Saturated Control Systems

Isabelle Queinnec, Sophie Tarbouriech, Luca Zaccarian

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Department of Industrial Engineering
via Sommarive 9, Povo - Trento, aula B104

The amplitude of the signal that can be delivered by an actuator is typically limited due to physical or security constraints. These limits clearly affect the attainable performance, but may even induce unpredictable responses unless the control system is suitably conditioned (airplane crashes, as an example). This course deals with stability of saturated systems, design controllers taking into account saturation a priori, or modify existing controllers a posteriori to account for saturations. The course is mostly based on Lyapunov theory with quadratic Lyapunov functions.

Schedule
Friday September 4, 15:00-18:00, aula B104
Introduction: motivation, examples, types of actuators and study of their nonlinear behaviors. Stability of Nonlinear systems: GAS, LAS, GES, domain of attraction, forward invariance, Stability domain and general Lyapunov theory.

Monday September 7, 15:00-18:00, aula B104
First Lyapunov approaches to deal with saturation. Stability for nonlinear systems. Disturbances, Quadratic Lyapunov functions. Use of LMI's and Finsler Lemma, Schur Complements and S-Procedure. Representation of Saturation and Sector conditions.

Tuesday September 8, 15:00-18:00, aula B104
State-feedback with external inputs. Matlab exercises.

Wednesday September 9, 15:00-18:00, aula B104
H_infinity-type approach to output feedback with input saturation. Static and dynamic direct-linear anti-windup.

Thursday September 10, 15:00-18:00, aula B104
Exercices with Matlab, also involving extensions to rate saturation.

Friday September 11, 15:00-18:00, aula B104
Model Recovery anti-windup and some nonlinear extensions.