. The author's approach, which is highly unusual in math, emphasizes intuition and visualization over abstractions and formulae - a winning strategy because it eases the learning curve for an otherwise difficult subject without stressing the technical details. Some readers will see this as a flaw, but I think the text is balanced correctly: after all, nonlinear dynamics is a field that yields very few analytical solutions, so why waste time discussing tools that don't work?

The author also does a terrific job making his subject interesting. Some readers might counter that nonlinear dynamics is already interesting to the intended audience, requiring very little reinforcement; this is all true, but in my experience, the average math writer is a curiosity killer. Not so in this text: nonlinear principles are applied somewhat liberally to an array of situations you wouldn't expect, like dating patterns and irreversible insect outbreaks.

Another reviewer called the book "a life-changing experience". Admittedly, it is the only book I have read that has made me want to go to graduate school.

Mark Gomer says

I skimmed this book while watching the author's corresponding lecture series on YouTube:
<https://www.youtube.com/playlist?list...>

Ruth says

This is kind of a lie, since we didn't go through the ENTIRE book, but we did cover the first two parts and a bit of the third. I feel like with a better teacher I could have both enjoyed it and learned something from it. I guess we'll never know, now. So long, Strogatz.

Elio Nakouzi says

Top quality book. Accessible but powerful. Excellent examples to demonstrate the concepts. Even useful as a course textbook.

Caroline says

This introduction to nonlinear dynamics is easy and entertaining to read. Those are qualities sorely missing from most math books out there. I recommend it to anyone -- undergraduate, graduate, or beyond -- who needs an excellent, beautifully clear introduction to nonlinear dynamics.

Saul says

Very clear and engaging text on nonlinear dynamics with lots of great examples from real-world systems. Rarely do you read a textbook and think to yourself "Wow, I can't wait to find time to work on some of these homework problems." The descriptions often make use of geometric intuition alongside more rigorous derivations, and when the derivations get too difficult, the author omits them in favor of references to more technical works.

One little gripe: the figures are sometimes kind of lousy or copied from much older works from as far back as the '80s and '90s. I could make better figures in a couple hours (and did while working the exercises), so the author could probably have found the time to do so (or had a grad student do it). Some of the problem may be the desire to make everything compatible with two-tone black-and-white for the paper editions. It's a shame, since the fractals are so beautiful when you render them nicely.

A second little gripe: The e-book displays equations using little graphic inserts, which are often completely the wrong size. The result is readable enough, but not very attractive.

Daniel Brandtner says

Strogatz delivers a readable and comprehensible introduction to nonlinear systems and chaos. He prefers intuitive explanations and examples to rigorous mathematical proofs (though he always indicates where one could find more detailed analysis).
