Geophysical Research Abstracts
Vol. 15, EGU2013-12639, 2013
EGU General Assembly 2013

Combined mid- and short-term optimization of multireservoir systems via dynamic programming with function approximators

Andrea Bottacin-Busolin, Anders Wörman, and Nicholas Zmijewski
KTH - Royal Institute of Technology, Dept. of Land and Water Resources Engineering, Stockholm, Sweden
(andreabb@kth.se)

A main challenge for the planning and management of water resources is the development of strategies for regulation of multireservoir systems under a complex stochastic environment. The sequential decision problem involving the release of water from multiple reservoirs depends on the stochastic variability of the hydrologic inflows over a spectrum of time scales. An important distinction is made between short-term and mid-term planning: the first is associated with regulation on the hourly scale within the one-week time horizon, whilst the second is associated with the weekly scale within the one-year horizon. Although a variety of optimization methods have been suggested, the achievement of a global optimum in the operation of large-scale systems is hindered by their high dimensional state space and by the stochastic nature of the hydrologic inflows. In this work, operational plans for multireservoir systems are derived via an approximate dynamic programming approach using a policy iteration algorithm. The algorithm is based on an off-line learning process in which policies are evaluated for a number of stochastic inflow scenarios by constructing approximations of their value functions, and the resulting value functions are used iteratively to design new, improved policies. In the mid-term planning phase, inflow scenarios are generated with a periodic autoregressive model that is calibrated against historical inflow data, and the policy iteration algorithm leads to a cyclostationary operating policy. In the short-term planning phase, the mid-term value function is used to calculate the value of a policy at the end of the short-term operating horizon, and synthetic inflow scenarios are generated by perturbing streamflow forecasts with Gaussian noise, following Zhao et al. (Water Resour. Res., 48, W01540, 2012). The variance of the noise is assumed to increase linearly over time and converges to the local variance of the historical time series. A case study is presented of a multi-reservoir system in the river Dalälven, Sweden, where the impact of forecast uncertainty and the performance of the proposed stochastic optimization model is evaluated using observed time series and synthetic inflow forecasts. The resulting electricity production is compared with the optimal production in case of perfect a priori information and the expected production from the application of a myopic operating policy.