Reliability based topology optimization considering fatigue lifetime

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Topology optimization plays an important role in structural design and analysis. Optimization techniques could deliver the best structural topology with optimal performance requirements such as strength, stiffness, weight, natural frequency, or buckling. Topology optimization is a potential technique for the improvement in the structural performance, since topology optimization procedures allow modifying in the connectivity of the geometry of the structure during the design process.

Actually, the field of topology optimization is undergoing important development. it is now being successfully used for the design of several automotive and aerospace components with respect to stiffness and strength, and several methods are proposed to consider buckling constraints, eigen-frequency constraints. However, the topology optimization is based on a deterministic approach which does not consider the variability of input parameters and the uncertainties related to design, loading, and material properties.

From another hand, the Reliability-Based Design Optimization (RBDO) has been developed to consider uncertainties in the design optimization procedure, while the safety requirements are fulfilled. It consists of finding the best design with optimal cost and safety assurance, based on structural reliability theory to take account for uncertainties.

Thus, a more rigorous approach for topology optimization should consider the uncertainties arising from the random nature of the loading fluctuations, the material properties and the geometrical dimensions. The integration of the reliability concepts into the topology optimization, lead to the so-called *Reliability-Based Topology Optimization.* At now, several works focus on developing efficient RBTO formulations or to consider buckling constrained topology optimization.

However, RBTO considering the fatigue lifetime remains challenging. This work aims to develop an efficient approach of the new RBTO tool which allows considering the fatigue damage constraints. To be successful, the spectral approach for the fatigue damage estimation should be preferred, because their efficiency and robustness.

In this work approximate metamodels will be also developed to provide surrogate models of finite element models for the compliance of the structure. Several strategies will be investigated in order to improve the prediction of the metamodels approximation for the RBTO.

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