Preface

The present book is devoted to studying optimal experimental designs for a wide class of linear and nonlinear regression models. This class includes polynomial, trigonometrical, rational, and exponential models as well as many particular models used in ecology and microbiology. As the criteria of optimality, the well known D-, E-, and c-criteria are implemented.

The main idea of the book is to study the dependence of optimal designs on values of unknown parameters and on the bounds of the design interval. Such a study can be performed on the base of the Implicit Function Theorem, the classical result of functional analysis. The idea was first introduced in the author's paper (Melas, 1978) for nonlinear in parameters exponential models. Recently, it was developed for other models in a number of works (Melas (1995, 2000, 2001, 2004, 2005), Dette, Melas (2002, 2003), Dette, Melas, Pepelyshev (2002, 2003, 2004b), and Dette, Melas, Biederman (2002)).

The purpose of the present book is to bring together the results obtained and to develop further underlying concepts and tools. The approach, mentioned above, will be called *the functional approach*. Its brief description can be found in the Introduction.

The book contains eight chapters. The first chapter introduces basic concepts and results of optimal design theory, initiated mainly by J.Kiefer. In the second chapter a general theory of the functional approach is developed. Particularly, it is proved that for the class of models considered in this book support points of optimal designs are real analytic functions of some values (the initial values of parameters for nonlinear models and the bounds of the design interval for linear models). This allows one to approximate the support points by the Taylor series. In Chapters 3 and 4 this approach is applied to polynomial and trigonometrical models, respectively. Chapters 5, 6, and 7 are devoted to rational and exponential models. In Chapter 8, a nonlinear model widely used in microbiology and called the Monod model is thoroughly studied.

I would like to thank Professor Sergey Ermakov, who attracted my attention to exponential models. A part of this book is based on works joint with Professor Holger Dette. I thank him for the permission to use our results here. Note that the computer calculations were performed under my

guidance by my Ph.D. students Andrey Pepelyshev and Liudmila Krylova. I am grateful to several anonymous referees for helpful comments on an earlier version of the book and to Dr. John Kimmel for agreeing to prepare this book for publication. The work was performed partly under the financial support of Russian Foundation of Basic Research (Project Ns 00-01-00495 and 04-01-00519).

I thank my wife for her care of me and her help during this work.

Viatcheslav B. Melas
St.Petersburg

http://www.springer.com/978-0-387-98741-5

Functional Approach to Optimal Experimental Design

Melas, V.

2006, X, 338 p., Softcover
ISBN: 978-0-387-98741-5