Course guide
340655 - CPAI - Model Predictive Control for Industrial Applications

Last modified: 17/05/2023

Unit in charge:	Vilanova i la Geltrú School of Engineering
Teaching unit:	707 - ESAII - Department of Automatic Control.

Degree:	MASTER'S DEGREE IN AUTOMATIC SYSTEMS AND INDUSTRIAL ELECTRONICS (Syllabus 2012). (Optional subject).

Academic year: 2023   **ECTS Credits:** 5.0   **Languages:** Spanish

LECTURER

Coordinating lecturer:

Others: Ramon Guzmán

TEACHING METHODOLOGY

LEARNING OBJECTIVES OF THE SUBJECT

STUDY LOAD

Type	Hours	Percentage
Self study	80,0	64.00
Hours small group	15,0	12.00
Hours large group	30,0	24.00

Total learning time: 125 h

CONTENTS

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title english

Description:
This course is intended for students who want to expand their control knowledge for different industrial applications. Throughout the course, the student will learn the concepts, both theoretical and practical, of real-time control systems, both for linear and non-linear systems, and paying special attention to model-based control. The course will start with optimal filtering based on adaptive estimators, specifically the Kalman filter. A theoretical part and a subsequent application of the Kalman algorithm will be developed to estimate signals in the presence of noise. Here it will be important to learn how to implement the algorithm in a processor so that the computational load is as low as possible. On the other hand, different model-based control techniques will be seen for different industrial, mechanical, chemical, electrical, etc. applications. Within these control techniques, a distinction will be made between techniques based on obtaining continuous control trajectories as well as finite-state control techniques. The latter is very typical in electronic power converters such as inverters, rectifiers, or active filters. The goal in all of these control techniques will always be to try to minimize the computational load on the processor so that these techniques are easily implementable in common digital signal processors, without the need to use faster processors such as FPGAs. Additionally, students will begin to use TrueTime within the Matlab / Simulink environment for simulating real-time control systems.

Contents

1. Introduction to real-time control systems
2. The Kalman filter
3. Model-based control for linear and nonlinear systems. Applications
4. Inclusion of restrictions in the controller. Algorithm optimization within the processor
5. Predictive control of finite states. Applications.

Full-or-part-time: 220h
Theory classes: 125h
Practical classes: 15h
Self study : 80h

GRADING SYSTEM

The course will have three types of classes. Theory classes, problem classes, and laboratory practices. The theory note will come from carrying out exams carried out within the class of problems. An exam will be made at the end of each topic in the same class of problems. The duration of the control will be 1 hour and the use of notes, books, computers, etc. will be allowed. The weight of each control will be the same for each topic. On the other hand, the delivery of a problem will be requested at the end of each topic. This problem will be done at home. There will be no partial or final exam. Laboratory practices will have two parts. A simulation part with Matlab / TrueTime and the other with an experimental part carried out in the control systems laboratory.
The final grade will be the arithmetic mean of the theoretical part and the practical part.

EXAMINATION RULES.

Books, notes, laptops, etc. may be used. The duration of the tests will be 1 hour and will take place in the last hour of class.

BIBLIOGRAPHY

Basic:
- Wang, Liuping. Model Predictive Control System Design and Implementation Using MATLAB® [Recurs electrònic] [on line]. London: Springer London, 2009 [Consultation: 08/02/2024]. Available on: https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-1-84882-331-0. ISBN 9781848823310.
- Camacho, E. F.; , Bordons, c. Model Predictive control [Recurs electrònic] [on line]. 2nd ed. London: Springer, 2007 [Consultation: 12/02/2024]. Available on: https://link-springer-com.recursos.biblioteca.upc.edu/book/10.1007/978-0-85729-398-5. ISBN 9780857293985.

Complementary:

- Ramon Guzmán, Luís García de Vicuña, Miguel Castilla, JaumeMiret, Antonio Camacho. "Finite Control SetModel Predictive Control for a Three-Phase Shunt Active Power Filter with a Kalman Filter-Based Estimation". Energies [on line]. Available on: https://www.mdpi.com/1996-1073/10/10/1553.