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A DIFFERENTIAL EVOLUTION TO FIND THE BEST MATERIAL GROUPINGS IN TRUSS OPTIMIZATION

AFONSO LEMONGE, José Pedro Gonçalves Carvalho, Patrícia Habib Hallak

Federal University of Juiz de Fora, Brazil
afonso.lemonge@ufjf.edu.br, jose.carvalho@engenharia.ufjf.br, patricia.hallak@ufjf.edu.br

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Abstract: Recently, the structural optimization has received a strong emphasis that leads in the formulation of the objective function questions regarding the possible combination of various materials. That is, the multi-material optimization in which these materials present different characteristics between them. For example, those referring to the behavior of the material that can be physically linear or non-linear, linear behaviors with different moduli of elasticity, different costs depending on the volume to be used, different behaviors in tension and compression, and so on. The topology structural optimization, particularly, has been receiving efforts in this direction and is extremely adequate to address this type of problem. Another issue in this process is to include the possibility of limiting the number of different materials to be used in the optimized final design. This is an interesting aspect where the designer has the freedom to define a priori the maximum number of materials to be used. In that sense, it will be possible to construct curves where the decision-maker can choose between various possibilities, the one or those that are more interesting. That is, the solution or solutions that present one, two, three, and so on, different type of materials. On the other hand, this is not a trivial task and would require numerous tentatives to be made by the designer making it virtually impossible to discover the desired solutions. The objective of this paper is to propose a strategy to obtain solutions to structural optimization problems in sizing, shape and topology, where the use of different materials will be incorporated in the formulation of the problem, besides the possibility of the designer choosing the maximum number of these materials. The search algorithm to be employed is the Differential Evolution and the control of the maximum number of materials to be used is done through the use of cardinality constraints.