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Space: the final frontier

Spatial Simulation: Exploring Pattern and Process. David O'Sullivan & George L. W. Perry, 2013, Wiley–Blackwell. 305 pp. £85.00 (hardback) / £39.95 (paperback) ISBN: 9781119970804 / 9781119970798; <http://eu.wiley.com>

In 1994, a special feature in *Ecology* highlighted the prominent role of space in ecological theory and emphasized that for many ecologists, spatial complications were used as a catch-all for explaining away surprising results (Kareiva 1994). And indeed, Volker Grimm reiterates in the foreword of 'Spatial Simulation' by O'Sullivan & Perry that there is still 'no general theory' of how space matters. However, while Kareiva complained that there were no serious experiments testing spatial theory, O'Sullivan and Perry complain 20 years later that there is no general theory. Consequently, their book is about simulation (something which might be considered to be between theory and experiments) of spatial patterns and processes with an emphasis on three broad categories: aggregation and segregation, random walk and mobile entities, and growth and percolation. For each of these categories the book provides systematic and comprehensive overviews of simple, generic models that can be used as building blocks for more complex and specific models. Throughout the book, well-developed examples are discussed and implemented in the free software NetLogo (Wilensky 1999). A companion webpage provides the reader with a model zoo, i.e. all simulation models chapter-by-chapter, ready to be investigated and explored by the interested reader, potential user and developer.

Covering examples across a wide range of disciplines that comprise the contemporary social and environmental sciences from archaeology to urban geography, O'Sullivan and Perry's general introductory chapters are very helpful in order to understand the various concepts, definitions and tools necessary to simulate complex spatiotemporal patterns and processes. I particularly liked their emphasis on the heuristic value of constructing spatial simulation models. Rather than emphasizing predictions, which may never be possible because of non-linearities and stochasticity leading to deterministic chaos, spatial simulation models

play a great role in exploring complex aspects and increasing our understanding of spatial patterns and processes. My own background is in plant ecology and an armada of conceptual, analytical and virtual spatial simulation models have been proposed for example to model the dynamics of forest communities or to explain species coexistence at spatial scales from local to global. What we are still lacking is a systematic overview of core ideas and concepts. O'Sullivan and Perry's first two chapters really help to tame 'the bewildering array of ideas' (Chesson 2000) in the context of spatial simulation models. The book may even contribute substantially to promoting consistent terminology and to ordering or organizing key concepts of spatial simulation models more formally.

After covering the basic building-block models (e.g. interacting particle systems, random walks, percolation and growth) quite comprehensively in chapters 3–5, the remaining chapters cover the various possibilities for representing space and time and put things into perspective by considering model uncertainty and evaluation (one of the best and most useful chapters). The two final chapters weave things together using the example of island resource exploitation by hunter-gatherers and provide an overall concluding chapter summarizing the main conceptual ideas and themes (i.e. utility of building-block approach, challenge of inferring process from pattern, need for careful evaluation of spatial simulation models).

Overall, this book and its associated webpage provide a very thorough and comprehensive starting point for students and researchers from various fields who might seriously consider adding a spatial component to their empirical or modelling work in order to answer their specific questions. There were, however, two points which I did not like very much. First, the authors promise to cover important points in some places, but

then merely scratch the surface by referring the reader to the vast literature reviewing specific topics (e. g. formal model selection). Similarly, a closer integration of simulation models with empirical data might have been possible in some cases (i.e. defining neighbourhoods as key aspects of spatial simulation models). Nevertheless, for most ecologists, and also geographers, landscape planners and social scientists (to name just a few), dealing with spatial information in one way or another cannot be avoided. The book by O’Sullivan and Perry thoroughly introduces basic theoretical work and offers not only a rich source of inspiration but also readily accessible examples from various applications that can be adopted and adapted in order to get started.

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