

# Water Supply Systems Management by Optimizing Simulation Model with Stochastic Gradient Methods

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Energy saving and the water deficit reduction are contrasting requirements, which should be considered optimizing a complex water supply system under drought conditions. These issues are characterized by a high stochasticity level, which results from hydrologic input variability and water demand behavior. Hence, in order to deal efficiently with the high uncertainty, a decision support methodology aimed at the water system authorities has been developed in this paper. Its purpose is to provide a robust decision policy able to minimize the risk of taking costly future decisions concerning the water resource management. More specifically, it has been done through the optimization of emergency water transfer activation schedules. This problem has been formulated using a cost-risk balanced approach to water resources management [2], balancing the damages originated from water shortage with energy and cost requirements for emergency transfers. In [3] this problem has been solved using a traditional scenario analysis approach with a two stages stochastic programming model. The obtained results were promising considering a limited number of scenarios characterized by a short time horizon. However, in order to take into account the effect of climate and hydrological changes and the realistic length of time horizon, it is necessary to increase substantially the number of considered scenarios, resulting in difficult computational problems. Therefore, in order to relax these limitations, it is necessary to apply a specialized approach for optimization under uncertainty, such as the combination of stochastic gradient methods [1] and simulation. A mixed simulation-optimization model has been implemented using the stochastic gradient method, applying this methodology to a real case study concerning a complex water supply system located the south-Sardinia (Italy) area.

## References

- [1] Gaivoronski, A, SQG: Stochastic Programming Software Environment, Applications of Stochastic Programming, 2005.
- [2] Gaivoronski, A., Sechi, G.M., Zuddas, P.: Cost/risk balanced management of scarce re-sources using stochastic programming, European Journal of Operational Research, v.216, pp. 214-224, 2012.
- [3] Napolitano, J., Sechi, G.M., Zuddas, P.: Scenario Optimization of Pumping Schedules in a Complex Water Supply System Considering a Cost-Risk Balancing Approach, Water Re-source Management, v.30, pp. 5231-5246, 2016.