Acta Applicandae Mathematicae **35**: 1–3, 1994.

Foreword

The International Federation of Information Processing (IFIP) is the largest international organization in the field of Computer Science. The working groups within the IFIP regularly organize workshops on topics of current scientific and/or technological interest. At the suggestion of the chairman of the working group WG 7/1 on *System Modeling and Identification*, Professor A. V. Balakrishnan, it was decided to hold a workshop in the Netherlands on *White Noise Models and Stochastic Systems*. The workshop took place on the campus of the University of Twente from 29 June to 2 July 1992. The papers included in this volume are largely based on lectures presented by the invited speakers at this workshop.

The choice of the topic needs some explanation. White noise is a pathology in the theory of stochastic processes, just as the Dirac δ-function is in the theory of functions. Despite this fact, white noise is routinely used as the basic building block in modeling stochastic phenomena, both within system theory and mathematical physics. This has many far-reaching applications in engineering and physics. That is why mathematicians have been engaged for a long time in developing a satisfactory theory of white noise. At this moment, different theories exist which are suitable for different applications. The most commonly used theory is the Itô stochastic calculus in which Gaussian white noise is replaced by its integral form, which is a Brownian motion. Despite enormous success, the theory has some unsatisfactory features and limitations. This led to other attempts for the mathematical modeling of white noise. Among these, we would like to mention specifically the 'finitely additive' white noise theory proposed by Balakrishnan and the direct modeling of white noise in the space of generalized functions due to Hida, along with the theory of anticipative stochastic integrals. All these theories are being applied to the rapidly growing field of stochastic partial differential equations. The most important applications of the 'finitely additive' white noise theory are in stochastic system theory; more specifically, in the filtering and detection of stochastic signals arising in communication and control engineering. By contrast, the theory of Hida's white noise has been most successfully applied in physics. Anticipative stochastic integrals form the essential ingredient for studying stochastic boundary-value problems. The purpose of the workshop was to bring together experts in these areas to exchange ideas and present recent results for the benefit of others.

There are altogether 10 articles in this double special issue of *Acta Applicandae Mathematicae*. The first five of those are expository in character, although they

include new (unpublished) results as well. The remaining five papers essentially contain new results only. All the papers included in this issue, except that of István Gyöngy, are based on the lectures presented by the authors at the workshop on *White Noise Models and Stochastic Systems*. Professor Gyöngy could not attend the workshop due to unavoidable circumstances.

The paper of Albeverio and Brzeźniak is on a basic mathematical approach to Feynman path integrals as infinite-dimensional oscillatory integrals. Asymptotic behavior of such integrals are developed and applied to problems in quantum mechanics. The paper of Bagchi and Mazumdar concentrates on modeling both the noises affecting the state and the observation of a dynamical system as 'finitely additive' white noises. The Radon–Nikodym derivative of finitely additive measures induced by nonlinear transformation on a Hilbert space with respect to the canonical Gauss measure thereon, is used to obtain a representation result for nonlinear filter maps which, in turn, is closely connected to the existence of finite-dimensional filters. Professor Hida deals with random fields which are represented by generalized white noise functionals and are indexed by a manifold running through a set of manifolds in a Euclidean space. Kallianpur and Karandikar took a critical look at the basic papers on specifying conditions under which the probability measure induced by a nonlinear transformation on an abstract Wiener space (γ, H, B) is absolutely continuous with respect to the abstract Wiener measure μ. These conditions, somewhat unsatisfactorily, involve the space B. Conditions are given in this paper on absolute continuity which are solely based on H. Finally, Robert Leland considers direct modeling of white noise appearing in a stochastic bilinear system model for laser propagation in atmospheric turbulence. Approximate solution of this equation arising in atmospheric optics is studied and used for approximate calculation of the mean field.

Of the five remaining papers, the first one by Shin-Ichi Aihara studies the estimation problem of a spatially dependent parameter (coefficient) in stochastic hyperbolic equations when the functional dependence of the parameter on the space variable is discontinuous. The method of sieves and some regularization technique are used to establish consistency of the maximum likelihood estimator of the discontinuous coefficient. The paper of Laszlo Gerencser is on the error of estimated parameters in a continuous time linear stochastic system which is obtained using an estimation method known as the fixed gain estimation. It is shown that the error can be written as a stochastic integral along with a residual term, the moments of which are of order $\lambda + o(1)$ with λ the forgetting factor. István Gyöngy studies the filtering problem on manifolds. He presents general conditions under which the conditional probability distribution of the signal process given the observation up to the current time admits a density and then studies analytical properties of this density. Mikulevičius and Rozovskii, on the other hand, consider weak solutions for nonlinear stochastic partial differential equations. This is done on the basis of necessary and sufficient conditions obtained in this paper for absolute continuity of measures generated by the infinite-dimensional martingale problem. Uniqueness of the weak solution is studied

based on a different methodology from that used in the finite-dimensional case. Finally, Jan van Schuppen considers the stochastic realization problem which arises in representing a stationary Gaussian process as the observation process of a Gaussian stochastic control system. This is a fundamental problem in system identification and, in the author's opinion, forms the natural setting for obtaining identifiability conditions.

The workshop *White Noise Models and Stochastic Systems* was made possible by generous financial support from the Royal Netherlands Academy of Arts and Science, the Systems and Control Network in the Netherlands, and the University of Twente. The burden of organizing the workshop was shared by Dr Rob Luesink (scientific program), and by Ms Marja Langkamp and Ms Joke Nijhuis (financial and administrative matters). They did a superb job and were responsible for the success of the workshop. This is, of course, also true for the participants and speakers of the workshop. Finally, the help and encouragement of Professor Michiel Hazewinkel was key to publishing this volume as a special issue of *Acta Applicandae Mathematicae*. Many thanks to them all for their support.

Enschede, July 1993 ARUNABHA BAGCHI