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Experimental evaluation of some preference parametrization schemes

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The final stage of a Multi-Objective Optimization process typically consists of the selection of a single solution, which is usually accomplished based on information provided by one or more Decision Makers (DM). There are several methods in the literature that enable the DM to explore different regions of the Pareto front by varying certain preference-related parameters, such as weights and goals. Thus, the dependence between the parameter values set by the DM and the solution selected should be as direct as possible, so that the DM may use those parameters to express actual preferences. Although the relation between scalarizing function parameters and the corresponding final solutions has been the object of experimental studies before, the authors are unaware of a well-established, quantitative approach to the assessment of the quality of such a mapping. A good preference-articulation method should be such that all Pareto-optimal solutions correspond to some setting of the parameters. In addition, a good correspondence between preference-articulation parameters and solutions should imply that a uniform sampling of the parameter space leads to a good discrete approximation of the Pareto front. Therefore, it would seem appropriate to adopt measures of the quality of discrete Pareto-front approximations, such as the hypervolume indicator, to assess the quality of the parameter-solution relation induced by different scalarizing functions. In this work, four different preference-articulation methods are compared using several bi-objective and three-objective benchmark problems from the literature: Reference-Point EMO, the Weighted Tchebycheff Metric, a form of Goal Programming (GP), and the authors' Weighted Stress Function (WSF) method. The WSF and GP methods can be seen to exhibit a more direct correspondence between the parameters set by the DM and the final solutions obtained than the other methods tested. However, the results obtained when coupling these preference-articulation methods with the NSGA-II algorithm also highlight some interesting differences between the two approaches.

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