ANTI-WINDUP DESIGNS FOR MULTIVARIABLE CONTROLLERS

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The control inputs for all industrial processes are subject to hard physical constraints. Such constraints are usually referred to as plant input limitations. Likewise, it is common practice to switch from manual to automatic mode, or between different controllers. Such mode switches are usually referred to as plant input substitutions. As a result of limitations and substitutions, the real plant input may differ from the controller output. When this happens, the closed-loop performance may be significantly degraded in comparison with the expected performance of the controller designed to operate in a linear regime. This performance deterioration is referred to as windup.A common approach in practice for handling the problem of windup is to perform a linear control design, then to add extra feedback compensation at the stage of control implementation. As this form of compensation aims to reduce the undesirable effects of windup, it is referred to as anti-windup (AW).

This paper addresses two important aspects of AW designs, namely the parametrization of linear AW compensators, and the role of artificial nonlinearity (AN) in the design of AW compensators for multivariable systems. For the first issue, a simple parametrization is given using the classical feedback structure in the framework of constrained unity feedback multivariable control system. Conditions for controller implementability and closed-loop stability are stated in terms of this parametrization. For the second issue, two existing AN designs for coordinate plant inputs whenever one plant input enters saturation are reviewed. The first design is the widely used input direction preserving technique, and the second is an optimal AN design. A comparative simulation study illustrates that the conditioning technique, enhanced by optimal AN design, gives the best tracking performance among different existing methods.