

Preface

This festschrift volume is dedicated to professor Zhi-Yuan Huang on the occasion of his 75th birthday.

Zhi-Yuan Huang was born on June 2, 1934, in Nanchang, the capital city of Jiangxi province of southern China. He entered Wuhan University, a prestigious university in China, in 1956 and graduated in 1960. After graduation, he remained as a faculty member at the Department of Mathematics. In 1962 he went to Zhongshan University for advanced studies on theory of stochastic processes and published his first research papers. Two years later, he returned to Wuhan University, where he spent more than thirty years as a faculty member.

From 1982 to 1983, he worked with Professor S. Orey as a senior visiting scholar at the University of Minnesota, USA. During that time, he proposed a theory of stochastic integration over a general topological measurable space, which included the well-known Itô integral as well as other existing stochastic integrals as special cases.

At the end of 1983, he returned to Wuhan University and gave lectures to graduate students on stochastic analysis. In 1984, he was appointed as associate director of the Research Institute for Mathematics at Wuhan University and the following year he was promoted to full professor. He continued his research on stochastic analysis and visited Kyoto University, Japan for one month in 1987 as visiting professor supported by JSPS.

In 1988, his book *Foundations of Stochastic Analysis* was published, which was the first monograph systematically presenting Malliavin calculus in Chinese. In fact he had got interested in Malliavin calculus earlier than 1985, when he published his paper *Malliavin calculus and its applications*. At the end of 1988, he also wrote an article introducing the quantum stochastic calculus, a new theory created by R. L. Hudson and K. R. Parthasarathy.

In 1990, he received the Natural Science Prize of Ministry of Education, China. The same year he was appointed as a doctoral advisor, a higher position at universities in China. In 1992, he moved to Huazhong University of Science and Technology (HUST), also in Wuhan, and since then he has been working there as a professor of mathematics, dean of the School of Science (1994-2000) and Vice President of Academic Committee of HUST (2000-2004). He also held a concurrent position of research fellow in the Institute of Applied Mathematics, Chinese Academy of Sci-

ences (1996-98). Currently, he is Director of the Research Center for Stochastics at HUST.

The white noise theory initiated by T. Hida is essentially an infinite dimensional analog of Schwartz distribution theory. Zhi-Yuan Huang was the first one who noted the potential role of the white noise theory in developing the quantum stochastic calculus. In 1993, he published his celebrated research paper *Quantum white noises: White noise approach to quantum stochastic calculus*. As is suggested by the title, he applied the white noise theory to the quantum stochastic calculus and proposed the notion of quantum white noises. He showed that the quantum white noises were pointwise-defined creation and annihilation operators on the boson Fock space and could be used to extend the Hudson and Parthasarathy's quantum stochastic integral to the non-adapted situation. Following this work, together with Shunlong Luo, he further developed the Wick calculus for generalized operators and successfully applied it to quantum field theory. Professor Hida said: Huang's calculus "has become a very powerful and important tool in the theory of quantum stochastic analysis". Professor Parthasarathy also highly appraised Huang's work and wrote: "the contributions of Professor Huang are very original and have a great potential for further developments in our understanding of rigorous quantum field theory."

From 1993 to 1999, Huang was invited to give talks about his calculus at several international conferences. In 1997, he and Jia-an Yan coauthored a new book entitled *Introduction to Infinite Dimensional Stochastic Analysis*, which was the first monograph dealing with Malliavin calculus and white noise theory in a unified framework (the English version appeared in 2000). The same year he was one more time awarded the Natural Science Prize of Ministry of Education, China. In 1998, he became an editor of the journal *Infinite Dimensional Analysis, Quantum Probability and Related Topics*. In 1999, he and Jia-an Yan shared a prize awarded by the Chinese Government for their joint monograph promoting mathematical learning.

