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Perspective

Emerging Trends in Evolutionary Optimization

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DESCRIPTION

Evolutionary optimization (EO) methodologies are now widely used in a wide range of problem-solving tasks involving nonlinearities, high dimensionality, non-differentiable functions, non-convexity, multiple optima, multiple objectives, uncertainties in decision and problem parameters, large computational overheads, and a variety of other complexities that classical optimization methodologies are known to be vulnerable. According to a recent poll done before to the World Congress on Computational Intelligence (WCCI), evolutionary multi-objective optimization is one of the three fastest expanding fields of research and application across all computational intelligence issues. The usage of a population of solutions in each iteration may appear to be overkill when solving single-objective optimization issues or other activities focusing on finding a single optimal solution; while handling multi-objective optimization problems, an EO technique may appear to be overkill.

In multi-objective optimization problems yield a set of Pareto-optimal solutions that must be processed further to get a single preferred solution. To accomplish the first aim, it is fairly natural to employ a modified EO, because the use of population in EO allows for the simultaneous discovery of many Pareto-optimal solutions in a single simulation. The concept of Evolutionary Multi-objective Optimization (EMO) is used to address constrained single-objective optimization issues by turning the work into a two-objective optimization challenge that also minimizes an aggregate constraint violation.

In a bi-objective formulation of a clustering issue, minimizing intra-cluster distance while maximizing inter-cluster distance yields better solutions than the traditional single-objective minimization of the ratio of intra-cluster distance to inter-cluster distance. To demonstrate the efficacy of identifying various trade-off solutions, EMO approaches are being and must be applied to more intriguing real-world challenges. Although some recent studies have found that EMO procedures are not computationally efficient for finding multiple and widely distributed sets of solutions on problems with a large number of objectives, EMO procedures can still be used in very large problems if the focus is changed to find a preferred region on the Pareto-optimal front rather than the entire front. Some preference-based EMO studies cover ten or more objectives. Because of the presence of redundant objectives in certain many-objective issues, the Pareto-optimal front can be low-dimensional, and EMO approaches can once again be useful in addressing such problems. Furthermore, reliability-based EMO and robust EMO processes are ready for usage in real-world multi-objective design optimization situations. Application studies are also interesting because they show how an EMO technique and a later Multiple Criteria Decision Making (MCDM) approach can be used iteratively to solve a multi-objective optimization problem. Such efforts may result in the creation of GUI-based software and approaches to problem solving, as well as the need to address other critical issues such as multi-dimensional data visualization, parallel execution of EMO and MCDM procedures, meta-modeling approaches and others.

CONCLUSION

EMO's wings have expanded to assist with other sorts of optimization issues, such as single-objective restricted optimization, clustering problems and so on. EMO has been utilized to uncover previously unknown information about what makes a solution optimal. EMO approaches are increasingly being discovered to offer enormous potential for usage in conjunction with MCDM tasks in not only generating a collection of optimal solutions but also assisting in the final selection of a preferred solution. We provide some relevant information regarding EMO research in the reference and appendix sections so that interested readers can become acquainted with and involved with the wide EMO.

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