INFORME FINAL

TÍTULO DEL PROYECTO: “MPC BASED ON ARX-CHEBYSHEV MODEL FOR TEMPERATURE TRAJECTORY CONTROL IN A BATCH REACTOR”

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Introduction:
The Proportional, Integral and Derivative PID controller has a tendency to overshoot in tracking trajectory temperature processes inside the batch reactors. Moreover the PID controller is slow to correct disturbances caused by the long time constant and the integral action of the reactors. In such a context we propose the use of MPC scheme instead of PID controller in order to track the trajectory by applying an ARX model based on Chebyshev functions and an algorithm straightforward of Dynamic Matrix Control (DMC).

The batch reactor identification was based on the black box model; the mainstay of this election was the lack of the process equations which represent the system. For this purpose the reactor was characterized by the input/output relation, for which we tested the system by applying one signal Pseudo Random Multilevel Sequences (PRMS) as input. In this sense, throughout the experiments on system, to ensure the collection of the most important information contained in the output signal, the batch reactor was maintained persistently excited by a PRMS signal, on the I/P /current/Pressure) transducer.

The required experiments to obtain an ARX model which faithfully represents the system process, were carried out based on the following hypothesis: The system is characterized by the input/output relation, such that the output can be expressed by \( y(k) = \Gamma(Q, P, Ti) \); were \( \Gamma \) is the system operator, \( Q \) is the flow rate, \( P \) is the pressure and \( Ti \) the temperature inside heating pipes. But keeping constants \( P \) and
Ti, we achieve reduce the system to one SISO Q-dependent type. In our case this flow rate was controlled by a pneumatic three-way valve. The MPC scheme that we propose was built with an ARX model based on the three lowest-order first-kind Chebyshev polynomials as OBF. The control law was obtained by minimizing a cost function involving both, the control effort and the error between the model of system and the reference signal (hyperbolic tangent function).

The remainder of this paper is organized as follows: Section II, the approach how to identify a batch reactor by using the ARX-Chebyshev model. The MPC controller that we proposed is rendered in section III. Finally, conclusions regarding the results of this work are drawn.

**Conclusions:**

An MPC based on the ARX-Chebyshev model has been presented; the approach makes uses of projecting model ARX parameters on to an orthogonal basis function. In this research the usage of the first-kind Chebyshev polynomials was used for represent all the system solely 6 parameters.

The potential of this research is manifested when the ARX-Chebyshev model enters in MPC strategy, which uses a DMC like algorithm. Furthermore the MPC performance when is applied for tracking temperature in reactor turns out to be proper as observed in the results where the output single overlaps to reference function. Thereby demonstrating the positive prospects set out in this article.

Indeed, simulation results using the MPC proposed reveals that using a simple optimization criterion, that involves both, the tracking trajectory error and the signal control effort, has an adequate potential for control temperature on batch processes.

The simulation shows that MPC proposed is free of overshoots and overheating, consequently the cooling systems are not demanding.