Water pollution management with evolutionary multi-objective optimisation and preferences

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ABSTRACT

Dealing with real world engineering problems, often comes with facing multiple and conflicting objectives and requirements. Water distributions systems (WDS) are not exempt from this: while cost and hydraulic performance are usually conflicting objectives, several requirements related with environmental issues in water sources might be in conflict as well. Commonly, optimisation statements are defined in order to address the WDS design and/or management. Nevertheless, such problems become difficult since, besides their multi-objective conflicting nature, the optimisation problem might be non-linear (due to head-loss relationships for example) and/or discrete combinatorial (due to standardization of pipe parameters) [1].

Multi-objective optimisation can handle such issue, by means of a simultaneous optimisation of the design objectives. At the end of such process, a potential set of solutions, the Pareto front, are calculated. In such a set of solutions, there is not *a best solution*, but a *preferable solution*. This meaning that several solutions are calculated, with different trade-off between conflicting objectives and the engineer will select among them the most preferable for the problem at hand.

In this paper, we will apply a multi-objective optimisation process with preferences [2] in order to deal with a water pollution management constrained problem [3] with 6 design objectives. Such design objectives are related with maximising dissolved oxygen concentration at three locations while minimizing financial costs. With the provided example, it will be shown the usefulness of such tools for decision making and trade-off analysis for WDS management.

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