

## Preface to special issue on Modeling with measures

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## PREFACE TO “MODELING WITH MEASURES”

Different communities met in the research workshop “Modeling with Measures” that took place at the Lorentz Center (Leiden, The Netherlands) during 26th–30th of August 2013. They were groups of researchers active in the following fields:

1. Measure-valued balance laws;
2. Measure-based structured-population and selection-mutation models;
3. Functional analysis and dynamical systems in both measure and metric spaces;
4. Modeling with measures of nonlocal collective dynamics.

On the one hand, these research areas clearly share the keywords *Modeling* and *Measures*. On the other hand, the backgrounds and of the participants were mostly diverse, as were their attitudes, notations, sensibility, etc.

This special issue reflects such diversity, not only through the variety of the arguments, but also through the spread of topics. The authors strived to present their results in a form that can be appreciated by colleagues from different areas. The questions, the techniques and the activities that allowed to develop the present results were influenced by the many discussions that took place during the meeting, as well as by the perspectives and orientations shown in the presentations. As a result, the reader finds below papers motivated by vehicular and pedestrian traffic, both in deterministic and probabilistic settings, general approaches to measure-valued balance laws, models specifically devoted to biology, studies on the convergence of numerical algorithms, abstract well posedness results and also stage-structured models seen through the eyes of evolutionary games.

More precisely, the contributions by Goatin & Mimault is devoted to the study of a model for two directional pedestrian flows, providing both analytical and numerical results. The presence of an elliptic region is a key analytic feature that makes both the theoretical and numerical studies rather difficult.

The paper by Corbetta, Muntean & Vafayi is also devoted to pedestrian traffic, but from the entirely different point of view of parameter estimation. Here, a probabilistic approach to the inverse problem is presented and then used to rank different models according to their reliability in fitting real data.

Probability also plays a role in the work by Schleper, but here randomness is used to account the diversity of the behaviors of pedestrians in a crowd, or of drivers in vehicular traffic. Qualitative properties of the solution are shown using a numerical algorithm developed *ad hoc* for this model.

A general theoretical approach to the description of balance situations through measures is the core of the article by Böhm & Höpker. This abstract presentation is then applied in detail to very specific situations: first to the evolution of colloidal particles and, second, to the dynamic group formation/dissolution in a population.

Evers, Hille & Muntean evaluate to which extent a point source can approximate a field generated by an extended body. The main analytic techniques exploited are those typical of parabolic equations and of measure theory. Clearly, the quality of

the approximation can be evaluated according to different criteria, depending on the various possible specific applications.

A convergence study of a first-order finite difference scheme specifically devised to integrate measure-valued balance laws motivated by hierarchically size-structured population models is presented by Ackleh, Chellamuthu & Ito. Remarkably, this first-order algorithm is able to deal with the insurgence of an atomic part in the measure-valued solution. The authors also present a second-order finite-difference scheme for solving this model without establishing convergence of this high order method.

Balance laws on graphs are used by Colombo & Garavello to state structure population models. In particular, they aim at tackling optimization problems, such as the optimal mating ratio or the optimal management of biological resources.

Andreianov, Donadello, Razafison & Rosini present results on Riemann problems with a nonlocal constraint. A first motivation, considered in detail, is provided by vehicular traffic modeling. Further applications are found in crowd dynamics and bio-medical modeling of cell membranes.

The contribution by Cleveland is devoted to stage-structured models, where the unknown is a positive measure. Within a theoretical setting deeply oriented to the biology of two-stages (larvae/adults) populations, the basic well posedness results that are obtained comprise the case of measures that may present both a continuous and an atomic part.

Guest Editors:

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