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Janos Englander • Brian Rider
Editors

Advances in Superprocesses and Nonlinear PDEs

Springer

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Preface

This book grew out of the conference *Advances in Superprocesses and Nonlinear PDEs* held between June 24 and June 26, 2010 at the University of Colorado Boulder. The main speakers at the meetings were

Zhen-Qing Chen (U. Washington)
Donald Dawson (Carleton, Ottawa)
Eugene B. Dynkin (Cornell)
Steve N. Evans (UC Berkeley)
Patrick J. Fitzsimmons (UC San Diego)
Klaus Fleischmann (Weierstrass Institute, Berlin)
Simon C. Harris (Bath, UK)
Andreas E. Kyprianou (Bath, UK)
Rinaldo Schinazi (University of Colorado, Colorado Springs)
Dan Stroock (MIT)

One of the motivations of the conference was recent advances in the theory of superprocesses. The last 10 years have witnessed intensive research on superprocesses, with important progress made on superprocesses over flows, backbone constructions, superprocesses in random media, interacting and branching-coalescing superprocesses, superprocesses with immigration, scaling limit theorems and self-intersection local times.

The meeting was also dedicated to the 60th birthday of our colleague, Sergei Kuznetsov.

Professor Kuznetsov is one of the top experts on measure-valued branching processes (or superprocesses) and their connection to nonlinear partial differential operators. His research interests range from stochastic processes and partial differential equations to mathematical statistics, time series analysis and statistical software. He has published over 90 papers in international journals.

Here we mention just two of his remarkable results. In 1980, Kuznetsov proved that every Markov process in a Borel state space (i.e., a measurable space

isomorphic to a Borel subset in a Polish space) has a transition function. His most well-known contribution to probability theory though is the so-called Kuznetsov-measure.

Duality is a very important notion in probability: the stationary Markov processes with transition functions p, $\hat{p}$ are duals with respect to a given σ-finite measure m if

$$m(\mathrm{d}x)p_t(x,\mathrm{d}y) = m(\mathrm{d}y)\hat{p}_t(y,\mathrm{d}x).$$

A closely related fact is that each Markov process can be considered in two time directions (this is the way Kolmogorov's forward and backward equations are deduced). In fact, Dynkin suggested that the functions p and $\hat{p}$ may be interpreted as forward and backward transition functions of a *single* Markov process with random birth time α and death time β. This approach was applied also to nonstationary transition functions $p(s,x;t,\mathrm{d}y)$, $\hat{p}(s,x;t,\mathrm{d}y)$ and measures m depending on the time interval (s,t). The process $\{X_t\}_{t\in(\alpha,\beta)}$ can be given by its two-dimensional distributions as

$$m_{st}(\mathrm{d}x,\mathrm{d}y) = P(\alpha < s, X_s \in \mathrm{d}x, X_t \in \mathrm{d}y, t < \beta).$$

The problem, however, is that the family $\{m_{st}\}$ should satisfy a normalization condition that guarantees that P is a probability measure; in the stationary case, this condition holds if m is a probability measure, invariant for both processes. Since the definition of duality requires only σ-finiteness of m, this assumption is too restrictive. This problem was solved by Kuznetsov in 1973, who managed to get rid of the condition: the measure P (called the Kuznetsov measure) and the corresponding m are both just σ-finite. In the theory of Markov processes, considering a process with random birth and death times with the help of the Kuznetsov-measure has proven to be a very useful alternative to working with dual processes.

Sergei obtained his Ph.D. in 1976 in the former Soviet Union under the guidance of Eugene Dynkin, who contributed the first chapter in this volume, and ever since that time Sergei has been the main research collaborator of his former advisor. This extremely fruitful collaboration resulted in 17 papers so far, in premier journals in probability and functional analysis. Sergei joined the Department of Mathematics at the University of Colorado at Boulder in 1998.

Finally, we are grateful to the National Science Foundation for their support of the meeting and to Springer for inviting this proceedings volume into their series. We offer our apologies for the unusually long editing time.

Boulder, Colorado, USA Janos Englander
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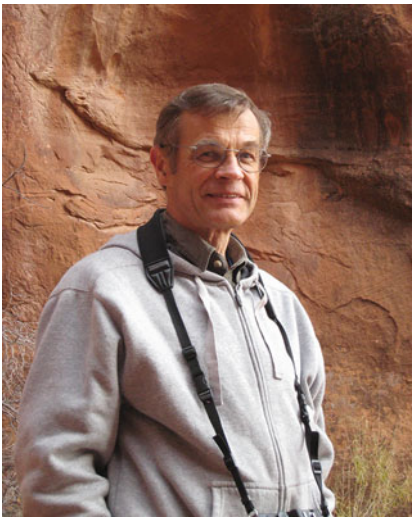

Professor Sergei Kuznetsov