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SHAPE & SIZE OPTIMIZATION OF TRUSS STRUCTURES APPLIED TO POWER TRANSMISSION TOWERS

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This work presents a methodology for the optimization of truss structures used as power transmission towers. The problem is approached as a shape and size optimization problem where practical and constructional particularities of the towers are considered to ensure the goodness of the methodology. Thus, we have taken into account that high tension towers are usually built as a combination of different predetermined modular blocks with fixed connectivity. In addition, the bars that form these blocks are almost always steel rolled bars with equal leg angle cross sections. Considering these aspects, the shape of the truss structure is optimized through the dimensions of the blocks and the size optimization is focused on the cross sections of the elements.

According to this approach, the optimization process involves design variables of two different natures. The optimization of the dimensions of the blocks has a continuous nature while the sizing problem is basically discrete. Thereby, the use of discrete and continuous variables together leads us to a mixed optimization problem. In addition, considering all the requirements of the applicable standards for this type of structures and the common load cases imposed, there are a large number of constraints involved, as in most common real engineering optimization problems.

Therefore, our methodology is based in an improved version of the Simulated Annealing algorithm since it can deal with continuous and discrete variables together naturally. One of the main enhancements introduced in the Simulated Annealing algorithm is the inclusion of a first order sensitivity analysis. Since the algorithm involves a large number of structural analysis, the sensitivity analysis is devoted to reduce the CPU cost of the computations of all the test designs.

The optimization methodology is then implemented in a user-friendly interface which provides a short guided sequence of steps to define any type of tower and optimize the design.