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EXPECTED INTERACTION ANALYSIS FOR DECENTRALIZED CONTROL ON TITO SYSTEMS: APPLICATION TO IMC BASED PI/PID CONTROLLER SELECTION

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Abstract. *One of the main issues in the control of multivariable processes are the effects generated by interaction terms. It is well known that the off-diagonal terms in the matrix transfer functions introduce interaction effects that are to be taken into account at the controller design stage. Even a full multivariable controller is an option, it is a fact that the most common solution found in industry is still the application of decentralized solutions based on PI/PID controllers. It is therefore of utmost interest to have design frameworks that allow well known approaches for single-loop PI/PID controllers to be applied on a MIMO decentralized setting. When decentralized control is to be used, special attention has to be paid to the potential instability caused by interaction effects generated by the control action on the other loop. It is in this sense that this paper provides a rather simple measure of interaction (defined in terms of the expected interaction to be generated into the control systems) with closed-loop design purposes. The resulting analysis equations will provide a framework where currently existing tuning approaches for single-loop PI/PID controllers can be applied to TITO systems within a decentralized approach.*

Keywords: Decentralized Control, IMC approach

1. Introduction.

Despite the great developments of advanced process control techniques [7], [16] it is widely recognized that PI/PID control is still the most commonly adopted control approach adopted in the process industry. The main reason lies on the fact that this controller is easily understandable to control engineers an its few parameters can be given easy meaning for *hand*-tuning. This popularity has been inherited in the control of multivariable processes, specially for Two-Input-Two-Output (TITO) processes, being decentralized PI/PID controllers the most popular. Within this MIMO context, the decentralized option obviously requires fewer parameters than the full multivariable counterpart. Another side advantage of decentralized PI/PID controllers is that of loop failure tolerance of the resulting closed-loop system [23].

Even the extensive advances on single-loop PI/PID control tuning methods [22, 2, 27, 3] all these methods cannot be directly applied to the design of decentralized control systems because of the existence of interaction among loops. Effectively, the presence of interactions among the loops introduce an inherent difficulty to the design of these local controllers. In the presence of strong interactions the effectiveness of the decentralized controllers can be seriously deteriorated or even cause instability. This fact has motivated the extension of single-loop tuning rules to decentralized control systems an active area of research.