

LABORATORY 16

Laboratory of Stochastic Dynamical Systems

Head of Laboratory – Dr.Sc. (Mathematics), Prof. **Aleksandr Veretennikov**

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The leading researchers of the laboratory include:

Dr.Sc. (Math.)	A.Veretennikov	Dr.	P. Kitsul
Dr.Sc. (Techn.)	R. Liptser	Dr.	A. Puhalskii
Dr.	F. Grigoriev	Dr.	A. Serebrovskii
Dr.	O. Gulinsky	Dr.	S. Lototsky
Dr.	V. Kistlerov		

Currently R. Liptser, P. Kitsul, A. Puhalskii and S. Lototsky are working abroad remaining the staff members of Laboratory.

ACTIVITY DIRECTIONS AND MAIN RESULTS

Main directions of activity in 2003 was stochastic analysis and its applications:

- large and moderate deviations for stochastic processes;
- large deviations and quasi classical approximations;
- large deviations for invariant measures;
- large and moderate deviations for stochastic graph;
- large and moderate deviations in statistical estimations;
- diffusion approximation for two scaled diffusion;
- diffusion approximation for stochastic differential equations with non smooth coefficients;
- mixing in stochastic equations;
- existence uniqueness and regularity for parabolic stochastic equations with smooth boundary conditions;
- regularity of invariant measure and smoothness of Markov chain generator;
- estimation control, control theory and data processing.

A. Veretennikov studied problems of diffusion approximation and large deviations for two-scaled diffusion with fast and slow components. The mixing theory for stochastic differential equations is developed. Connection between the smoothness of invariant measure and generator of Markov chain are established. New results on diffusion approximation of Poisson equation are obtained.

R. Liptser and A. Veretennikov studied moderate deviations for smooth processes.

Large deviation results for stochastic differential equations driven by Brownian motions are known. However in some problems of mathematical physics it is more natural to consider equations with smooth random perturbations. A large deviation principle are established for a family of vector-valued smooth random processes defined by a system of ordinary differential equations with perturbations defined by smooth vector function of vector-valued ergodic diffusion.

R. Liptser obtained new results on large and moderate deviations for statistical estimation problems and filtration theory. He studied the problem of diffusion approximation for stochastic differential equations with non-smooth coefficients.

A. Puhalskii obtained new results on the connection between large deviation principles for trajectories of stochastic processes and the associated invariant measures. The large deviation accumulation point of a sequence of invariant measures is identified as invariant measure of the limit idempotent processes. Application to diffusion and queuing processes are provided. New approach based on the theory of stochastic processes is developed to studying of random graphs. With the help of this tools new results on normal moderate and large deviations are obtained.

S. Lototsky obtained new results on existence uniqueness and regularity for parabolic stochastic equations with smooth boundary conditions. Asymptotic properties of two-dimensional projection based parameter estimator for stochastic parabolic equations are studied.

O. Gulinsky continued studying non-standard problems of the large deviation theory.

The motivation is coming from some problems of quantum mechanics. Developed tools make it possible to handle non-commutative asymptotic problems as one would handle classical large deviations and consider infinite dimension the Laplace method and stationary phase method from the general point of view. The approach is applied to analysis of mean-field quantum crystal model.

F. Grigoriev obtained new results on estimation control, control theory and data processing. These results are applied to some problem of chemical kinetic processes.

Teaching:

– Moscow Institute of Physics and Technology: O. Gulinsky, A. Serebrovskii, and F. Grigoriev;

– Universities abroad: A. Veretennikov, R. Liptser, A. Puhalskii, P. Kitsul, S. Lototski.

International collaboration. Fruitful collaboration is established with the probability group of the LAMP CMI Universite de Provence, Marseille, France, and, in particular, with Professor Etienne Pardoux as its leader.

We also have close contacts with Universite Paris 6 (Professors Jean Jacod and Pierre Priouret); Universite du Main in France (Professor Yuri Kutoyants); Weierstrass Institute for Applied Analysis and Stochastics – WIAS, Berlin, Germany; the University of Warwick, UK (Professor David Elworthy); Mathematical Institute of the University of Copenhagen; University of Trier (Professor Dieter Baum); University of Wuerzburg (Professor Elart von Collani), and some others.

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PUDLICATIONS IN 2003

1. Григорьев Ф.Н., Григорьева Е.Н., Ясенько-Галат М., Качмарчик Я., Янковска А. Структура и реакционная способность шунгитовых углеродов в среде водорода и кислорода // 2 Международная научно-практическая конференция "Энергосберегающие и природоохранные технологии", Улан-Удэ, август 2003. С. 183-189.

2. Григорьев Ф.Н., Мандра Б.М. Управление наблюдениями в задаче оценивания координат двух стохастических объектов // *Материалы конференции по теории управления, посвященной памяти академика Б. Н. Петрова, Москва, 2003. Т. 1. С. 130.*
3. Gulinsky O.V. Asymptotics of Varadhan-type and Quantum Large Deviations // *"Kolmogorov and contemporary mathematics", Moscow, 2003. P. 449-451.*
4. Gulinsky O.V. The principle of the largest terms and quantum large deviations // *Kybernetika. 2003. V. 39. No. 1. P. 229-247.*
5. Lototsky S. V. Nonlinear Filtering of Diffusion Processes in Correlated Noise: Analysis by Separation of Variables // *Applied Mathematics and Optimization. 2003. V. 47. No. 2. P. 167-194. Also, posted on the journal web site and the archive site.*
6. Lototsky S.V. Parameter Estimation for Stochastic Parabolic Equations: Asymptotic Properties of a Two-Dimensional Projection Based Estimator // *Statistical Inference for Stochastic Processes. 2003. V. 6. No. 1. P. 65-87. Also available on the journal web site.*
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8. Puhalskii A.A. On large deviation convergence of invariant measures // *J. Theoret. Prob. 2003. V. 16. No. 3. P. 689-724.*
9. Veretennikov A.Yu. On Approximate Large Deviations for 1D Diffusion Georgian // *Math. J. 2003. V. 10. No. 2. P. 381-399.*
10. Veretennikov, A.Yu. On large deviations for approximations of SDEs // *Probab. Theory Relat. Fields. 2003. V. 125. No. 1. P. 135-152.*
11. Григорьев Ф.Н., Зыков Р.В., Пряничников А.В. Управление наблюдениями за двумя скалярными объектами // *Научная конференция МФТИ, Москва, ноябрь 2003 (in print).*
12. Baxendale P., Chigansky P., Liptser R. Asymptotic stability of the Wonham filter: ergodic and nonergodic signals // *SIAM Journal on Control and Optimization (in print).*
13. Chigansky P., Liptser R. Stability of nonlinear filters in non-mixing case // *Annals of Applied Probability (in print).*
14. Goldentayer L., Liptser R. On-line tracking of a smooth regression function // *Statistical Inference for Stochastic Processes (in print).*
15. Puhalskii A.A. Stochastic processes in random graphs (to appear).