PRONTO

PROcess NeTwork Optimization for efficient and sustainable operation of Europe's process industries taking machinery condition and process performance into account

Adjustments to mitigate for change of condition

Imperial College London, Norwegian University of Science and Technology, University of Valladolid

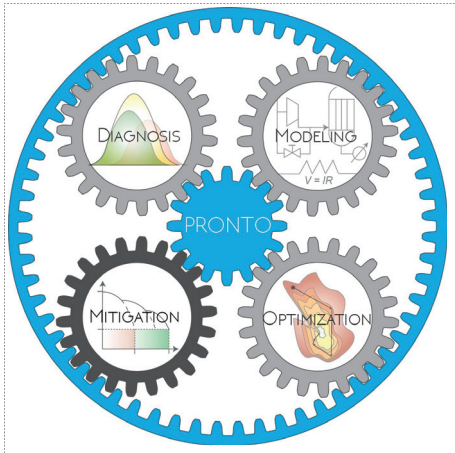
Eric Bradford (NTNU/BASF) — Stochastic predictive control for batch processes

Francesco Borghesan (Imperial/ABB DE) — Predicting disturbances to improve control

Anibal Galan (UVA/Petronor, CMU) — Predictive simulation for decision support

Marta Zagorowska (Imperial/ABB NO) — Compressor degradation management

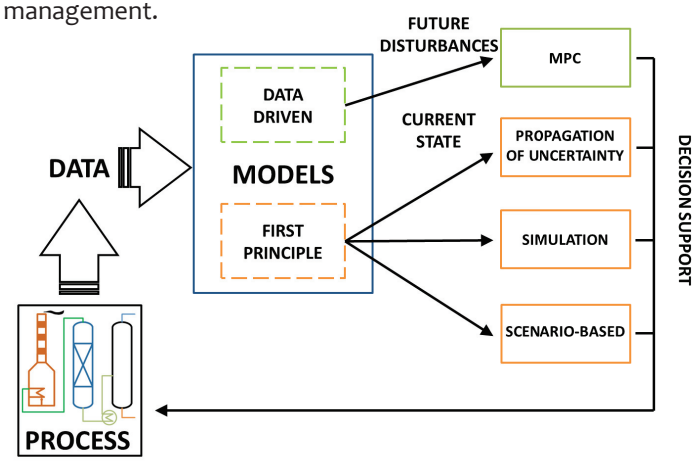
Mitigation for change of condition



New predictive tools and methods have been developed to **improve system behaviour** and operation **decision support.**

Estimation of the **current and future condition** of the system enables corrective actions and improves **process control.**

Different approaches for mitigation due to **change of condition** have been studied: **stochastic predictive control, disturbance prediction, predictive simulation** and **compressor degradation** management.

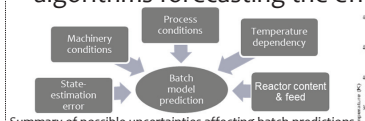


Methodologies and approaches applied for change of condition mitigation.

Stochastic predictive control for batch processes

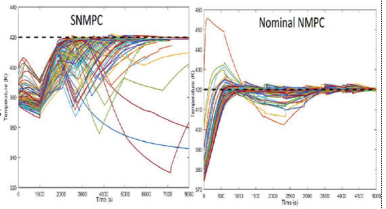
Scope is to design a model predictive control for batch processes that explicitly consider stochastic uncertainties.

- Desire for optimal operation despite uncertainties present
- Novel scenario-based nonlinear model-based control algorithms forecasting the effect of the disturbances



Summary of possible uncertainties affecting batch predictions

Illustration of probability constraint for state trajectories

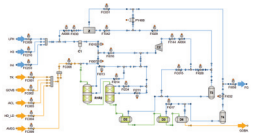


Comparison of temperature control for the proposed SNMPC algorithm(left) compared to standard NMPC (right)

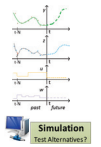
Predictive simulation for decision support

Research is aimed at developing decision support tools for process network operators. An actual refinery hydrogen network is used as case study.

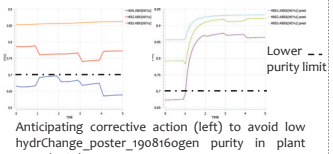
- Reconciliation of parameters and MHE applied on dynamic models
- Simulation with current state estimation for analysis of uncertain conditions (e.g.: What-if analysis).



Actual plant flowchart



Past and future actions

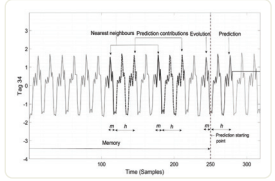


Anticipating corrective action (left) to avoid low hydrChange_poster_190816ogen purity in plant HDS1 (right).

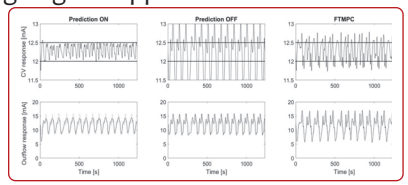
Predicting disturbances to improve control

Scope is enabling a controller to learn how to optimally counteract disturbances in a plant section.

- This is done by integrating an MPC controller with a disturbance forecaster based on a k-NN method
- Forecasting the evolution of the disturbance, the controller reacts better to what it is going to happen



Principle of k-NN forecasting method

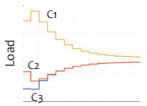


Compared to other industrial solutions, the proposed MPC keeps the CV variable within limits and minimizes the disturbance propagation

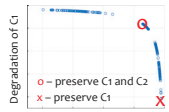
Compressor degradation management

Scope is to:

- Design a load-sharing algorithm that will consider degradation of compressors
- Provide a decision support tool for active degradation management



Load-sharing depending on degradation



A trade-off between degradation of two compressors C1 and C2

For these purposes:

- Compressor degradation due to fouling is modelled as a function of the load of the compressors
- A ratio-based algorithm is proposed to allocate the loads w.r.t. the current value of degradation, updated in real time

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