Using Interactive Archives in Evolutionary Multiobjective Optimization: A Case Study for Long-Term Groundwater Monitoring Design

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**Abstract.** Monitoring design is a problem of paramount importance to the environmental engineering field because environmental observation data provide the sole means of assessing if engineered systems are successfully protecting human and ecologic health. The monitoring design problem is extremely challenging because it requires environmental engineers to capture an impacted system’s governing processes, elucidate human and ecologic risks, limit monitoring costs, and satisfy the interests of multiple stakeholders (e.g., site owners, regulators, and public advocates). Evolutionary multiobjective optimization (EMO) has tremendous potential to help resolve these issues by providing environmental stakeholders with a direct understanding of their monitoring tradeoffs. This paper demonstrates how \( \varepsilon \)-dominance archiving and automatic parameterization techniques for the NSGA-II can be used to significantly improve the algorithm’s ease-of-use and efficiency for computational intensive applications. Results are presented for a four-objective groundwater monitoring problem in which the archiving and parameterization techniques for the NSGA-II combined to reduce computational demands by more than 80-percent relative to prior published results. The methods of this paper can be easily generalized to other multiobjective applications to minimize computational times as well as trial-and-error parameter analysis.