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# PERFORMANCE DEGRADATION ANALYSIS OF CONTROLLER TUNING MODES: APPLICATION TO AN OPTIMAL PID TUNING

Orlando Arrieta[1,2] and Ramon Vilanova[1]

[1]Departament de Telecomunicació i d'Enginyeria de Sistemes, ETSE
Universitat Autònoma de Barcelona
08193 Bellaterra, Barcelona, Spain
{ Orlando.Arrieta; Ramon.Vilanova }@uab.cat

[2]Departamento de Automática, Escuela de Ingeniería Eléctrica
Universidad de Costa Rica
San José 11501-2060, Costa Rica
Orlando.Arrieta@ucr.ac.cr

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Abstract. *In this paper, an analysis about how performance of optimal tuning settings for PID controllers, can be degraded when the operating mode is different from the selected one for tuning. An index for measuring the overall Performance Degradation is proposed and from the minimum of this,* trade-off *tuning settings are given.*
**Keywords:** Performance degradation, PID control, Optimal tuning

1. **Introduction.** Proportional-Integrative-Derivative (PID) controllers are with no doubt the most extensive option that can be found on industrial control applications [1]. Their success is mainly due to its simple structure and to the physical meaning of the corresponding three parameters (therefore making manual tuning possible). This fact makes PID control easier to understand by the control engineers than other most advanced control techniques. In addition, the PID controller provides satisfactory performance in a wide range of practical situations.

During the last years, in fact since the initial work of Ziegler and Nichols [2], much work has been done developing methods to determine the PID controller parameters. Since the manual tuning is a laborious task and requires close attention of the process control engineer, special attention has been devoted to autotuning methods. These methods rely on the application of a special input to the system and by measuring its response, process parameters can be determined and the PID controller gains can be selected. Some of the methods employ information about the step response curve such as [2, 3, 4] and [5] for example. A good review of approaches can be found in [6, 7, 8, 9, 10] and [11, 12, 13, 14].

Within the wide range of approaches to autotuning, optimal methods have received special interest. These methods provide, given a simple model process description -such as a First-Order-Plus-Dead-Time (FOPDT) model- settings for optimal closed-loop responses.

For One-Degree-of-Freedom (1-DoF) controllers, it is usual to relate the tuning method to the expected operation mode for the control system, known as *servo* or *regulation*. Therefore, controller settings can be found for optimal set-point or load-disturbance responses. This fact allows better performance of the controller when the control system operates on the selected *tuned mode* but, a degradation in the performance is expected when the tuning and operation modes are different. Obviously, there is always the need to choose one of the two possible ways to tune the controller, for set-point tracking or to