



## Foreword

This 47th volume contains review articles as well as original results related to the conference *Mathematical Modelling of Complex Systems* that took place at Ecole Centrale Paris in December 2013. The meeting was a celebration of the tenth birthday of the laboratory MAS (Mathematics Applied to Systems).

Over the past 20 years, the notion of complex systems has gradually evolved from being a convenient shorthand notation for physicists and engineers, to becoming a full-fledged object of scientific research in Mathematics and Computer Science. The paradigm of complexity as a result of the interactions between numerous, heterogenous components (or agents) over various time scales and subject to possibly random individual behaviour and complicated feedback mechanisms, has led to many interesting and innovative concepts that were first enunciated in Physics, and then in Mathematics and Computer Science. The long-lasting enthusiasm for systems of interacting particles has been renewed with the emergence, particularly in life sciences and social sciences, of descriptive models that possess all the features associated to complex systems - and sometimes more... The aim of this 3-day conference was to bring together a panel of renowned contributors to the development of new theories in Mathematics and Computer Science arising in the modelling of complex systems. The main topics of interest were : mathematical and computational biology ; interacting agents in social science ; population dynamics ; structured and "big" data ; statistical inference in large dimensions...

The articles that are gathered in this volume, and that reflect the variety of topics which were represented in the conference, are

- *Explicit equilibria in bilinear kinetic models for socio-economic interactions*, by Federico Bassetti and Giuseppe Toscani,
- *Local well-posedness of the generalized Cucker-Smale model with singular kernels*, by José A. Carrillo, Young-Pil Choi and Maxime Hauray,
- *Multiscale modeling, stochastic and asymptotic approaches for analyzing neural networks based on synaptic dynamics*, by David Holcman,
- *Modeling heterogeneity in random graphs through latent space models: a selective review*, by Catherine Matias and Stéphane Robin,
- *The resistance of the respiratory system, from top to bottom*, by Bertrand Maury,
- *Random graph ensembles with many short loops*, by ES Roberts and ACC Coolen,
- *Branching and aggregation in self-reproducing systems*, by Vitaly Volpert.

The organizing committee wishes to express its gratitude to the authors of the papers, to the speakers, and, last but not least, to the attendees of the conference.

The organizing committee:  
Frédéric Abergel, Marc Aiguier, Paul-Henry Cournède, Gilles Faÿ and Pauline Lafitte.