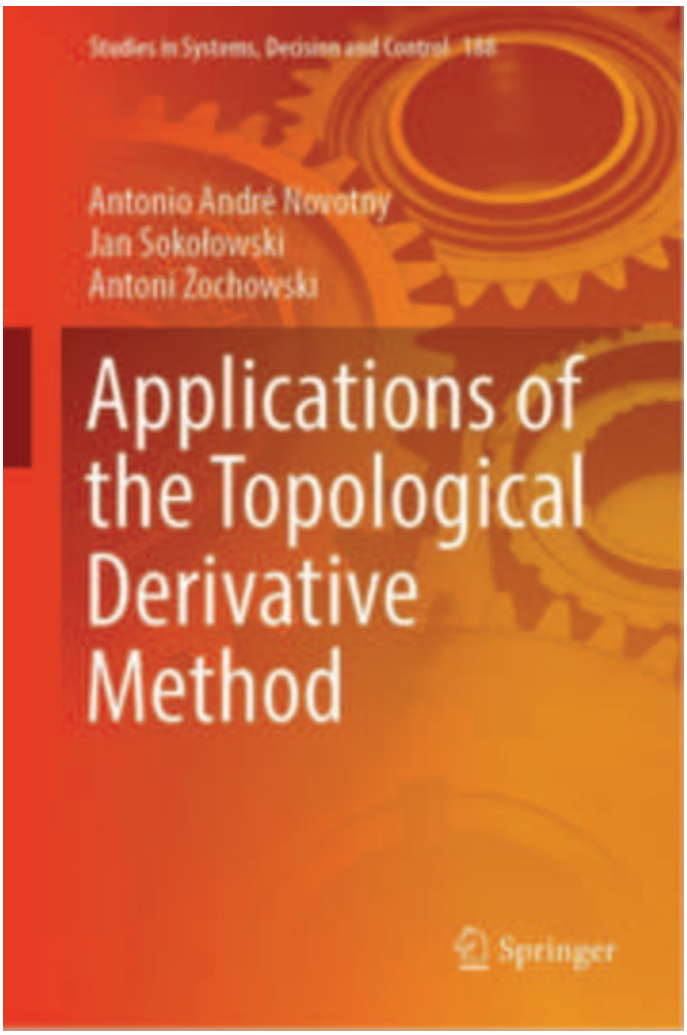
A. A. Novotny, J. Sokołowski, A. Żochowski:

Applications of the Topological Derivative Method



The book presents new results and applications of the topological derivative method in such fields of methodological and practical significance as control theory, topology optimization and inverse problems. It also introduces the theory in singularly perturbed geometrical domains using selected examples. The methodology, which is recognized as a robust numerical technique in engineering applications, such as topology optimization, inverse problems, imaging processing, multi-scale material design and mechanical modeling including damage and fracture evolution phenomena, the topological derivative method is based on the asymptotic approximations of solutions to elliptic boundary value problems combined with mathematical programming tools.

The book provides the first order topology design algorithm and its applications in topology optimization, and introduces the second order Newton-type reconstruction algorithm, which is based on higher order topological derivatives for solving the inverse reconstruction problems. It is intended for researchers and students in applied mathematics and computational mechanics interested in the mathematical aspects of the topological derivative method as well as its applications in computational mechanics.

Published by Springer Nature in the series Studies in Systems, Decision and Control as volume 188.

Jan W. Owsiński:

Data Analysis in Bi-partial Perspective: Clustering and Beyond

The book offers a valuable resource for all data scientists, who wish to broaden their perspective on the fundamental approaches available in the broadly conceived field of data analysis. It presents a general formulation, properties, examples, and techniques associated with an objective function of a general nature. Results from studies on data analysis, especially cluster analysis and preference aggregation are provided.

This volume presents the so-called bi-partial approach to data analysis, which is both uniquely general and enables the development of techniques for many data analysis problems, including related models and algorithms. It is based on adequate representation of the essential clustering problem, namely: to group together the similar, and to separate the dissimilar. This leads to the formulation of a general objective function and subsequently to a broad class of concrete implementations. Using this basis, a suboptimising procedure can be developed, together with a variety of implementations.

This suboptimisation procedure has a striking affinity with the classical hierarchical merger algorithms, while also incorporating the stopping rule, based on the respective objective function. The approach resolves the cluster number issue, as the solutions obtained include both the content and the number of clusters. Further, it is demonstrated how the bi-partial principle can be effectively applied to a wide variety of problems in data analysis. Hence, the book offers a valuable material for those data scientists, who wish to broaden their perspective on basic approaches and essential problems, and to thus find answers to questions that are often overlooked or have yet to be solved convincingly. It is also intended for graduate students in the computer and data sciences, and will complement their knowledge and skills with fresh insights on problems that are otherwise treated only in the standard academic manner.

Published by Springer Nature in the Series Studies in Computational Intelligence as volume 818.