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Application of weather generator to flood control

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To the most efficient preventive flood control measures belong methods of the real-time control of water resources. Recently, a number of various concepts of mathematical models of control systems has been proposed. The quality of those models is obviously strongly affected by the reliability of a hydrological forecast, which represents one of the most important input to the decision making model. This contribution describes calibration of a stochastic weather generator and discusses a possibility of its application to improve the flood control of reservoirs.

The flood control represents very difficult question namely in the case of reservoirs located at the upper parts of catchments, where our chance to obtain reliable hydrological forecast is usually rather limited. Main idea is based on creation of a large database of synthetic flood events for which it is possible to find an optimal control with the use of standard techniques as nonlinear programming or dynamic programming. According to optimal control strategy it will be possible consequently divide particular flood events to several characteristic clusters, which may be found very useful in the real time flood control.

The database of flood events has been created with the use of a stochastic weather generator and rainfall-runoff model. The weather generator consists of a precipitation occurrence model and precipitation amount model to generate daily rainfalls in one station. Consequently a series of daily average temperatures is generated with respect to the rain occurrence. Daily temperatures are modeled by a standard autoregressive approach. The precipitation occurrence model is based on a Markov chain model and appropriate transition probabilities are estimated in observed daily weather sequences. The order of Markov chain and the transition probabilities are optimized separately for each month to generate daily precipitation occurrence with respect to the year variability. This optimization is performed by minimization of likelihood based criteria AIC and BIC. Minimization was carried out by the genetic algorithm method and results

were compared with those reached by standard nonlinear programming techniques. The daily precipitation amounts are generated as uncorrelated variable under assumption of the gamma distribution. Parameters of the gamma distribution are also assessed separately for daily precipitation amounts in each month.

Proposed weather generator was tested on the case of the upper catchment of the Moldava river for the Lipno reservoir profile in the Czech Republic. Validation of the generator has proven its good performance according to all statistics over year period.

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