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A Fast Fixed Point Algorithm for Topology Optimization with Multiple Loading Conditions

Ashok D. Belegundu[1]

[1] The Pennsylvania State University

Abstract

A new fixed point algorithm is presented for a class of nonlinear programming (NLP) problems. The algorithm is applicable to problems where increasing the available resource reduces the objective function value such as expending greater effort increases the probability of finding the treasure or target, or allocating more material reduces deflection. Application areas include continuous variable resource allocation and in inventory models involving monotonic functions, and sizing and topology problems in structural optimization involving compliance minimization with multiple load cases. The fixed point update or re-sizing formula, within this general context, is given physical significance which brings out a strength and trim feature. The algorithm has been extended to handle multiple constraints by using a new scheme based on the surrogate multiplier method. No active set strategies or dynamic step size or scaling factors are needed. The resulting algorithm for a small number of multiple constraints is vastly superior to sequential QP and other NLP methods for the subclass of problems considered. Moreover the number of function evaluations remain independent of the number of variables allowing the efficient solution of problems with large number of variables. The algorithm is especially suitable for topology optimization with multiple loading conditions.