Title:	Application of Inverse Problem Theory and Markov Chain Monte Carlo Technique
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Abstract:	Determining the model space parameters from given data is an important research area in Mathematics and Statistics having applications in Physics, Chemistry, Biology and Engineering. In this thesis we consider having data on the observable variables for a certain model having multiple parameters, and attempt to do parameter estimation for the model parameters using the data and some given information. We proceed to solve the problem treating it as an inverse problem, and build the probability density functions for the model and data parameters. The probability functions we have constructed using the system equations, can't be fully determined due to mathematical complexity. So, we use the Markov Chain Monte Carlo (MCMC) method for estimating the model parameters. We do various kinds of analysis of the estimated parameters by substituting back into the system equations, trying to verify whether they are consistent with the model or not. In this thesis, first we describe the model space and data space, give a basic introduction to some probability and inverse theory, and then discuss the MCMC approach. Finally, we apply the concepts and methods of inverse problem theory and MCMC techniques on an example problem called Ellipse model (with two parameters), and give detailed analysis of the parameter estimation procedure. We then consider the Lorenz model, which is known to display a variety of dynamics, stable to chaotic, for different values of its three parameters, and give a brief description of how to do it's parameter estimation.
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