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A MEMETIC ALGORITHM FOR ROBUST OPTIMAL SOLUTION SEARCH — HYBRIDIZATION OF MULTI-OBJECTIVE GENETIC ALGORITHM AND QUASI-NEWTON METHOD

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Abstract. *In recent years, various optimization algorithms have been proposed, but little attention has been given to algorithms for finding robust optimal solutions. A robust optimal solution is defined as a solution which has optimal or near-optimal value of a given optimization function and which is robust against small value changes of variables due to some uncertainties like manufacturing errors. A robust solution search method using Multi-Objective Genetic Algorithm (MOGA) has been proposed and called Design For Multi-Objective Six Sigma (DFMOSS). Although DFMOSS can find robust optimal solutions with little parameter adjustments, DFMOSS requires enormous search cost to find the robust optimal solutions. This paper proposes a memetic algorithm for robust optimization in order to enhance the local search facility and reduce search cost. The proposed memetic algorithm combines DFMOSS and quasi-Newton method, and also uses aging model. Experimental results show that the proposed algorithm can find robust optimal solutions with less cost than DFMOSS at most ten dimensions problem.*
Keywords: Robust optimization, Memetic algorithm, Multi objective optimization, Genetic algorithm, Quasi-Newton method

1. **Introduction.** Many theoretical and empirical studies focusing on finding a global optimal solution have been performed. In recent years there has been renewed interest in robust optimization as a practical optimization methodology considering margins of errors, noises, and other uncertainties on manufacture, design, observation and so on [1, 2, 3, 4]. General optimization algorithms evaluate solution candidates focusing only on optimality of an objective function. If a solution obtained by the algorithms is sensitive to small perturbations of variables as shown in Figure 1, it may not be appropriate or risky for practical use. Such small variation may cause undesired deviations of engine performance in automobile valvetrain control [1], or collisions or interference in controlling machines. Robust optimization finds solutions which are moderately good in terms of optimality and also good in terms of robustness against small perturbations of values, as shown in Figure 1. In many practical optimization tasks, there is a need to search for robust solutions whose value of optimization function is sufficiently high and will not change due to the small variation of parameter values.

Design For Six Sigma (DFSS) is a methodology for designing new products or processes and can be considered as a robust optimization algorithm. But in DFSS, weight parameters exist in an optimization function and the parameters must be adjusted manually,