RESÚMENES EN INGLÉS
*ENGLISH ABSTRACTS*

## PREDICTION FOR CONTROL: A SURVEY

**Julio E. Normey-Rico\*, Eduardo. F. Camacho\*\***

*\* Depto. de Automação e Sistemas, Universidade Federal
de Santa Catarina, 88040-900, Florian\'opolis, SC, Brasil,
julio@das.ufsc.br
Depto de Ingeniería de Sistemas y Automática,
Universidad deSevilla, Sevilla 41092 España,
eduardo@cartuja.us.es*

Abstract: This paper presents an analysis of dead-time compensating controllers for processes exhibiting a dead time. The robustness and performance of several dead-time compensating control structures are analysed and the effect of the predictor on the closed-loop is studied. A unified approach is used considering ideas from "Model Pedictive Control" (MPC) and "Dead-time Compensators" (DTC). The main papers in the area are revised and the relationships between MPC and DTC are shown. The paper shows that the predictors designed to produce optimal open-loop predictions are not optimal when operating in closed loop. Furthermore, structures based on the Smith predictor offer more robust controllers and similar nominal performance even when the process exactly matches the situation required by optimal controllers. A new concept "Predicción para Control" is introduced where predictors should be designed as an integral part of the controller in order to produce better closed-loop response. *Copyright © 2006 CEA-IFAC.*

Keywords: dead time, dead-time compensators, predictors, robustness.

## CONTROL OF SOLAR COLECTOR FIELD

**Francisco R. Rubio\*, Eduardo F. Camacho\* and Manuel Berenguel\*\***

*\*Dept. Ingeniería de Sistemas y Automática.
Escuela Técnica Superior de Ingenieros. Universidad de Sevilla.
Camino de los Descubrimientos s/n. 41092-Sevilla.
{rubio,eduardo}@esi.us.es
\*\*Dept. de Lenguajes y Computación.
Área de Ingeniería de Sistemas y Automática. Universidad de
Almería. Carretera Sacramento s/n. 04120-La Cañada, Almería.
beren@ual.es*

Abstract: An overview of different basic control algorithms applied during the last twenty-five years to the control of the distributed solar collectors field ACUREX, located in the Solar Platform of Almería, is presented in this paper. Different aspects of the control problem are dealt with, from the modeling of the solar field to the development and real application of several control algorithms, all of them incorporating a series feedforward controller based on a steady-state energy balance for disturbance cancellation purposes.

Although distributed solar collector fields are characterized by complex dynamics, including high frequency antiresonance modes, this work has been focused in several algorithms that use low order models of the system (thus representing the behaviour of the plant at low frequencies), or even that are based on the operators experience without explicitly using any model. Representative results are shown. The work also includes a complete list of references of the works published by different international groups in this field. *Copyright © 2006 CEA-IFAC.*

Keywords: Solar Plant, Automatic Control, Temperature Control, Thermal Solar Energy.

# PREDICTIVE CONTROL OF A PARALLEL ROBOT

**Andrés Vivas\*, Philippe Poignet\*\***

*\* Universidad del Cauca, Calle 5 No. 4 – 70, Popayán, Colombia*
*\*\* LIRMM, 161 rue Ada, 34392 Montpellier, France.*

Abstract: This paper presents an efficient application of a model based predictive control scheme in parallel robots. A predictive functional control strategy based on a simplified dynamic model is implemented. Experimental results are shown for the H4 robot, a fully parallel structure providing 3 degrees of freedom (dof) in translation and 1 dof in rotation. Three control strategies are compared (PID, computed torque control and predictive functional control) in complex machining tasks trajectories. Tracking performance and robustness are enlightened. *Copyright © 2006 CEA-IFAC.*

Keywords: Model based control, predictive control, robot control.

# DEVELOPMENT AND EXPERIMENTATION OF A VEHICLE BASED ON A PENDULUM (PPCAR)

**A. Viguria\*, A.Prieto\*, M. Fiacchini\*, R. Cano\*,
F.R. Rubio\*, J.Aracil\* and C. Canudas-de-Wit\*\***

*\*Dept. Ingeniería de Sistemas y Automática, Universidad de Sevilla, Spain*
*\*\*Lab. d'Automatique, Grenoble (CNRS-LAG), France*

Abstract: This paper describes the development of a vehicle based on the stabilization of an inverted pendulum. The prototype has been designed and developed by the School of Engineering of Seville using commercial and low-cost components. Two vehicle controllers (linear and nonlinear) have been developed and applied. Moreover, they have been tested successfully in various experiments. *Copyright © 2006 CEA-IFAC.*

Keywords: Inverted pendulum, nonlinear control, real time, subactuated systems, transport vehicle..

