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EDITORIAL

Proceedings of the XXXIInd Seminar of the French-Speaking Society for Theoretical Biology; Saint-Flour (Cantal), France, 10–13 June, 2012

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The XXXIInd seminar of the French-speaking Society For Theoretical Biology was held in its traditional ground of Saint-Flour (France) from 10 to 13 June 2012. The seminar was this year enriched by the spring school of the society, that took place the week before, on the issue of "Numerical Experiments and Hybrid Systems as Alternatives to Understand Living Systems". This theme was inspired by the increased awareness that discrete approaches have progressively invaded the landscape of theoretical biology over the past decade and deserved to be discussed on its success and its limitations (Bernard; Kurbatova et al.; Jeannin-Girardon et al.).

The seminar was influenced by these discussions which were transposed throughout the seminar and its leading theme "Robustness, Resistance and Resilience in the Natural Systems". Assessing such features of a living system modeled by mean of a discrete approach (e.g. a cellular automaton) is different to a classical study of an ODE-based model since the behavior of the discrete system and the outcome of the simulations cannot be predicted, compared to simulations based on mathematical equations like ODE, reversible in time. This limitation led to the concept of "numerical experiments", which, coupled to statistical analysis, constitute a good manner to explore the properties of a discrete virtual system.

In a scientific era of massive data collection (e.g. all "omic" data) these questions of Robustness, Resistance and Resilience in natural systems are emerging and appear crucial to their understanding. Fast models made to "explain" those data, often based on O/PDE or networks, rarely take the 3R into account, particularly

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because they often show non-stochastic behaviors and because they do not use a redundancy of elements, while multi-agent systems and cellular automata—although they are poorly controllable, with too many degrees of freedom, and although it is difficult to extract laws from them—are very efficient to study the coherence, adaptability, hardiness to noise or competition, etc., all these fundamental characteristics of the living.

Robustness, Resistance and Resilience are clearly hallmarks of natural systems since these "3R" underlie evolution. Concepts such as viability (Aubin; Sanogo et al.), catastrophes (Morier), inhibition (Demongeot et al.), biodiversity (Fleury; Sanchez-Palencia and Françoise), adaptation (Kergosien) reversibility (Belgacem and Gouzé) and physiology (Fontecave-Jallon et al.) are all related to the 3R as alternatives, consequences or examples. Each of these concepts are—specifically—illustrated in the papers selected for this special issue.

The number of papers submitted for this special issue was significantly higher than usual due to the combination of the two events (school and seminar) that interfed each other. Seventeen papers were received and twelve of them have been retained. This special issue demonstrates once again the huge diversity of approaches that make theoretical biology such a fascinating field of research.

To conclude this introduction, we would like to congratulate the recipients of the 2012 Pierre Delattre prize traditionally awarded to the most distinguished young researcher. The prize was, for this year 2012, jointly attributed to Yoan Eynaud (LMGEM, Marseille) for his contribution on "regression trees as an interesting tool for model simplification", Anne Jeannin-Girardon (Université de Bretagne Occidentale, Brest) for her were work on "software architecture to simulate multi-cell systems on GPU", and David Ojeda (LTSI, Rennes) for his presentation on the "sensibility analysis of coronary circulation on patients with tri-troncular coronary disease".

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