VISUALIZATION IN MANY-OBJECTIVE OPTIMIZATION

Visualization of population in a high-dimensional objective space throughout the evolution process presents an attractive feature that could be well exploited in designing many-objective evolutionary algorithms. In this talk, we will survey existing tools available for visualization to motivate the development of a new visualization framework. It maps individuals from a high-dimensional objective space into a two-dimensional polar coordinate plot while preserves Pareto dominance relationship, retains shape and location of Pareto front, and maintains distribution of individuals. From it, a decision-maker can observe the evolution process, estimate location, range, and distribution of Pareto front, assess quality of the approximated front and trade-off between objectives, and easily select preferred solutions. Furthermore, its applications can be scalable to any dimensions, handle a large number of individuals on front, and simultaneously visualize multiple fronts for comparison. Based on this visualization tool, a performance metric, named polar-metric, is designed. The convergence of the approximate front is measured by radial values of all population members on that front. Meanwhile, the diversity performance is mainly determined by niche count of each sub region in a high-dimensional objective space. Experimental results show that it can provide a comprehensive and reliable comparison among many-objective evolutionary algorithms. In addition, a novel knee based decision making method is presented to search for several solutions of interest from a large number of solutions on the Pareto front, each of which contains the best convergence performance at least within its neighborhood and can be identified as a global or local knee solution.