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Experiments with ROPAR, an approach for probabilistic analysis of the optimal solutions' robustness

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Robust optimization is defined as the search for solutions and performance results which remain reasonably unchanged when exposed to uncertain conditions such as natural variability in input variables, parameter drifts during operation time, model sensitivities and others [1].

In the present study we follow the approach named ROPAR (multi-objective robust optimization allowing for explicit analysis of robustness (see online publication [2]). Its main idea is in: a) sampling the vectors of uncertain factors; b) solving MOO problem for each of them obtaining multiple Pareto sets; c) analysing the statistical properties (distributions) of the subsets of these Pareto sets corresponding to different conditions (e.g. based on constraints formulated for the objective functions values of other system variables); d) selecting the robust solutions.

The paper presents the results of experiments with the two case studies: 1) a benchmark function ZDT1 (with an uncertain factor) often used in algorithms comparisons, and 2) a problem of drainage network rehabilitation that uses SWMM hydrodynamic model (the rainfall is assumed to be an uncertain factor).

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