

From biological and clinical experiments to mathematical models

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Published December 2009

Special offer price for print issue: £47.50 (usual price: £58)



This theme issue discusses the complex cross-disciplinary interactions among the various disciplines involved in the study of a living system (biology, mathematics, and computer sciences). The usual way to formalize, in a rational form, the structure of a biological system is to propose a mathematical formulation of the key processes and of interactions among them which have been identified as fundamental for the studied system. This approach allows one to study, from a mathematical point-of-view, the properties arising from the mathematical model. It is then possible to return to reality with proposals for new experiments in order to validate (or to invalidate) the emergent properties predicted by the mathematical model.

However, the complexity of living systems precludes a complete model of their behaviour, and models of the subsystems of interest are sometimes mathematically intractable. Moreover, compared to a biological system, the simplified hypotheses required to construct a mathematical model may be too unrealistic. In these cases, the model may be too simple to reproduce the interesting behaviour or, at the opposite extreme, too complex to be well understood. In the latter case, the only possible use of such mathematical objects is to mimic the behaviour of the biological system while accepting a limited knowledge of the dynamic behaviour of the mathematical model.

All of these questions raise the need for the development of mathematical methods capable either of reducing the complexity of a mathematical model while keeping the richness of its dynamics or of constructing simple comprehensible models that can generate complex dynamics. The authors in this issue present original approaches in order to answer such questions in many fields of mathematical biology, mainly dynamical systems and evolution PDEs.

Full contents of *From biological and clinical experiments to mathematical models* can be accessed online at: rsta.royalsocietypublishing.org/site/issues/biological_experiments_to_models.xhtml

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Contents

Introduction: from biological and clinical experiments to mathematical models

J Demongeot, J-P Françoise and D Nerini

Dependence of the period on the rate of protein degradation in minimal models for circadian oscillations

C Gérard, D Gonze and A Goldbeter

Study of a virus–bacteria interaction model in a chemostat: application of geometrical singular perturbation theory

J-C Poggiale, P Auger, F Cordoleani and T Nguyen-Huu

Exploration of beneficial and deleterious effects of inflammation in stroke: dynamics of inflammation cells

T Lelekov-Boissard, G Chapuisat, J-P Boissel, E Grenier and M-A Dronne

Application of interval iterations to the entrainment problem in respiratory physiology

J Demongeot and J Waku

A model of mechanical interactions between heart and lungs

JF Jallon, E Abdulhay, P Calabrese, P Baconnier and P-Y Gumery

Endogenous circannual rhythm in luteinizing hormone secretion: insight from signal analysis coupled with mathematical modelling

A Vidal, C Médigue, B Malpoux and F Clément

A note on semi-discrete modelling in the life sciences

L Mailleret and V Lemesle

Approximating the distribution of population size in stochastic multiregional matrix models with fast migration

JA Alonso and L Sanz

Synchrony in reaction–diffusion models of morphogenesis: applications to curvature-dependent proliferation and zero-diffusion front waves

L Abbas, J Demongeot and N Glade

Propagation of bursting oscillations

B Ambrosio and J-P Françoise

Mathematical modelling of atherosclerosis as an inflammatory disease

N El Khatib, S Génieys, B Kazmierczak and V Volpert

An integrated formulation of anisotropic force–calcium relations driving spatio-temporal contractions of cardiac myocytes

P Tracqui and J Ohayon

A model of a fishery with fish stock involving delay equations

P Auger and A Ducrot

A multiformalism and multiresolution modelling environment: application to the cardiovascular system and its regulation

Al Hernández, VL Rolle, A Defontaine and G Carrault

Micro-RNAs: viral genome and robustness of gene expression in the host

J Demongeot, E Drouet, A Elena, A Moreira, Y Rechoum and S Sené

Distance-driven adaptive trees in biological metric spaces: uninformed accretion does not prevent convergence

YL Kergosien