Preface

This volume contains the Proceedings of the *Sixth Seminar on Stochastic Analysis, Random Fields and Applications*, which took place at the Centro Stefano Franscini (Monte Verità) in Ascona (Ticino), Switzerland, from May 19 to 23, 2008. *All papers in this volume have been refereed.*

The previous five editions of this conference occurred in 1993, 1996, 1999, 2002 and 2005. This Seminar is a periodically occurring event that attempts to present a partial state of the art in stochastic analysis and certain related fields, both theoretical and applied. The theoretical topics of the conference included infinite-dimensional diffusions and multi-parameter random fields; among the applied topics, significant attention was given to fluid mechanics and mathematical finance, but also to financial issues related to energy management and to the impact of climate variations. In view of the timeliness and importance of this last subject, the meeting was honored by the presence and opening address of On. Marco Borradori, president of the State Council of Ticino (the executive branch of the government of the Italian-speaking canton of Switzerland), who was also in charge of the *Department of Territorio* and whose responsibilities include energy issues.

As was to be expected, an important area of investigation by the Seminar speakers is infinite-dimensional stochastic calculus, which includes fundamental questions such as pathwise uniqueness and uniqueness in law for stochastic partial differential equations, including not only wave and heat equations but also Navier-Stokes and many other equations; in relation to such equations, large deviations estimates, ergodicity results, and perturbations by fractal noise were discussed. Related subjects included infinite-dimensional backward stochastic differential equations, local times of random fields, and, of course, Malliavin calculus.

Malliavin calculus remains an important investigation technique, both with respect to existence, smoothness and estimates of densities of the laws of continuous or jump processes and random fields, and as a technique for stochastic integration with respect to non-semimartingale processes (or random fields). New promising applications appear however, in probabilistic potential theory and in statistics, for instance via generalizations of the classical *Stein's method*.

Multi-parameter processes and infinite-dimensional processes remain an important tool in mathematical finance: they appear naturally in the study of the term structure of interest rates and of other financial assets whose price depends on the present time t and some additional parameter such as a delivery time T

(such assets are also present in commodities and energy markets). Mathematical finance and stochastic analysis remain intimately connected: new stochastic volatility models are being considered, involving both continuous and jump diffusions; risk measures, hedging in incomplete markets, portfolio management with transaction costs, together with the formulation and study of general semimartingale (and even non-semimartingale) models, require extensions of the classical tools of stochastic analysis as well as the creation of new tools; new numerical techniques, which can be deterministic or probabilistic, are also required. In this last topic, substantial efforts have been devoted to simulating solutions of backward stochastic differential equations.

A phenomenon which has been the subject of much recent investigation is the impact of *microstructure noise*. Statistical and econometric tools are being implemented in order to model and analyze such noises using perturbations by classical Lévy or continuous diffusions. Other researchers analyze the robustness of Black-Scholes and related formulas under non log-normal assumptions while conserving the quadratic variation properties of the underlying. Quadratic variation becomes an important *approximatively observed* process related to the price process of a financial asset, and has motivated theoreticians and practitioners to introduce path-dependent options such as variance swaps, which are closely related to this quantity.

Applications of finite- and infinite-dimensional stochastic analysis arise in *climatology*, a science which has been the subject of several interdisciplinary research projects. One afternoon during the conference was devoted to climate and energy; this session was open to the general public. In addition to the address of On. Marco Borradori mentioned above, three presentations were aimed toward a wider audience:

- Prof. René Carmona (Princeton University) spoke on *The European Union emissions trading scheme from a mathematician's perspective*;
- Prof. Arturo Romer (Università della Svizzera Italiana) spoke (in French) on *Energie et environnement. Quel avenir?*
- Prof. Peter Imkeller (Humboldt-Universität Berlin) lectured on *Mathematical challenges of managing energy and weather risk*.

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