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Performance evaluation of a multiobjective optimization algorithm for the design of water distribution networks

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Multiobjective water distribution networks (WDNs) are a very lively area of research (Marques et al., 2018). To evaluate the performance of these algorithms, different metrics can be used to quantify and compare the quality of the solutions during the run-time and at the end-time of the optimization process. The quality evaluation of the set of non-dominated solutions found by these algorithms is not a trivial process. The literature review by Audet et al. (2018) includes 57 distinct performance indicators that can be used to evaluate solutions provided by multiobjective algorithms, and groups these indicators into four categories: cardinality, convergence, distribution and spread. These categories aim at characterizing, respectively, the number of solutions provided by each algorithm, the approximation of the solutions to the best-known front, the distribution of solutions along the front and the range of the set of solutions found. To evaluate a multiobjective algorithm, performance indicators that cover all these four categories should be considered to prevent any kind of misleading conclusions. The authors have recently proposed a new multiobjective simulated annealing algorithm. It is an enhanced version of the algorithm presented in (Marques et al., 2018) in that it uses special features to generate candidate solutions and a final step that involves a local search. Different generation processes guide the search and allow the algorithm to reach some parts of the Pareto front that would not be possible if a single generation process was used. The local search, a reannealing phase, is implemented as a supplemental phase of the algorithm to concentrate the search in specific areas of the front to identify the best possible solutions. The present work proposes to evaluate the performance of this algorithm by means of performance indicators of different categories, computed for a set of different benchmark WDNs presented in Wang et al (2015). From the results it can be concluded that the proposed algorithm achieves higher quality solutions than other algorithms, and does so without increasing the computational effort. The results found are evaluated with performance metrics from the four categories.

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