Unifying approaches to Robust PID Control

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At the core of process control we find an indispensable tool: the Proportional-Integrative-Derivative, PID, controller. Although many changes and innovations have been introduced since its early development during the 1930s and '40s, the basic idea behind the PID controller still applies successfully in practice. it seems that PID control is here to stay as the preferred control algorithm, at least at the bottom layer. In general, the tuning of the controller must be done taking into account different objectives, such as output performance, robustness, input usage and noise sensitivity, etc. With this context in mind, the basic aim of the proposed talks is to give some new insights into the tuning problem by considering a unifying approach to take care of the most relevant conflicting objectives, namely the robustness/performance and servo/regulator trade-offs.

Intended audience; The tutorial is specially addressed to researchers, PhD students and students interested in the practical approach to PID control. With emphasis on the ones that aim at process control applications and to develop practical approaches for PID controller tuning and design.

The tutorial is organized according to the following 5 seminars.

Seminar 1, (19/05/2021) PID Control: from the scaffold to the stage: General overview of PID control, putting the light on several aspects related to PI/PID control of several process dynamics. Considerations on tuning aspects and properties are commented as well as aspects of PI/PID control that actually still deserve attraction and even more, have made PID a very active research area.

Seminar 2 (20/05/2021) PID formulations and process dynamics normalization. Even this could be presented aside from the MoReRT scenario, it is useful to be presented here before the generation of the tuning rules. In which sense normalization is useful for the reduction of process dynamics parameters and generation of normalized controller parameters. Also different formulations for PID controllers and its relations are presented.

Seminar 3 (26/05/2021) Robust PID Control and The Model Reference Robust Tuning (MoReRT) approach to PID control. A general overview of different approaches; from classical ones to more modern conceptions; to consider robustness in PI/PID tuning are first reviewed. Afterwards, the MoReRT formulation, its purpose and conception is presented a) as a general framework for the design of fixed structure controllers and b) how it has been used to approach the tuning of PID controllers

Seminar 4 (27/05/2021) The MoReRT aproach to PID control: Tuning Rules. For the different process dynamics, the tuning rules generated by using the MoReRT approach are presented and evaluated. Even different process dynamics are considered, the control system specifications as well as approach to the solution is the same. The resulting tuning rules are presented and frameworks for comparison of PI/PID robust performance presented. The need for tuning rules is also raised.

Seminar 5 (28/05/2021) Alternative unified PID design as a weighted sensitivity problem, Attention is focused on model-based tuning of single-loop PID controllers in terms of the robustness/performance and servo/regulator trade-offs. Although the robustness/performance compromise is commonly considered, it is not so common to also take into account, for example, the conflict between input and output disturbances, referred also as the servo/regulator trade-off. As interested in providing a unified tuning approach, it is shown how the proposed methodology allows to deal with different process dynamics in a unified way.