Banks, H. T.; **Kunisch, K.**
Estimation techniques for distributed parameter systems. (English) ‖ Zbl 0695.93020
Systems & Control: Foundations & Applications, 1. Boston, MA: Birkhäuser. xiii, 315 p. DM 96.00; sFr. 84.00 (1989).

The monograph deals with the identification of parameters in distributed systems. A typical class of problems under consideration are parabolic problems where the coefficient functions of the elliptic part have to be reconstructed from accessible state measurements. Problems of this type are ill-posed, with the degree of ill-posedness depending on many different factors.

From the very beginning, the authors do not intend to give a comprehensive study of the nature of this ill-posedness. Following the lines of their personal research interests, they are mainly concerned with the aproximate solution of least squares formulations associated with the identification problem. To focus on the least squares approach has some justification from the fact that this technique is rather universally applicable and the most popular one. Another advantage is that the involved mathematical machinery is not overly complicated, so that the text remains accessible to readers from the applied sciences. The large number of numerical examples and the detailed description of the numerical algorithms are also very helpful for a better understanding of the theory. Moreover, while focusing on the least squares method, the authors also give an introduction to other recently developed identification techniques. In conclusion, although the more mathematically oriented reader might miss a reference to recently developed deeper analytical tools to treat the more delicate aspects of the inherent ill-posedness, the monograph is a welcome contribution to the identification literature. In particular, engineers and applied scientists will find it very useful for their practical purposes.

The text itself is divided in seven chapters, followed by an appendix on the properties of spline spaces. Chapter I brings a detailed discussion of some typical identification problems arising from applications, while in Chapter II a number of well-known functional analytic tools are cited for later use. Chapter III is the "heart" of the monograph: A general functional analytic framework for a convergence analysis of approximation schemes for parameter estimation is developed (this part of the book is rather abstract and not always easy to read). Chapter IV is devoted to the problems of identifiability and stability. Here also some aspects of the inherent ill-posedness are discussed. In Chapter V parameter identification problems in one space dimension are considered, including a quite detailed discussion of their concrete numerical solution. Chapter VI is concerned with linear elliptic problems in several space dimensions. Besides the output-least-squares technique, in this section also a number of other methods are presented: method of characteristics, equation error method, adaptive control techniques, augmented Lagrangian method. The final Chapter VII brings an annotated bibliography.

Reviewer: J.Sprekels

MSC:

93B30	System identification
35R25	Ill-posed problems for PDEs
93-02	Research exposition (monographs, survey articles) pertaining to systems and control theory
35R30	Inverse problems for PDEs
93C20	Control/observation systems governed by partial differential equations
93B40	Computational methods in systems theory (MSC2010)

Cited in **2** Reviews
Cited in **178** Documents

Keywords:

distributed systems; ill-posed; least squares approach; parameter estimation; identifiability; stability