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Optimization of Truss Arches under Multi-Loading Cases

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Abstract

This paper proposes an effective strategy able to simultaneously perform the topology, geometry and size optimization of steel truss-type arches with circular hollow cross-sections. As for a single load case, just an optimal arch shape exists, a truss-type arch layout could be obtained as optimal solution of a multi-loading case optimization problem. This paper presents a new effective method applied to simultaneously optimize the layout (topology), the shape and the size of cross-section parameters of different truss-type arches by minimizing their volume (cost) for multi load cases. Different topologies have been considered by varying the number of nodes and bars (topology design variables) of the arch and two different shape functions has been considered (respectively a parabolic curve and a Rational Cubic Bèzier curve function) to define the geometry design variables. Different diameters and thickness for the circular hollow cross-sections have been considered and optimized as size design variables. The proposed optimization method has been performed in the MATLAB environment, by applying a modified version of Differential Evolution algorithm (DEa) implemented with a Constraint Domination Selection (CDS) criteria. For each design variable vector, a FEM analysis of the resulting structure has been carried out from SAP2000 in order to evaluate the objective function value (volume) and the maximum demand/capacity ratio among all the bars of the model that must be less than 0,99 for each load case in order to consider that design variable vector as a feasible solution.

References

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