MECA2671 Automatic : Theory and implementation

[30h+45h exercises] 6 credits

This course is taught in the 1st semester

Teacher(s): Michel Gevers, Vincent Wertz
Language: French
Level: Second cycle

Aims

The aim of this course is to present different methods of model-based control (pole placement control, predictive control, LQ control, robust control) and to study the implementation aspects of digital control. These methods will be supported by real life cases studies. The course also involves control design exercises (MATLAB), and a set of laboratory sequences during which the students will implement some of these methods on pilot processes at the laboratory. At the end of this course, the students will be able to :
- Understand the major issues of digital control design.
- Calculate, with specialized software, digital controllers with specified performances.
- Implement numerical control laws on real processes (in the laboratory).
- Present major aspects of a theory or an application in automatic control.

Main themes

Model-based control (pole placement control, predictive control, LQ control, robust control) ;
Implementation aspects of digital control

Content and teaching methods

- Discretization of continuous models, Shannon's theorem, choice of sampling periods.
- Classical digital control (numerical PID).
- Predictive control.
- Prediction compensation of measurable perturbations.
- Multivariable control, decoupling, linear quadratic control.
- Observers, Kalman filter.
- Delay compensation.
- Parameterization of Youla Kucera.
- Recursive model estimation.
- Robust control.
- Iterative controller design.
- Controller design with different methods using MATLAB and SIMULINK.
- Test of different control methods on pilot processes.

The course comprises a set of lectures on theoretical aspects in control design or regarding industrial control applications developed by members of the Automatic Control Lab, as well as a set of compulsory exercises and laboratory sequences. Moreover, each student will have to make an oral presentation on a theoretical topic, or on results obtained in the laboratory or, finally, on an article describing an industrial application.

Other information (prerequisite, evaluation (assessment methods), course materials recommended readings, ...)

Prerequisite:
ELEC 2510 or MAPR 2720
References:
Cfr synopsis and reference book entitled: "Computer Controlled Systems: Theory and Design" by K.J. Aström and B. Wittenmark, Prentice Hall, 1997.

Other credits in programs

ELEC22	Deuxième année du programme conduisant au grade d'ingénieur civil électricien	(6 credits)
ELME22/M	Deuxième année du programme conduisant au grade d'ingénieur civil électro-mécanicien (mécatronique)	(6 credits)
INCH23	Troisième année du programme conduisant au grade d'ingénieur civil chimiste	(6 credits)
MAP22	Deuxième année du programme conduisant au grade d'ingénieur civil en mathématiques appliquées	(6 credits)
MAP23	Troisième année du programme conduisant au grade d'ingénieur civil en mathématiques appliquées	(6 credits)