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Tree-Scenario Based Model Predictive Control

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Real-time control is becoming an accepted engineering solution for reducing the impact of undesired situations occurring in water systems. Model Predictive Control (MPC), which is generally used in a deterministic environment, can be used effectively to exploit best the information contained in an forecast.
In case of Ensemble Forecast, the problem of optimal control in MPC can be reshaped in a probabilistic formulation, but such a formulation is very complex and requires calculation time that is often not suitable for a use in real time.
Scenario reduction techniques can be used to reduce the calculation time until an acceptable value, while minimizing the decrease in performance due to such simplification. Uncertainty of the prediction increases further in time and the ensembles spread out. We can reduce the number of scenarios by pruning the ensemble at different stages. The way in which the pruning takes place changes with time. Tree-shaped scenario reduction refers to a corresponding decision tree to take into account that the decision at the present moment is influenced by the knowledge that new and more accurate information will be available in the future.
Tree-shaped scenario reduction has been applied in a Model Predictive Controller to a drainage canal system in Delfland (The Netherlands) and compared with results obtained using deterministic MPC. To conclude, we summarize the advantages and limits of this novel method, and possible future solutions to overcome these limits.