021MI - OPTIMAL AND ROBUST CONTROL

Academic Year 2015/2016

Teaching staff	
	FELICE ANDREA PELLEGRINO
Period	
	Second semester
Delivery method	
	Standard teaching

Aims

To know the fundamentals of modern control systems design, including in particular dealing with the uncertainty. To know the main tools and methods for analysis and synthesis of MIMO control systems.

Prerequisites

Fondamenti di Automatica (Fundamentals of Automatic Control), Teoria dei Sistemi e del Controllo (Systems and Control Theory)

Contents

Equilibrium, stability. Lyapunov's theorem. Krasowskii's lemma. Domain of attraction. Invariant sets. Lyapunov's theorem for linear systems. The control problem. Feedback. Parametric uncertainty. Interval polynomials. Kharitonov's theorem. Affine and multi-affine uncertainty. Edge's theorem. Bialas test. Value set of polynomials and transfer functions. Spectral set. Signal norms. Systems norms. MIMO systems: frequency response, singular value diagram, maximum and minimum gain directions. Closed-loop operator. Parameterization of stabilizing controllers (stable plant). Weighted performance. Unstructured uncertainty. Additive, multiplicative and feedback uncertainty. Small Gain Theorem (SGT). Robust stability and performance. Structured singular value. Nominal performance and robust performance. Modelling of mechanical systems. Optimal control. Cost functional. Principle of optimality. Hamilton-Jacobi-Bellman equation. Finite-horizon linear quadratic (LQ) control. Differential Riccati equation. Infinite horizon LQ control. Algebraic Riccati equation. Fundamental theorem of LQ control. LQ control with prescribed "degree of stability". Robustness of LQ control. Predictive control (sketches). Optimal control and linear programming.

Teaching Format

Blackboard lectures and numerical applications

Assessment

Oral examination (date and time to be agreed with the teacher)

Reading List

[1] Lalo Magni e Riccardo Scattolini, Complementi di Controlli Automatici, Pitagora Editrice Bologna 2006, ISBN 8837116470 [2] Okko H. Bosgra, Huibert Kwakernaak and Gjerrit Meinsma, Design Methods for Control Systems, freely downloadable from http://wwwhome.cs.utwente.nl/~meinsmag/courses/dmcs/dmcs0708.pdf [3] Jurgen Ackermann, Robust Control. The Parameter Space Approach, Springer-Verlag 2002, ISBN 1852335149