Introduction to special issue ECCS'09 in Theory in Biosciences

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The papers collected in this special issue of Theory in Biosciences represent a part of the research presented during European Conference on Complex Systems 2009 (ECCS'09), located at the University of Warwick, United Kingdom. Complex Systems research has become a major innovation for many sciences as it opens a new view to many very relevant scientific problems, including especially applications to the biosciences. The journal 'Theory in Biosciences' has supported this process for some time, and we are pleased to add another ECCS contribution.

The papers in this special issue reach from data analysis, to genetics and finally cancer treatment strategies. All papers discuss different important aspects of complex systems, so often found in biological organisation. The paper 'ERG Signal Analysis Using Wavelet Transform' by Barraco, Persano Adorno and Brai gives an excellent example of a signal analysis of a complex data set stemming from the interaction of a many component system. The components in this case are the cells of the retina at different layers, which when stimulated by a light flash give different responses in form of electric potentials. The wavelet analysis reveals that self-organisation of the collective behaviour can be detected when different types of such stimuli are applied.

In the paper 'Multi-Scale Genetic Dynamic Modelling I: An Algorithm to Compute Generators' from Kirkilionis, Janus and Sbano, a novel molecular-based detailed modelling framework to understand regulatory dynamic genetic systems is discussed. The many components of the system are in this case different macro-molecules which states or conformations are modelled with the help of Markov chains. The novel idea is to derive the corresponding dynamic model describing the whole regulatory process semi-automatically from the structure and function of the different molecular players. In a second paper 'Multi-Scale Genetic Dynamic Modelling II: Application to Synthetic Biology' by the same authors the same ideas are applied to a concrete real genetic system, the so-called Atkinson oscillator. Complex systems are often studied in engineered environments, and synthetic biology offers the great opportunity to construct biological entities with pre-set desirable properties.

Finally the paper 'Stochastic dynamics of leukemic cells under an intermittent targeted therapy' by Pizzolato, Persano Adorno, Valenti and Spagnolo analyses a control problem of a very problematic disease, chronic myeloid leukemia (CML). Due to adaptive behaviour like so often in cancer therapies, leukaemic cells tend to lose their response to chemotherapy. This can only be circumvented by clever strategies timing the chemotherapy treatment.

A whole complex systems analysis will surely go from data, modelling up to control, optimisation or design of the system under consideration. We have covered in this special issue all aspects of this process in an important area, the life sciences. Finally we hope the reader of this special ECCS'09 issue finds in these published contributions much of the spirit that was present during the conference.

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