Stochastic Control Methods in the Theory of Large Deviations

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This course is based on the recent book, *Analysis and Approximation of Rare Events: Representations and Weak Convergence Methods*, Prob. Theory and Stoch. Modelling Series, 94, Springer, by A. Budhiraja and P.Dupuis. The book treats a broad range of topics in the theory and applications of large deviations. In the approach taken in the book, Laplace principles, methods of weak convergence, and stochastic control representations take center stage. In this short course I will present some of the main ideas and key features of this approach. A tentative outline is as follows. The course will consist of eight two hour-lectures.

- **Lecture 1:** Background material: Large deviation principle and Laplace principle, properties of relative entropy, basic results in the theory.
- **Lecture 2:** Stochastic control representations for functionals of finite and infinite dimensional Brownian motions.
- **Lecture 3:** Stochastic control representations for functionals of Poisson random measures.
- **Lecture 4:** Abstract sufficient conditions for large and moderate deviation principles for small noise stochastic dynamical systems and examples.
- **Lecture 5:** Weakly interacting jump-diffusions and Dawson-Gärtner large and moderate deviations.
- **Lecture 6:** Multiscale jump-diffusions and large deviations from a stochastic averaging principle.
- **Lecture 7:** Lattice systems with local interaction and large deviations from hydrodynamic limits.
- **Lecture 8:** Explicit solutions of calculus of variations problems in certain large deviation problems for random graphs.

References:

1. A. Budhiraja and P. Dupuis, *Analysis and Approximation of Rare Events: Representations and Weak Convergence Methods*, Prob. Theory and Stoch. Modelling Series, 94, Springer.

2. P. Dupuis and R.S. Ellis (1997), *A Weak Convergence Approach to the Theory of Large Deviations*, John Wiley & Sons, New York.

Audience:
This course is suitable for Ph.D. students and interested postdocs and staff members from the stochastic analysis, probability, statistics, and mathematical finance groups.