Some fundamental issues in robust structural optimization and the solution approaches

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Abstract

Most of the structural behavior constraints involved in structural robust design and optimization are *non-convex* in nature. Therefore if local optimality criteria based optimization algorithms are employed to find the worst case structural responses that are used for examining the feasibility of a given design, it is highly possible that the optimization process will get stuck in a local optimum. If this is the case, the reliability of a "robust" design cannot be guaranteed, at least theoretically. On the other hand, compared with deterministic structural optimization problems, benchmark examples which are very important to test the validity and efficiency of numerical solution approaches are hard to be found for general robust structural optimization problems. In the present work, some fundamental issues in robust structural optimization problems as mentioned above will be

discussed in detail. We will show what the important role played by the notation of convexity in dealing with this kind of challenging optimization problems. It is also suggested that in order to solve the robust structural optimization problems in a confidence way, some convexification treatment should be performed. As illustrative examples, we will show how to obtain confidence robust optimal solutions by formulating the corresponding optimization problems as *convex* linear semi-definite programs (LSDPs), which can be solved very efficiently by modern mathematical programming algorithms. Furthermore, we will also discuss how to construct benchmark for robust structural optimization problems with use of global optimization approaches.

Keywords: Robust structural optimization; Convexity; Benchmark examples.