Since 2000, Huang has been devoting himself to the study of Lévy white noise as well as fractional noises. He has published a series of research papers independently or jointly with his students and much progress has been made. He, together with his Ph.D. students, gave an interacting Fock expansion of Lévy white noise functionals and developed a white noise approach to analysis for fractional Lévy processes. In 2004, he published his third book *Quantum White Noise Analysis* (in Chinese, with Caishi Wang and Guanglin Rang). In 2006 and 2009, he received the Natural Science Prize and Teaching Achievement Prize of Hubei Province, China, respectively.

Ph.D. Graduate Students of Zhi-Yuan Huang

Shunlong Luo (Wuhan University, 1995)
 Zongxia Liang (Institute of Applied Mathematics CAS, 1996)
 Mingli Zheng (Institute of Applied Mathematics CAS, 1996)
 Qingquan Lin (Institute of Applied Mathematics CAS, 1998)
 Caishi Wang (Huazhong University of Science and Technology, 1999)
 Xiangjun Wang (Huazhong University of Science and Technology, 1999)
 Shaopu Zhou (Huazhong University of Science and Technology, 2000)
 Xiaoshan Hu (Huazhong University of Science and Technology, 2002)
 Jihui Hu (Huazhong University of Science and Technology, 2002)
 Guanglin Rang (Huazhong University of Science and Technology, 2003)
 Ying Wu (Huazhong University of Science and Technology, 2005)
 Chujin Li (Huazhong University of Science and Technology, 2005)
 Guanghui Huang (Huazhong University of Science and Technology, 2006)
 Peiyan Li (Huazhong University of Science and Technology, 2007)
 Xuebin Lü (Huazhong University of Science and Technology, 2009)
 Junjun Liao (Huazhong University of Science and Technology, 2010)

Publications of Zhi-Yuan Huang Since 1980

Books

- (1) Foundations of Stochastic Analysis (in Chinese), Wuhan Univ. Press (1988);
Second edition, Science Press (2001)
- (2) Introduction to Infinite Dimensional Stochastic Analysis (in Chinese, with Jia-An Yan), Science Press (1997); English version, Kluwer (2000)
- (3) Quantum White Noise Analysis (in Chinese, with Caishi Wang and Guanglin Rang), Hubei Sci. Tech. Publ. (2004)

Papers and Invited Lectures

- (1) On the generalized sample solutions of stochastic differential equations, Wuhan Univ. J., No. 2 (1981), 11-21 (in Chinese, with M. Xu and Z. Hu)
- (2) Martingale measures and stochastic integrals on metric spaces, Wuhan Univ. J. (Special issue for Math.), No. 1 (1981), 89-102
- (3) Stochastic integrals on general topological measurable spaces, Z. Wahrs. verw. Gebiete, Vol. 66 (1984), 25-40
- (4) On the generalized sample solutions of stochastic boundary value problems, Stochastics, Vol. 11 (1984), 237-248

