Preface

Over the last 15 years or so statistical and stochastic methods in inverse problems research have rapidly emerged, mainly as a result of the dramatic increase in computing power available to scientists and engineers. In contrast to the classical deterministic methods, the statistical approach allows to objectively determine confidence levels in the numerical reconstruction of the quantity of interest. In other words, the framework of statistical and stochastic inverse problems yields a rigorous way to characterize the impact of variability and lack-of-knowledge in the underlying mathematical models. This highly interdisciplinary field of research is at the boundary between analysis, probability theory and numerical mathematics with broad applications ranging from problems in engineering and medical or environmental imaging to problems in quantitative finance.

In this thesis, we study a stochastic extension of the classical deterministic inverse problem of EIT, also known as Calderón's problem, which is commonly used as a prototype problem. We develop both the theoretical and computational framework for the numerical solution of an inverse anomaly detection problem in heterogeneous random media. Although the details of the proposed method depend on the problem at hand, the principle idea presented in this work is applicable to a wide variety of inverse problems. The book is meant for researchers, practitioners and graduate students working in the field of statistical and stochastic inverse problems.

My research activities, which led to the writing of this monograph, have greatly benefited from the influence of numerous colleagues and friends: First and foremost, I would like to express my sincere gratitude to my "Doktorvater" Prof. Dr. Martin Hanke-Bourgeois for introducing me to the field of inverse problems and for his guidance, confidence and constant support over the last years. His dedication and attention to detail have always been a source of inspiration to me.

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