



Model Predictive Control application for real time operation of controlled structures for the Water Authority Noorderzijlvest, The Netherlands

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In the Netherlands, flood protection has always been a key issue to protect settlements against storm surges and riverine floods. Whereas flood protection traditionally focused on structural measures, nowadays the availability of meteorological and hydrological forecasts enable the application of more advanced real-time control techniques for operating the existing hydraulic infrastructure in an anticipatory and more efficient way.

Model Predictive Control (MPC) is a powerful technique to derive optimal control variables with the help of model based predictions evaluated against a control objective. In a project for the regional water authority Noorderzijlvest in the north of the Netherlands, it has been shown that MPC can increase the safety level of the system during flood events by an anticipatory pre-release of water. Furthermore, energy costs of pumps can be reduced by making tactical use of the water storage and shifting pump activities during normal operating conditions to off-peak hours. In this way cheap energy is used in combination of gravity flow through gates during low tide periods.

MPC has now been implemented for daily operational use of the whole water system of the water authority Noorderzijlvest. The system developed to a real time decision support system which not only supports the daily operation but is able to directly implement the optimal control settings at the structures. We explain how we set-up and calibrated a prediction model (RTC-Tools) that is accurate and fast enough for optimization purposes, and how we integrated it in the operational flood early warning system (Delft-FEWS). Beside the prediction model, the weights and the factors of the objective function are an important element of MPC, since they shape the control objective. We developed special features in Delft-FEWS to allow the operators to adjust the objective function in order to meet changing requirements and to evaluate different control strategies.