# Multi-Criteria Optimization with Uncertainty one Approach to Engineering Preliminary Design

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This paper highlights some possibilities to investigate engineering preliminary design using multi objective optimization techniques and also including uncertainty in some variables or design characteristics.

Several optimization techniques have been employed to solve engineering preliminary design and also many ship preliminary design problems. The development of Genetic Algorithms (GA) technique with consideration of uncertainty variables has also been recently applied to solve many different optimization mathematical problems. This article discusses the techniques of G.A. and treatment of variables and characteristics with a degree of uncertainty.

Genetic algorithms (GAs) are adaptive methods which may be used to solve search and optimization problems. A genetic algorithm allows a population of possible solutions composed of many individuals to develop, under specified rules of selection, a state that minimizes the cost function. The selective mechanisms achieve the changes that determine the evolution of a population across generations. Such changes may occur due to interactions between individuals or due to environmental influences on the individual. It derives three basic mechanisms, crossing or recombination, reproduction and mutation, called genetic operators, to carry out the development of the algorithm. The application of these operators is preceded by a process of selection of individuals best adapted, which uses a function to evaluate the individuals named function fitness or, function setting.

In many engineering problems the variable or design characteristics could be consider as uncertainty and be included in the mathematical model as a statistical function. Monte Carlo simulation approach can be used simultaneously with the genetic algorithm optimization procedure to indicate a good solution considering the average, the standard deviation or any other variable or design characteristics statistical property.

Ship preliminary design mathematical model was included as a case study to indicate the procedure applicability. Results are shown and discussed. Mode Frontier™ software is used as model building and also solution research.

**Keywords:** optimization, uncertainty, engineering and ship preliminary design