Abstract

It is well-understood that the choice of experimental conditions for distributed systems modelled by partial differential equations has a significant bearing upon the accuracy achievable in parameter-estimation experiments. Since for such systems it is impossible to observe their states over the entire spatial domain, optimal placement presents a critical problem. However, existing methods of sensor location in parameter estimation experiments are either limited to one-dimensional spatial domains or require large investments in software systems.

The aim of this monograph is to give an account of both classical and recent work on sensor placement for parameter estimation in dynamic distributed systems modelled by partial differential equations. It discusses the characteristic features of the sensor placement problem, analyzes classical and recent approaches, and proposes a wide range of original solutions, culminating in the most comprehensive and timely treatment of the issue available. It constitutes an attempt to meet the needs created by practical applications through the development of new techniques and algorithms or adopting methods which have been successful in akin fields of optimum experimental design. By presenting a step-by-step guide to theoretical aspects and to practical design methods, this book provides a sound understanding of sensor location techniques. While planning, real-valued functions of the Fisher information matrix of parameters are primarily employed as the performance indices to be minimized with respect to the positions of pointwise sensors. Particular emphasis is placed on determining the `best' way to guide scanning and moving sensors, and making the solutions independent of the parameters to be identified. This text also offers results that translate easily to MATLAB and to MAPLE. Assuming only a basic familiarity with partial differential equations, vector spaces, and probability and statistics, and avoiding too many technicalities, this is a valuable resource for researchers and practitioners in the fields of applied mathematics, electrical, civil, geotechnical, mechanical, chemical, and environmental engineering.