

## **Proceedings of the XXIXth Conference of the French-Speaking Society for Theoretical Biology Quantitative and Qualitative Approaches in Life Science: Formalisms, Models and Simulations in Biology and Health**

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The papers comprising the present issue deal with quantitative and qualitative approaches in life science. They form an issue focused on formalisms, models and simulations in biology and health which has its roots in the congress on the same topic held by the French-speaking Society for Theoretical Biology (SFBT) from 14 to 17 June 2009 in Saint-Flour (France). Indeed, the central role of modelling and simulation in systems analysis of biological and physiological systems is now clearly established. Emerging disciplines, such as Systems Biology, and research programs at the international level, such as the IUPS Physiome, or European level, such as the “Virtual Physiological Human” (VPH), are well defined and rely extensively on methods and tools for modelling and simulation in the fields of biology and biomedical research.

The SFBT was created in the early 80s with the objective to promote the development of methods and theoretical formalisms useful for understanding fundamental biological concepts as well as for biological research and practical application. At the present time, this society turns rather into mathematical biology. The strength and the originality of this society are to bring together scientists from various formations and with heterogeneous backgrounds for debating around hot topics in mathematical biology. These cross-disciplinary connections often raise interesting and fruitful discussions, and sometimes give birth to new collaborations. For most of the participants, the SFBT meeting, which takes place once a year in St Flour (France) and once every three years in a French-speaking country (Canada, Morocco), is the place where they can exchange new ideas and discover new theoretical works in mathematical biology.

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One other important vocation for the SFBT society is to provide young researchers an overview of last researches developed in their area and to give them a different reading of their research topics through meetings with scientists with formation often away from their usual working environment. Each year, the society awards a price to the best training young researcher presentation. It also gives the opportunity to publish their first works in the form of a special issue.

The theme issue will include theoretical and experimental works which tackle new mathematical models, new tools for modelling and simulation and their validation by confrontation with experimental or clinical data as well as data from literature. The contributions presented propose original approaches in many fields of life science: biology, physiology, medicine, neuroscience, genetics and agronomy. This articles published in this special issue illustrate the diversity of topics usually discuss during SFBT events.

Valérie Lemesle et al. study modelling and resistance evolution of a pest on a cropping system in which some plants that are toxic for the pests are used. Classical approaches to fight the evolution of pest-resistance are modelled: spatial refuges and temporal refuges. Such a cropping system is relevant for some African countries.

Audrey Houillon et al. present a probabilistic modeling approach applied to the first steps of the vision process. Based on a Bayesian formalism, the model principally gives a system-level understanding of the phototransduction mechanism from the light input until the 'decision' of the 'observer'.

Hedi Ben Amor et al. extend a trend of researches on the use of isochrones in the study of biologically-inspired systems. The article deals both with continuous and discrete systems and contributes to the theory and to the numerical simulations. It emphasizes some new phenomenon on the maxima of curvature of isochrones.

François Guillaud and Patrick Hannaert describe a computer model of renin production and circulating renin-angiotensin system (RAS) that has been integrated into Guyton's circulatory model. Model validation is presented by comparing model results with reference clinical data.

Guillemette Chapuisat et al. propose a mathematical model of ischemic stroke which describes the occurrence of spreading depressions by taking into account ionic exchanges. The model specifically investigates the influence of the intensity and the duration of blood flow reduction upon cell death and the resulting final size of the infarcted area, while differentiating necrosis and apoptosis.

The article of Francis Colas et al. is a review of the wide-spread Bayesian probabilistic framework and it uses in modeling cognitive (perceptual) behaviors of biological and artificial systems. It reviews a number of frequently encountered cognitive issues: ambiguities, fusion, multimodality, conflicts, modularity, hierarchies and loops.

Madalena Chaves et al. propose to generate a Boolean model starting from a piecewise affine equation. The relationship between the two formalisms is explored for the carbon starvation response network in *E. coli*.

As in physiology, a psychological function may be considered as a regulating system working on a vital parameter. Jacques Viret tries to describe the archetypal system of Jung's psychology by the morphologies of the catastrophe theory that Thom used to define the physiological function.

Kebir Amira et al. propose an individual based model for the dynamics of a grouper population, with the aim of introducing a generic modelling approach that permits the physiological complexities of individuals of this population to be considered.

Pascale Calabrese et al. present a simplified model of the respiratory system including the rib cage and the abdominal compartments. The model is validated using experimental signals measured on eleven healthy volunteers with pneumotachography and respiratory inductive plethysmography.

Jacques Demongeot et al. incorporate demography elements with the diffusion and mutation of infectious agents in the classical models of epidemics dynamics by Ross and McKendrick. Two examples are presented, one concerning the malaria in Mali and the other the plague at the middle-age.