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Geophysics, Bayesian statistics, and Differential Geometry
steps towards a more efficient observational data analysis

Our understanding of a physical word is entirely based on observational information and ability of its analysis. Unfortunately, information needed for a further inference are not available directly for us in many cases. In such a situation an extracting it from observational data is an inference problem by itself. This happen in many branches of sciences among which geophysics is a very well known example. Traditionally this task, referred to as an inverse problem was solved by applying methods of linear algebra and theory of linear operators under assumptions of linear relation between observed data and thought ones. The limitation due to an assumed linearity as well as lack of robustness of such approach has quickly been recognized and lead to variety of different approaches among which Bayesian inference seems to be the most powerful. However, Bayesian (probabilistic) inference meets many obstacles among which a lack of solid mathematical background seems to be the most important. This leads to many open questions concerning, among others uniqueness of probabilistic inference, the role and form of a priori information and general structure of the theory. A way to overcome, at least partially these problems was put forward by I. Amari by using a method of differential geometry to probabilistic inference approach. The resulting so called "information geometry" provides a new insight into the classical inverse problems inspiring new methods (algorithms) of advanced data analysis. In this talk I will present foundation of the Bayesian inverse theory and basic elements of information geometry orientated towards a task of prior selection (a priori information description).