S2F2 Hauptseminar Stochastische Prozesse & Stochastische Analysis

S4F3 Graduate Seminar Applied Probability **WS 2014/15**

Markov Processes & Monte Carlo Methods

Andreas Eberle **Tuesdays 14-16,** **Room 0.003**

Markov chain based Monte Carlo methods (MCMC) are widely used in application areas including Bayesian statistics, statistical physics, filtering etc. In most practically relevant cases, the methods applied are not really well-understood mathematically in the sense that there are no feasible error bounds. Nevertheless, there is a rapidly growing number of mathematical results related to MCMC, reaching from rigorous bounds in specific models over asymptotic statements to more conceptual results. These are related to a variety of areas in probabality and stochastic analysis including convergence to equilibrium of Markov processes, couplings, functional inequalities, interacting particle systems and scaling limits, phase transitions, diffusion limits, and numerical methods for stochastic differential equations.

In the seminar, we introduce some of the most important MCMC methods, and we study related mathematical theory where it is available. The level of difficulty of the theory varies a lot, so that a part of the talks are accessible at Bachelor level, whereas others are more appropriate for Master students. For this reason, the seminar addresses both Bachelor and Master students.

Monographs on Monte Carlo methods:
- Madras, *Lectures on Monte Carlo Methods,* AMS (2002)
- Liu, *Monte Carlo Strategies in Scientific Computing*, Springer (2001)
- Robert, Casella, *Monte Carlo Statistical Methods,* 2nd ed., Springer (2004)
- Cappé, Moulines, Ryden, *Inference in Hidden Markov Models,* Spr. (2005)

Books on theoretical background:
- Levin, Peres, Wilmer: *Markov chains and mixing times,* AMS (2009)
- Jerrum: *Counting, Sampling and Integrating,* Birkhäuser (2003), available at www.dcs.ed.ac.uk/home/mrj/
- Meyn, Tweedie: *Markov chains and stochastic stability,* 2nd ed. Cambridge (2009), 1st ed. available at probability.ca/MT
- Roberts, Rosenthal: *General state space Markov chains and MCMC algorithms,* available at probability.ca/jeff.

Prerequisites: „Stochastic Processes".

Preliminary meeting 15.7.2014, 10.00 c.t., N0.008