SIAM REVIEW
Vol. 45, No. 1, pp. 127–164

Book Reviews

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Featured Review: Diffusion and Ecological Problems: Modern Perspectives. Second Edition. *By Akira Okubo and Simon Levin.* Springer-Verlag, New York, 2001. $59.95. xx+467 pp., hardcover. ISBN 0-387-98676-6.

This is a revised and expanded version of Okubo's classic 1980 text *Diffusion and Ecological Problems: Mathematical Models* [2]. While building on the original text, the revision has brought the subject well into the 21st century: the length has almost doubled and the number of references has tripled; themes hinted at in the original version have been developed and matured. Before his death, Okubo asked that his notes on book changes and expansions be left to a close colleague, Simon Levin, and that "he would know what to do with them." Well, Levin did know what to do with them. The result is an excellent book on the role of diffusion theory in modern spatial ecology. In addition to Okubo's original book and its revisions, the contents have been fleshed out by 12 additional authors, all experts in spatial ecology.

This book occupies the middle ground between mathematical theory and ecological theory. It contains many innovative and original models, some analytical results, but no theorems. However, mathematicians and quantitative biologists alike will find the book a useful guide to the formulation and analysis of diffusion-based models in ecology. While biological applications are discussed, the main focus is not on methods for relating model output directly with experimental or field measurement. By contrast, a text that more fully develops the interplay between diffusion models and experiment is Turchin [3].

The original text grew from Okubo's interest in understanding ecological systems with the tools and background of a mathematical physicist. In this original text, the details of diffusion in the atmosphere and ocean are laid out beautifully, as are the variety of different stochastic and deterministic modeling approaches for describing diffusive processes. Later chapters of the original text include examples of animal diffusion, dynamics of animal grouping, movements in home ranges, patchy distributions of organisms, pattern formation, traveling waves, and the effect of community interactions (e.g., competition predation and so forth) on the spatial distribution of animals. In the revised edition it is these later chapters of the book that have been expanded the most to include new advances, such as receptor kinetics-based taxis, evaluation of diffusion models as a standard tool in animal ecology, continuum approximations for animal grouping, data on home range movements of animals, microscale patchiness in plankton systems, and advances in modeling critical domain size problems, to name a few.

If the reader is looking for a comprehensive review of spatial ecology, he or she will likely put this book down disappointed. Many important contributions to spatial ecology, such as cellular automata, interacting particle systems, lattice or integrodif-

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ference models, and metapopulation models, are left untouched. For example, there is little overlap between *Diffusion and Ecological Problems* and the excellent recently published text edited by Dieckmann, Law, and Metz [1]. However, as noted in Levin's preface to this volume, the goal of the book is not to include all of spatial ecology but to extend Okubo's original text and revisions to include recent scientific and mathematical advances. Here diffusion remains the integrative theme.

My first exposure to Okubo's classic 1980 text was as a mathematical postdoc living part-time in a zoology department. After being told this was "something I should read and learn," I set out to master the contents. It has now become an essential part of my library. I still read and reread Okubo's classic text, as do my students and postdocs. The revised and expanded book is destined to have a similar impact on students, postdocs, and faculty.

Okubo was an exceptional scientist, well loved by colleagues, until cancer caused his untimely death. His expertise and enthusiasm for the subject is reflected in this recent edition, and they are shared by his coauthor. Hence, the last words of Levin's preface:

"This book is a gift from Akira's friends and colleagues to the memory of our Sensei. Akira, we hope you like it. It was a work of love."

REFERENCES

[1] U. Dieckmann, R. Law, and J. A. J. Metz, eds., *The Geometry of Ecological Interactions: Simplifying Spatial Complexity*, Cambridge University Press, Cambridge, UK, 2000.

[2] A. Okubo, *Diffusion and Ecological Problems: Mathematical Models*, Springer-Verlag, New York, 1980.

[3] P. Turchin, *Quantitative Analysis of Movement: Measuring and Modeling Population Redistribution in Animals and Plants*, Sinauer, Sunderland, MA, 1987.

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Trust-Region Methods. *By Andrew R. Conn, Nicholas I. M. Gould, and Philippe L. Toint.* SIAM, Philadelphia, PA, 2000. $119.00. xx+959 pp., hardcover. ISBN 0-89871-460-5.

When I was asked to review *Trust-Region Methods* (henceforth referred to as TRM), the task of writing about such a comprehensive work appeared daunting. Then I checked Amazon.com and discovered, among other unexpected bits of information, that the brief editorial review claimed that the book had to do with stability in control problems and that it was written by an entirely different author. I decided that I could almost certainly do better. So, here goes.

We rely on local models or approximations to solve optimization problems iteratively. The trust-region idea is beautifully simple: at each iteration, we deal with the locality of the model explicitly, but take advantage of the model in a larger region if the model happens to exhibit better than local behavior. This is accomplished by computing the model's optimum in a bounded region where one currently "trusts" the model to represent the behavior of the actual problem well. In computing the initial step, the bound on the trust region is arbitrary to some degree, but in all subsequent step computations it is modified systematically, based on the predictive properties of the model merit function with respect to the behavior of the actual merit function. The current predictive properties of the model also determine whether the computed step is accepted or rejected. This conceptually straightforward procedure gives rise to a large class of flexible, robust, widely ap-