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Editor

Optimization of Structures and Components

Springer

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Preface

The term *Structural Optimization* was coined by Lucien Schmit in 1960, when he published an innovative paper[1] and launched a revolution in structural design procedures. His idea consisted in coupling nonlinear numerical optimization techniques, typically used in operations research, to finite element structural analyses, in order to achieve an optimal design. Although the origin of optimization methods traces back to the days of Newton, Leibnitz, and Cauchy, it was Schmit's contribution that settled a mark for the development and application of modern optimization techniques in engineering. Certainly, the parallel evolution of computer technology and its rapid dissemination in the following decades were deterministic for the success of this new design strategy.

One example of structural optimization has to do with minimization of weight, which has always been a major concern in aeronautical and aerospace engineering. More recently, the automotive industry has also focused in developing lighter vehicles, since engine technology has reached such a maturity level, that efficiency in fuel consumption is now guided by weight reduction. Following this trend, in modern world, competition for a market share requires better products with higher efficiency and lower costs, so that new design challenges are set every day. In this context, it is important that both, researchers and practitioning engineers, be continuously developing and applying optimization methods to solve problems that are ever increasing in complexity and computer storage needs. In spite of all the evolution that this area has experienced, several design problems still cannot be solved in an efficient manner.

In order to have a good structural optimization method, quite a large number of factors must be accounted for: the selection of an overall strategy (size, shape or topology optimization); the selection of an appropriate objective function, constraints and design variables; the selection of an approximation technique for the functions involved and the selection of a robust optimization algorithm. If the optimization algorithm requires derivatives, an efficient and accurate sensitivity analysis procedure is also necessary.

[1] Schmit, L. A.: Structural Design by Systematic Synthesis, Proceedings, 2nd Conference on Electronic Computation, ASCE, New York, pp. 105–122, 1960.

In this book, eight chapters discuss recent and sometimes original developments in one of the aforementioned aspects, ranging from analytical expressions for topological derivatives to the application of meta-models for the solution of large scale problems. The authors were asked to decide about the length of their chapters, such that the presentation of the kernel ideas would not be sacrificed by space limitations. Hence, it is expected that the contents can be adopted as referential texts due to their detail level.

I would like to thank sincerely the commitment of all the contributors who made this text possible. Their patient cooperation at all stages of the book project until the final form of the manuscripts was crucial to the high quality of the result.

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Contents