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Autor	FRANZ HOFSTADLER
Orientador	HERBERT MARTINS GOMES

MULTI-OBJECTIVE OPTIMIZATION OF COMPOSITE MATERIALS CONSIDERING UNCERTAINTIES

Academic: Franz Hofstadler
Advisor: Prof. Dr. Herbert Martins Gomes
GPRIQI - Grupo de Pesquisa em Risco, Identificação e Quantificação de Incertezas
DEMEC-Departamento de Engenharia Mecânica-UFRGS.

When analyzing the various scientific and technological areas, it is perceived that the use of composite materials is increasing. Currently, there are several types of composite matrix reinforcement materials, such as Carbon Fiber, Fiberglass, Aramid, Epoxy, etc. To improve performance in terms of safety of resistance, dynamic behavior, buckling loads or material costs, optimization processes are usually carried out. The optimization process begins by defining the free parameters sought and the corresponding objective functions to be improved. Depending on the number of functions, the problem is said to be mono or multi-objective. Material properties, number of layers, thickness, and fiber orientations are the design variables one can choose. The angles of each layer are optimized and the corresponding optimal objective functions are plotted on Pareto Fronts charts. The developed algorithms are intended to evaluate natural frequencies, internal stresses and buckling load factors for composite materials based on CLT theory. Literature is studied and validated by mono-objective examples of maximizing the 1^{st}. buckling load of a 64-layer laminated Graphite-Epoxy plate and maximizing the 1^{st}. natural frequency of a Graphite-Epoxy plate simply supported with 8 layers by the DEA algorithm. Later, a multi-objective an example of a simply supported 12-layer graphite-epoxy plate (SSSS) is optimized to (*i*) first ply failure criterion, (i) first fundamental frequency, and (iii) first buckling load, simultaneously. The study demonstrates that the choice of fiber orientation has a direct impact on the coefficients established in the objective functions, besides predicting that the dimensions and constraints of the design variables had little impact on the results, less than 7.5% in relation to the first study. Finally, in each case, a robustness analysis with 20 independent runs is done in order to demonstrate the reliability of the code.