SIZING, SHAPE AND TOPOLOGY OPTIMIZATIONS OF ROOF TRUSSES USING HYBRID GENETIC ALGORITHMS

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Abstract

Structural optimizations are of a great concern to structural engineers. Several optimization methods have been proposed including evolutionary strategies and genetic algorithms. This paper considers hybrid genetic algorithms for roof truss optimizations. Practically, roof truss optimizations are unique. In this case, the pitch angles are usually governed by roof covering types. In the optimization process, the pitch angle is set to constant, while the coordinates of the joints are determined by genetic algorithms. The optimization process utilizes hybrid genetic algorithms, i.e., a combination of binary and real coded genetic algorithms. Genetic algorithms are optimization methods that have been used successfully for various problems. For the sizing, shape and topology optimizations considered in this paper, the sizes of the truss members are optimized using binary coded genetic algorithms, while the coordinates of the joints are determined using real coded genetic algorithms. The optimization process for binary and real coded algorithms is done subsequently. The use of real coding for joint coordinates of structures gives the flexibility to the program to obtain the final position of the joints. The arithmetic crossover is used to tackle this matter. In every generation, a portion of new individuals is inserted randomly replacing the old individuals. This can be considered as to increase the variability of the population. In addition the fittest individual is always transferred into the next generation. The penalty to the individuals that are violating the constraint is set to a minimum fitness in this paper. It can be shown that the proposed procedure is able to obtain the optimum design of roof truss structures.

Keywords : roof truss, optimization, genetic algorithms, real coding, binary coding, hybrid genetic algorithms