Thermodynamic Pareto Optimization of Turbojet Engines using Multi-objective Genetic Algorithms

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Abstract:

Multi-objective genetic algorithms (GAs) are used for Pareto approach optimization of thermodynamic cycle of ideal turbojet engines. On this behalf, a new diversity preserving algorithm is proposed to enhance the performance of multi-objective evolutionary algorithms (MOEAs) in optimization problems with more than two objective functions. The important conflicting thermodynamic objectives that have been considered in this work are, namely, specific thrust ($ST$), thrust-specific fuel consumption ($TSFC$), propulsive efficiency ($\eta_p$), and thermal efficiency ($\eta_t$). In this paper, different pairs of these objective functions have been selected for two-objective optimization processes. Moreover, these objectives have also been considered for a four-objective optimization problem using the new diversity preserving algorithm of this work. The comparison results demonstrate the superiority of the new algorithm in preserving the diversity of non-dominated individuals and the quality of Pareto
fronts in both two-objective and 4-objective optimization processes. Further, it is shown that some interesting and important relationships among optimal objective functions and decision variables involved in the thermodynamic cycle of turbojet engines can be discovered consequently. Such important relationships as useful optimal design principles would not have been obtained without the use of a multi-objective optimization approach. It is also demonstrated that the results of four-objective optimization can include those of two-objective optimization and, therefore, provide more choices for optimal design of thermodynamic cycle of ideal turbojet engines.