**Congress on Numerical Methods in Engineering**
Lisboa, June 29 to July 02, 2015


RESUMO N° 108

# FRAME STRUCTURE OPTIMIZATION AND MATERIAL CHOICE USING GENETIC ALGORITHMS

**Diogo Rechena,** diogo.rechena@gmail.com
*IST, Portugal*

**António Brites,** antonio.brites@tecnico.ulisboa.pt
*IST, Portugal*

**Luís Sousa,** luis.goncalves.sousa@tecnico.ulisboa.pt
*IST, Portugal*

**João Sousa,** jmsousa@tecnico.ulisboa.pt
*IST, Portugal*

**Keywords:** Genetic Algorithms, Finite Elements, Cost, Weight, Frame Structures

Nowadays, one of the most used structural elements is the beam due to its high stiffness under bending loads. Since frame structures are very common, two needs arise being them: reduction of weight and cost. In a generic frame structure there are several local solutions for the minimization problem, being the number of minima increased if material properties (density, cost, yield stress, etc.) are taken into account. If direction search algorithms are used then the only way of finding the best material and beam dimensions combination is through optimizing the structure for each material type and, in each optimization process using a grid search in order to get "all" the minima. Since each optimization process needs several finite element analysis, obtaining the best solution possible is computationally heavy. An alternative solution is using a genetic algorithm that uses both materials and dimensions as design variables in order to get the lightest or cheapest structure possible. The objective of the proposed algorithm is to obtain the best combination of material and beam outer diameter taking into account the needs of the user (minimization of the structure's weight or cost). In order to test this algorithm, a library comprised of 34 metallic alloys was used. After testing it was shown that the algorithm can converge to the analytical solution of simple (isostatic) problems as well as find several solutions for more complex (hyperstatic) problems.