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BOOK REVIEW

Nonlinear Dynamics in Biological Systems

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Nonlinear Dynamics in Biological Systems edited by Jorge Carballido-Landeira and Bruno Escribano, Springer International Publishing, Switzerland, 2016, pp. vii + 128. Scope: edited collection, £69.75, ISBN 978-3-319-33053-2 (Hardcover). Level: professional researchers.

Nature is inherently nonlinear, at every level, and the physicist's comfortably familiar linear approximation can only rarely be applied in practice. So applications of physics to biology must always be mindful of the resultant effects, which can often be counter-intuitive. Provided that nonlinearity it is taken properly into account, however, physics has a great deal to say about biology. Indeed, there are many biological phenomena that can only be understood in the context of physics, e.g. the beating of the heart, cardio-respiratory synchronisation, cell synchronisation, calcium signalling in cells, and the dynamics of protein folding. Practical applications of nonlinear dynamics methods in physiology, either already existing or quickly coming into view, include for example cochlear amplifiers, early diagnosis of autism spectrum disorder, identification of melanoma, and measurement of depth of anæsthesia.

This relatively slim volume is effectively the proceedings of the First BCAM Workshop on Nonlinear Dynamics in Biological Systems, held at the Basque Center of Applied Mathematics (BCAM), 19-20 June 2014. Obviously, it can only deal with some selected aspects of this huge subject area – a major tome would be needed to do full justice to the title. There are three chapters at the subcellular level, dealing respectively with evolving RNA replicators, analysis of synthesised nucleic acid pools, and logic gates in transcriptional regulation. The fourth chapter is more on the cellular level, about pattern formation on cellular membranes; and the last two chapters are basically at the whole-organ level, on the mathematical modeling of the heart and on the origins of the cardiac alternans phenomenon where there is a beat-to-beat alternation in the strength of the heart's contraction. Nonlinear dynamics is, of course, also relevant at the whole whole-organism and species levels, but these topics were seemingly not represented at the conference.

So the book is effectively a collection of six roughly 20-page reviews, on quite a wide range of topics, but linked by the common theme of nonlinear dynamics in biology, and pulled together by the Editors' explanatory Preface. They are mostly well-written, I enjoyed reading them, and I particularly liked the chapter on transcriptional regulation, where I felt that Till Frank and co-authors had made a real effort to address readers not already closely involved in their field.

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