- (5) A comparison theorem for solutions of stochastic differential equations and its applications, *Proc. Amer. Math. Soc.*, Vol. 91 (1984), 611-617
- (6) The weak projection theory and decompositions of quasi-martingale measures, *Chinese Ann. Math. (Ser. B)*, Vol. 6 (1985), 395-399
- (7) The Malliavin calculus and its applications, *J. Applied Probab. Statist.*, Vol. 1, No. 2 (1985), 161-172 (in Chinese)
- (8) On the product martingale measure and multiple stochastic integral, *Chinese Ann. Math. (Ser. B)*, Vol. 7 (1986), 207-210
- (9) Spectral analysis for stochastic integral operators, *Wuhan Univ. J.*, No. 4 (1986), 17-24 (in Chinese, with Y. Liao)
- (10) Functional integration and partial differential equations, *Adv. Math. (China)*, Vol. 15, No. 2 (1986), 131-174 (based on a series of lectures given by Prof. P. Malliavin in Wuhan Univ. in June 1984)
- (11) Spectral analysis for stochastic integral operators, invited lecture given in Kyoto Univ. (1987)
- (12) An introduction to quantum stochastic calculus, *Adv. Math. (China)*, Vol. 17, No. 4 (1988), 360-378
- (13) Quasi sure stochastic flows, *Stochastics*, Vol. 33 (1990), 149-157 (with J. Ren)
- (14) Some recent development of stochastic calculus in China, *Contemporary Math.*, Vol. 118 (1991), 177-185
- (15) Stochastic calculus of variation on Gaussian space and white noise analysis, in "Gaussian Random Fields", K. Ito and T. Hida eds., World Scientific (1991)
- (16) Quantum white noises - White noise approach to quantum stochastic calculus, *Nagoya Math. J.*, Vol. 129 (1993), 23-42
- (17) Quantum white noises analysis - a new insight into quantum stochastic calculus, invited lecture of 9th Conference on Quantum Probability and Applications, Nottingham (1993)
- (18) P-adic valued white noise functionals, *Quantum Prob. Related Topics*, Vol. IX, (1994), 273-294 (with Khrennikov)
- (19) An extension of Hida's distribution theory via analyticity spaces, in "Dirichlet Forms and Stochastic Processes", Walter de Gruyter, 1995 (with H. Song)
- (20) Generalized functionals of a p-adic white noise, *Doklady Mathematics*, Vol. 52 (1995), 175-178 (with Khrennikov)
- (21) Quantum white noises and quantum fields, 23rd SPA Conference, Singapore (1995) (with S. Luo)
- (22) A model for white noise analysis in p-adic number fields, *Acta Math. Sci.*, Vol. 16 (1996), 1-14 (with Khrennikov)
- (23) Quantum white noise analysis, invited lecture of Conference on Stochastic Differential Geometry and Infinite Dimensional Analysis, Hangzhou (1996)
- (24) Analytic functionals and a new distribution theory over infinite dimensional spaces, *Chinese Ann. Math. (Ser. B)*, Vol. 17 (1996), 507-514 (with J. Ren)
- (25) Quantum white noises, Wick calculus and quantum fields, invited lecture of

- Conference on Infinite Dimensional Analysis and Quantum Probability, Rome (1997)
- (26) The weak solution for SDE with terminal conditions, *Math. Appl.*, Vol.10, No.4 (1997), 60-64 (with Q. Lin)
 - (27) Quantum white noises and free fields, *IDAQP*, Vol.1, No.1 (1998), 69-82 (with S. Luo)
 - (28) D^∞ -Approximation of quadratic variations of smooth Ito processes, *Chinese Ann. Math. (Ser. B)*, Vol.19 (1998), 305-310 (with J. Ren)
 - (29) Wick calculus of generalized operators and its applications to quantum stochastic calculus, *IDAQP*, Vol.1, No.3 (1998), 455-466 (with S. Luo)
 - (30) Positivity-preservingness of differential second quantization, *Math. Appl.*, Vol.11 (1998), 31-32 (with C. Wang)
 - (31) Quantum integral equation of Volterra type with generalized operator-valued kernels, *IDAQP*, Vol.3 (2000), 505-517 (with C. Wang and X. Wang)
 - (32) Quantum cable equations in terms of generalized operators, *Acta Appl. Math.*, Vol.63 (2000), 151-164 (with C. Wang and X. Wang)
 - (33) Wick tensor products in Levy white noise spaces, *Second Sino-French Colloquium in Probability and Applications, Invited Lecture, Wuhan (2001)*
 - (34) Explicit forms of Wick powers in general white noise spaces, *IJMMS*, Vol.31 (2002), 413-420 (with X. Hu and X. Wang)
 - (35) $L^2(E^*, \mu)$ -Weyl representations, *IDAQP*, Vol.5 (2002), 581-592 (with X. Hu and X. Wang)
 - (36) A white noise approach to quantum stochastic cable equations, *Acta Math. Sinica*, Vol.45 (2002), 851-862 (with C. Wang)
 - (37) Quantum integral equations with kernels of quantum white noise in space and time, *Advances in Math. Research Vol.1 (2002)*, G.Oyibo eds. NOVA SCI. PUBL., 97-108 (with C. Wang and T-S. Chew)
 - (38) Quadratic covariation and extended Ito formula for continuous semimartingales, *Math. Appl.*, Vol.15 (2002), 81-84 (with J. Hu)
 - (39) White noise approach to interacting quantum field theory, in "Recent Developments in Stochastic Analysis and Related Topics", eds. S. Albeverio et al., World Scientific, 2004 (with G. Rang)
 - (40) Quantum stochastic differential equations in terms of generalized operators, *Adv. Math. (China)*, Vol.32 (2003), 53-62 (with C. Wang and X. Wang)
 - (41) White noise approach to the construction of Φ_4^4 quantum fields, *Acta Appl. Math.*, Vol.77 (2003), 299-318 (with G. Rang)
 - (42) Generalized operators and operator-valued distribution in quantum field theory, *Acta. Math. Scientia*, Vol.23(B) (2003), 145-154 (with X. Wang and C. Wang)
 - (43) A W -transform-based criterion for the existence of bounded extensions of E -operators, *J. Math. Anal. Appl.*, Vol.288 (2003), 397-410 (with C. Wang and X. Wang)
 - (44) The non-uniform Riemann approach to anticipating stochastic integrals, *Stoch.*

