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Fuzzy-Genetic Algorithm Multi-Objective Optimization Methodology for Cylindrical Stiffened Tanks Conceptual Design

Authors : H. Naseh, M. Mirshams, M. Mirdamadian, H. R. Fazeley

Abstract : This paper presents an extension of fuzzy-genetic algorithm multi-objective optimization methodology that could effectively be used to find the overall satisfaction of objective functions (selecting the design variables) in the early stages of design process. The coupling of objective functions due to design variables in an engineering design process will result in difficulties in design optimization problems. In many cases, decision making on design variables conflicts with more than one discipline in system design. In space launch system conceptual design, decision making on some design variable (e.g. oxidizer to fuel mass flow rate O/F) in early stages of the design process is related to objective of liquid propellant engine (specific impulse) and Tanks (structure weight). Then, the primary application of this methodology is the design of a liquid propellant engine with the maximum specific impulse and cylindrical stiffened tank with the minimum weight. To this end, the design problem is established the fuzzy rule set based on designer's expert knowledge with a holistic approach. The independent design variables in this model are oxidizer to fuel mass flow rate, thickness of stringers, thickness of rings, shell thickness. To handle the mentioned problems, a fuzzy-genetic algorithm multi-objective optimization methodology is developed based on Pareto optimal set. Consequently, this methodology is modeled with the one stage of space launch system to illustrate accuracy and efficiency of proposed methodology.

Keywords : cylindrical stiffened tanks, multi-objective, genetic algorithm, fuzzy approach
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