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Practical application of drainage system control by using MPC in Noorderzijlvest

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We discuss the implementation of a Model Predictive Control (MPC) approach for the control of the pump stations and tidal spilling sluices in the district of the regional water authority Noorderzijlvest in the north of the Netherlands.

The RTC component is integrated in a Delft-FEWS application that connects to the SCADA system of the waterboard and also
17 aggregated structures including 127 individual pumps and gates The approach consists of a Nonlinear MPC in combination with a low-pass filter for state updating. The MPC runs hourly for a 5-day forecast horizon.

One main objective of the control is flood mitigation during extreme taken into account by anticipating approaching rainfall events by flow forecasting. Another objective has is the reduction of pumping costs by taking advantage of gravity flow through gates during low tide conditions and the exploitation of cheaper electricity at night, both in combination with tactical usage of the available storage in the water system.

Firstly the approach is tested in a closed-loop setting in combination with a detailed one-dimensional hydraulic model as the real-world replacement. A performance comparison of the approach against the existing feedback control shows pumping cost reductions in the range of 7-35% for different sub-systems or total annual cost savings in the order of 150-200 thousand Euros as well as significantly reduced peak water levels during flood events.