The Bayesian Approach to Inverse Problems: Overview
Invited Talks at the University of Cambridge, UK
Preamble

- This is no commercial for the Bayesian approach to inverse problems.
- The term "Bayesian" is en vogue and used all too frequently.
- Especially it is often used to reformulate well established methods.
- This provokes (justified) resistance and reservation.
- Motivation of this talk: Counteract some common objections and highlight some interesting features of the Bayesian approach.
Overview

Three talks on the Bayesian approach to inverse problems.

**Talk 1:** “Theoretical Aspects”.

**Talk 2:** “Computational Aspects”.

**Talk 3:** “Hierarchical Bayesian Approaches to EEG/MEG Source Reconstruction”.

Felix Lucka (felix.lucka@wwu.de)
Overview

Three talks on the Bayesian approach to inverse problems.

Talk 1: “Theoretical Aspects”.
- Deterministic, statistical and Bayesian perspective on inverse problems.
- Basic principles and concepts of Bayesian inference and modeling applied to inverse problems;
- Connections to variational regularization and ridge regression;
- Point estimates: Common myths and recent results;
- Advanced topics and some recent trends;
- What might be real benefits of Bayesian inference over other approaches?

Talk 2: “Computational Aspects”.

Talk 3: “Hierarchical Bayesian Approaches to EEG/MEG Source Reconstruction”.

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Overview

Three talks on the Bayesian approach to inverse problems.

Talk 1: “Theoretical Aspects”.

Talk 2: “Computational Aspects”.
- Exemplary application: High-dimensional inverse problems using sparsity constraints;
- Basic principles and algorithms of Markov chain Monte Carlo (MCMC) based posterior inference;
- Iterative optimization and sampling;
- More advanced topics and some recent trends;

Talk 3: “Hierarchical Bayesian Approaches to EEG/MEG Source Reconstruction”.

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▶ Indispensable tools for neuroimaging;
▶ Challenging, severely ill-posed inverse problem;
▶ Various demands from the application;
▶ Hierarchical Bayesian modeling (HBM) to address various uncertainties;
▶ Own results on fully-Bayesian inference for HBM;
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