# CARTESIAN MOTION CONTROL APPLIED TO A LAPAROSCOPIC SURGERY ROBOTIC ASSISTANT

**V. F. Muñoz, I. García Morales, C. Pérez del Pulgar, J. M. Gómez de Gabriel, J. J. Fernández Lozano, A. García Cerezo, C. Vara, R. Toscano**

*Dpto. Ingeniería de Sistemas y Automática.*
*Universidad de Málaga.*
*Plaza El Ejido, s/n. 29013, Málaga. España.*
*e-mail: vfmm@uma.es*

Abstract: This paper is focuses on the motion control applied to a cameraman robotic assistant for minimally invasive surgery. In particular, this paper is devoted to the camera navigation problem refered to robots endowed with passive wrists. The proposed methodology is based on a previous kinematic analysis of the task. By using this information, an adaptive cartesian motion controller has been designed. This scheme generates on-line trajectories for moving the laparoscopic camera to a desired target position in such a way that the actuators saturation is taken into account. The proposed strategy has been implanted in the ERM assistant used to carry out clinical trials on thirty two patients. *Copyright © 2006 CEA-IFAC.*

Keywords: control approaches, robots, medical applications, adaptive control, estimation algorithms.

# ROBUST IDENTIFICATION OF A BIOMEDICAL PROCESS USING EVOLUTIONARY ALGORITHMS

**J.M. Herrero, X. Blasco, M. Martínez, J. Sanchis**

*Department of Systems Engineering and Control*
*Polytechnic University of Valencia*
*Camino de vera s/n, 46022 Valencia, Spain*
*Tel.: +34-96-3879571,*
*Fax: +34-96-3879579*
*e-mail: juaherdu@isa.upv.es*

Abstract: In this paper, a non-linear robust identification (RI) methodology to characterize the feasible parameter set (FPS), when the identification error is unknown but bounded simultaneously by several norms, is presented. For that, the Robust Identification (RI) problem is transformed into a multimodal optimization one with an infinite number of global minima which constitute the FPS. For the optimization task a special Genetic Algorithm (e-GA), inspired by Multiobjective Evolutionary Algorithms (MOEA), is presented, which characterizes the FPS by means of a discrete set of models (FPS*) well distributed along the FPS. An application example to a biomedical model which shows the blockage that produces a given drug on the ionic currents of a cardiac cell is presented to illustrate the methodology. *Copyright © 2006 CEA-IFAC.*

Keywords: Modelling, Robust Identification, Parametric Identification, Evolutionary Algorithms, Multimodal Optimization.

# INTEGRATED DESIGN OF WASTEWATER TREATMENT PROCESSES USING MODEL BASED PREDICTIVE CONTROL

**Mario Francisco\*, Pastora Vega\***

*\* Dpto. Informática y Automática. E.T.S. Ingeniería Industrial*
*Universidad de Salamanca*
*Av. Fernando Ballesteros 2, 37700*
*Béjar, Salamanca, (España). Fax: +34 923 408127*
*e-mail: mfs@usal.es , pvega@usal.es*

Abstract: In this work the Integrated Design of the activated sludge process in a wastewater treatment plant has been performed, including a linear multivariable predictive controller with constraints. Mathematically it is stated as a multiobjective optimization problem with constraints, taking into account costs and controllability. Performance indexes for optimal automatic MPC tuning are the ISE norm and the $H_\infty$ norm of disturbances transfer functions and of the error signal. The optimization problem is tackled in two iterative steps including a part of stochastic optimization. *Copyright © 2006 CEA-IFAC.*

Keywords: Integrated Design, predictive control, controllability, nonlinear optimization, stochastic optimization.

# A BOOST CIRCUIT HYBRID MODEL'S DYNAMICAL BEHAVIOR

**E. Zulueta, T. Rico\*, I. Manero\*\***

*\*System Engineering and Automation Department*
*\*\*Electrical Engineering Department*
*University College of Engineering at Vitoria-Gasteiz*
*(University of Basque Country)*
*Email: ekaitz.zulueta@ehu.es*

Abstract: In this article we study the dynamical behaviour of a boost circuit hybrid model. This circuit is analyzed with battery charge. The circuit is controlled by PWM modulation. The model has been implemented by Simulink. At first we have described the dynamical behaviour in open loop by a discrete time model. We have studied the chaotic behaviour dynamic of this model because the equivalent discrete time model has a discontinuity. We have imposed a 2 level duty cycle control. This control is based on current error. We have realized that this model hasn't chaotic behaviour because it hasn't initial conditions sensibility. In the other hand, it is quite easy to give a chaotic behaviour with very low changes in the control law. *Copyright © 2006 CEA-IFAC.*

Keywords: Hybrid dynamics, boost circuit model.