

## Stochastic methods in computational neuroscience

Petr Lánský, *Institute of Physiology AV ČR, Prague, CZ*

Mathematical descriptions of single neuronal cells have a long tradition. From a biophysical point of view, the models of a single neuron mimic the electrical properties of its membrane via systems of differential equations, such as the Hodgkin-Huxley system; the involved parameters are then specified directly via physical measurements. In mathematical modeling the emphasis is instead put on more general properties of such systems of equations without accent on concrete parametric identification and verification. We will review the basic stochastic models and new concepts will be mentioned. Our original results from recent years will be summarized.

### Methods for Early Detection of Market Crashes - Crash and Rally Options

Jan Večeř, *Department of Statistics, Columbia University, New York, USA*

In this talk, we introduce new types of options which do not yet exist in the market with some very desirable features. These proposed contracts can directly insure events such as a market crash or a market rally. Although the currently traded options can to some extent address situations of extreme market movements, there is no contract whose payoff would be directly linked to the market crash and priced and hedged accordingly as an option. We give analytical and characterization of their price and hedge, investigate them numerically, and link them with the existing techniques in change point detection (CUSUM).

### Stochastic nonlinear beam equations

Jan Seidler, *ÚTIA AV ČR, Prague, CZ*

An extensible beam subjected to a random forcing of a white noise type will be considered. Lyapunov techniques will be employed to show existence of global solutions to the resulting stochastic partial differential equation and to establish asymptotic stability of its trivial solution.

The talk is based on a joint paper with Z. Brzezniak and B.Maslowski.

### Optimal investments with proportional profit-share fee

Karel Janeček, *RSJ Invest, a.s., Prague, CZ*

The objective of this paper is to find an optimal investment strategy for the case where an investor pays profit share to an investment manager (for example a hedge fund). We assume that upon investing into a hedge fund, the size of agent's total investment is followed, and a provision is charged whenever the total accumulated profit exceeds the historical maximum - the so-called high water mark. We assume that the agent holds a CRRA utility function, and derive the HJB equation for this problem. As expected, the optimum invested proportion is lower than the Merton proportion. We provide numerical results for several interesting cases.

### Nelineární stochastické vlnové rovnice

Martin Ondreját, *Matematický ústav AV ČR, Praha, ČR*

Formulace problému, existence, jednoznačnost a vlastnosti řešení. Otevřené problémy.

## On Parameter Estimates in Stochastic Evolution Equations Driven by Fractional Brownian Motion

Jan Pospíšil, *Department of Mathematics, University of West Bohemia, Plzeň, CZ*

We study stochastic evolution equations in Hilbert spaces. This general framework has a straightforward application to stochastic partial differential equations. We show the existence and ergodicity of the strictly stationary solution, which is crucial for the parameter (especially the drift) estimates. Having an observation of the solution on some time interval  $[0, T]$ , consistent drift estimates are given for  $T \rightarrow \infty$ . Such a constraint is not necessary for the diffusion estimates that can be calculated for  $T < \infty$  using the variation of the solution. These results are presented in infinite dimension, however, they apply to finite dimensional case as well.

### Pathwise uniqueness for a SDE with non-Lipschitz coefficients

Jan Swart, *ÚTIA AV ČR, Prague, CZ*

In this talk we will consider the SDE  $dX = -cXdt + \sqrt{2(1 - |X|^2)}dB$  on the closed unit ball in  $R^d$ . I will show how it follows from recent work of myself and of D. DeBlassie that solutions to this SDE are pathwise unique if  $c = 0$  or  $c > 2(\sqrt{2} - 1)$ . The case  $0 < c \leq 2(\sqrt{2} - 1)$  is still open.

### Optimální obchodní strategie s transakčními náklady placenými pouze za jednu z akcií

Petr Dostál, *KPMS MFF UK, Praha, ČR*

Uvažujme investora, který může investovat celkem do  $n$  akcií, kde  $n$  není příliš velké, a který se zajímá o odpověď na otázku, jaká je optimální investiční strategie obchodování s akciemi za předpokladu, že by platil transakční náklady pouze za  $i$ -tou akcií. Dále předpokládáme, že tržní ceny akcií se chovají jako  $n$ -dimenzionální geometrický Brownův pohyb a že cílem investora je maximalizovat asymptotiku očekávaného užitku počítaného z tržní ceny portfolia. Uvažujeme pouze užitkové funkce s konstantní hyperbolickou averzí vůči riziku (HARA). Pro názornost odvodíme první nenulový člen v Taylorově rozvoji funkce spojující transakční náklady a šířku „no-trade region“.

### Stochastic Linear and Semilinear Equations with Gaussian Noises

Bohdan Maslowski, *Mathematical Institute AV ČR, Prague, CZ*

The aim of the talk is to present some recent results on infinite-dimensional fractional Ornstein-Uhlenbeck processes that are solutions to linear stochastic evolution equations driven by fractional Brownian motions. A Girsanov-type theorem will be given that is used to establish weak existence and uniqueness of corresponding semilinear equations with additive fractional noise. Initially, basic notions and facts concerning fractional noises will be recalled.