

# Anti-Windup Designs for Multivariable Controllers

Youbin Peng, Damir Vrančić\*, Raymond Hanus, and Steven R. Weller\*\*

Department of Control Engineering, CP. 165  
ULB, Avenue Franklin D. Roosevelt 50, B-1050, Brussels, Belgium  
phone: +32-2-650-26-75; e-mail: peng@labauto.ulb.ac.be

\*Department of Computer Automation and Control,  
J. Stefan Institute, Jamova 39, 1001 Ljubljana, Slovenia  
phone: +386-61-1773-732; e-mail: damir.vrancic@ijs.si

\*\*Department of Electrical & Electronic Engineering,  
University of Melbourne, Parkville 3052, Australia  
e-mail: s.weller@ee.mu.oz.au

**Abstract:** This paper addresses two important aspects of anti-windup (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.

**Keywords:** Control nonlinearities, multivariable control, saturation, anti-windup.