- Anal. Appl. Vol. 22 (2004), 429-442 (with T-S. Chew and C. Wang)
- (45) Generalized operators and $P(\Phi)_2$ quantum fields, Acta Math. Scientia, Vol. 24(B) (2004), 589-596 (with G. Rang)
- (46) Analytic characterization for Hilbert-Schmidt operators on Fock space, Acta Math. Sin. (Engl. Ser.), Vol. 21 (2005), 787-796 (with C. Wang and X. Wang)
- (47) A filtration of Wick algebra and its application to quantum SDE, Acta Math. Sin. (Engl. Ser.), Vol. 20 (2004), 999-1008 (with C. Wang)
- (48) A moment characterization of B-valued generalized functionals of white noise, Acta Math. Sin. (Engl. Ser.), Vol. 22 (2006), 157-168 (with C. Wang)
- (49) δ -Function of an operator: A white noise approach, Proc. Amer. Math. Soc., Vol. 133, No. 3 (2005), 891-898 (with C. Wang and X. Wang)
- (50) Fractional Brownian motion and sheet as white noise functionals, Acta Math. Sin. (Engl. Ser.), Vol. 22, No. 4 (2006), 1183-1188 (with C. Li, J. Wan and Y. Wu)
- (51) Interacting Fock expansion of Lévy white noise functionals, Acta Appl. Math., Vol. 82 (2004), 333-352 (with Y. Wu)
- (52) Lévy white noise calculus based on interaction exponents, Acta Appl. Math., Vol. 88 (2005), 251-268 (with Y. Wu)
- (53) Anisotropic fractional Brownian random fields as white noise functionals, Acta Math. Appl. Sinica, Vol. 21, No. 4 (2005), 655-660 (with C. Li)
- (54) White noise approach to the construction of Φ_4^4 quantum fields (II), Acta Math. Sin. (Engl. Ser.), Vol. 23, No. 5 (2007), 895-904 (with G. Rang)
- (55) On fractional stable processes and sheets: white noise approach, J. Math. Anal. Appl., Vol. 325, No. 1 (2007), 624-635 (with C. Li)
- (56) Explicit forms of q-deformed Lévy-Meixner polynomials and their generating functions, Acta Math. Sin. (Engl. Ser.), Vol. 24, No. 2 (2008), 201-214 (with P. Li and Y. Wu)
- (57) Generalized fractional Lévy processes: A white noise approach, Stochastics and Dynamics, Vol. 6, No. 4 (2006), 473-485 (with P. Li)
- (58) Fractional generalized Lévy random fields as white noise functionals, Front. Math. China, Vol. 2, No. 2 (2007), 211-226 (with P. Li)
- (59) Fractional Lévy processes on Gel'fand triple and stochastic integration, Front. Math. China, Vol. 3, No. 2 (2008), 287-303 (with X. Lü and J. Wan)
- (60) Fractional noises on Gel'fand triples, Invited lecture of International Conference on Stochastic Analysis and Related Fields, Wuhan (2008) (with X. Lü).