Autoprofit

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WP 4 – PERFORMANCE MONITORING AND DIAGNOSIS

WORK PACKAGE OBJECTIVES

The objective of this workpackage is twofold and applies to MPC-controlled processes.

One objective is the development of a performance monitoring algorithm. This algorithm triggers a diagnostic tool when performance is deemed insufficient.

The diagnostic tool is the second objective, i.e., the development of a detection algorithm that is able to - using least-costly experiments on the process - detect the cause of the observed performance drop.

EXPECTED OUTCOME

- A generic performance measure which is applicable to many large-scale industrial processes.
- A diagnosis algorithm that can distinguish between two types of performance drops: changes in plant dynamics and in disturbance characteristics. We exclude base-layer problems from our diagnosis.

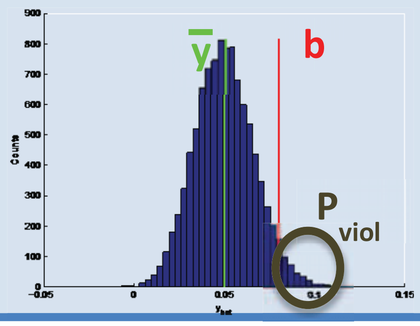
PROGRESS AND PLANS

The proposed performance measure computes the cost of the process, using data from a moving time window, and consists of two components. One part is associated with the distance between the mean of the money-making variable ($\bar{y}$) and its respective constraint (b). The second part is a cost involved due to constraint violations. The cost at time t is given by

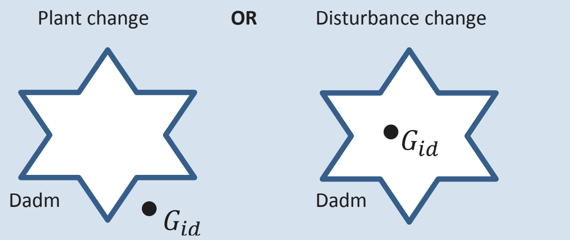
$$J(t) = c_1 P_{viol}(t) + c_2|\bar{y} - b|$$

where c_1, c_2 are user-defined constants and $P_{viol}(t)$ is the probability of violating constraint b. A performance drop occurs when $J(t) > \beta$. This measure accommodates typical MPC behaviour in where a money-making variable is pushed towards its constraint.

The figure shows a histogram of a money-making variable (blue) at a particular point in time, from which the cost is computed.



The above mentioned types of performance drops are diagnosed by checking whether an identified model (G_{id}) of the true system lies in a set (D_{adm}) containing all models that exhibit satisfactory closed-loop performance under the original disturbances. See visualisation below.



We also consider optimal design of the diagnosis experiment, in where the excitation signal has minimal power whilst ensuring a particular accuracy on the identified model. Furthermore, a joint framework has been developed for optimal design of both the diagnosis experiment and the (eventual) re-identification experiment (WP3).
It allows us to minimize the overall excitation cost incurred for detection and re-identification through optimal design of the excitation signals.

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