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MULTI-OBJECTIVE EVOLUTIONARY ALGORITHM WITH ENSEMBLE OF EXTERNAL ARCHIVES

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Abstract. *This paper proposes an ensemble of ε parameter values and an ensemble of external archives in a multi-objective optimization algorithm namely the multi-objective particle swarm optimization algorithm (MOPSO) so that the difficulty of tuning the numerical values of the ε parameters for every objective in every problem can be overcome. From the literature, we observe that different objectives and different optimization algorithms require different ε values to perform the ε non-dominance sorting in order to maintain the diversity of the population. We also observe that there is only a trial-and-error procedure for determining a suitable ε value for each objective in a multi-objective optimization problem for a given optimization algorithm. Our experimental results show that an ensemble of external archives with different ε values yields good spread and convergence to the true Pareto-optimal front for difficult problems with different characteristics. Furthermore, we apply the proposed approach to solve the optimal asset allocation problem in portfolio optimization. The experimental results also show the superior performance of the ensemble of external archives with different ε values over implementations with only one archive. Although we form an ensemble using different ε values, it is also possible to use different diversity preservation methods in different archives in an ensemble of external archives.*

Keywords: Ensemble of external archives, Multi-objective evolutionary algorithm, Multi-objective particle swarm optimization, Epsilon non-dominance sorting, Optimal asset allocation, Portfolio optimization

1. **Introduction.** Numerous optimization problems have more than one objective in conflict with each other. As there is no single solution for these problems, our aim is to find Pareto optimal trade-off solutions that represent the best possible compromises among the objectives. As evolutionary algorithms (EAs) are able to find multiple Pareto-optimal solutions in one single run, development of evolutionary algorithms to solve multi-objective optimization problems has attracted much interest and several multi-objective evolutionary algorithms (MOEAs) have been suggested [1,3,11,15,22,23]. While most of these algorithms were developed taking into considerations two common goals, namely fast convergence to the Pareto-optimal front and good distribution of solutions along the front, each algorithm employs a unique combination of specific techniques to achieve these goals.

In order to avoid solutions becoming clustered, some techniques must be used so that solutions can adequately represent the whole of the Pareto front. The ε-dominance is one such technique [14] that does not allow more than one solution with difference in all (i^{th}) objective values less than ε_i to be non-dominated by each other. Hence, removal of such similar solutions improves diversity in the fixed sized external archive. However, the ε non-domination sorting method requires the user to choose individual ε_i values depending on