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RESÚMENES EN INGLÉS
ENGLISH ABSTRACTS

INTRODUCTION TO THE FRACTIONAL CONTROL

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Abstract: This work aims to introduce the reader to the essentials of Fractional Order Control (FOC), on the understanding that it refers to the set of applications of Fractional Calculus in Control Theory. At the same time, it aims to motivate the control community members to consider fractional calculus as a way to expand their discipline horizons. Consequently, the contents of this work have been organized following a book structure that covers from the fundamentals and basic definitions of fractional calculus, to the strategies for the implementation of fractional controllers and filters, going through the analysis and design of this type of systems and controllers. Finally, a short review of the state of the art of fractional order control is outlined.

Keywords: Fractional calculus, control theory, controllers implementation, discretization, numerical approximation.

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FLEXIBLE ROBOTS: TOWARDS A GENERATION OF ROBOTS WITH NEW PERFORMANCES

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Abstract: This article presents an overview of the research carried out up to date in the subject of flexible robots, is to say, in the category of robots that exhibit a noticeable elasticity in their links. These robots are endowed with some interesting mechanical properties like their large payload/robot weight ratio. However their dynamics exhibit an increased complexity compared to the standard robots, and their control becomes a difficult task. At present, mechanical design and control of these manipulators remain as challenging tasks for researchers in robotics. Moreover the author presents in this paper his own points of view about this subject and the future evolution of these robots.

Keywords: flexible robots, dynamics of mechanisms, servosystem, force control.

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STUDY ABOUT THE EFFECT OF FUNCTIONAL FACTORS IN THE PERFORMANCE OF TELEMANIPULATION SYSTEMS

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Abstract: This work study the effect of the functional factors in the performance of a telemanipulation system. Functional factors are identified, then a taxonomy is proposed in order to facilitate their study. An intensive experimentation was done: four factorial experimental designs were proposed. These designs obtain the effects of the factors and the effects of their interactions in the performance of the system. Finally, it is proposed to divide the complex task in several basic subtasks in order to generalize the results and get general rules for the design of telemanipulation systems. *Copyright © 2006 CEA-IFAC.*

Keywords: Telemanipulation, Robotics, Master-Slave systems, Statistical Analysis.

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PATH PLANNING METHOD BASED ON THE RRT ALGORITHM. APPLICATION TO NONHOLONOMIC ROBOTS.

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Abstract: Rapidly-Exploring Random Trees (RRT) have been the focus of a significant amount of interest during the last years. This article describes the basis of this method. Even more, the most outstanding versions of this technique are illustrated. Likewise, the extension of the algorithm to path planning for nonholonomic vehicles is also presented. Finally, a new approach for nonholonomic motion planning using the concept of restricted manoeuvre and the RRT algorithm is proposed. The efficiency of the method is illustrated by applying the approach to a differential steering vehicle and a car-like robot. *Copyright © 2006 CEA-IFAC.*

Keywords: Path Planning, Mobile Robots, Nonholonomic System, randomized motion planning.

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MIN-MAX MULTIMODEL CONSTRAINED PREDICTIVE CONTROL, VALIDATED ON A LABORATORY PLANT

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Abstract: A Min-Max Predictive Controller is developed and implemented on a laboratory plant. Some modifications of the previous formulations in the literature needed to make feasible the implementation on real systems are discussed. The proposed controller makes possible to consider the effect of uncertainty in a Predictive Control framework, using a numerically efficient formulation, based on Linear Programming, which is not difficult to understand, and has simple tuning parameters. The proposed technique has been validated on a laboratory plant that consists on two coupled tanks: experimental results show the stability, robustness and good performance of the proposed controller.

Keywords: Min-max, Predictive Control, Constraints, Impulse Response, Linear Programming.

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MULTI-PHASE PCA BATCH PROCESS MONITORING

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Abstract: Statistical methods, like Principal Components Analysis (PCA), have been widely used for batch process monitoring. Nonetheless, these methods are based on the adjustment of a linear model to the process data. Hence, their performance is reduced when modelling data of non-linear nature. One solution to model non-linearity in batch processes is to divide the model in several sub-models, one for each segment of the batch well approximated by a linear model. In this paper, a monitoring framework based on the automatic recognition of the linear segments in a batch process is proposed. Each segment will be modelled independently. Finally, monitoring charts are modified in order to include the various sub-models.

Keywords: Multivariable Statistical Process Control, Multi-Phase PCA, Process Monitoring, Batch Processes, Local Models.

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IDENTIFICATION OF LPV MODELS FOR THE CONTROL OF NON-LINEAR SYSTEMS

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Abstract: In this paper we suggest a methodology for the identification of linear parameter time varying models (LPV), based on a previous local identification at some operating points, which presents a high degree of flexibility in adaptations to non-linear processes. These LPV models are characterised by containing within their dynamic trajectories those ones of the original non-linear system, and they will be defined by a linear fractional dependence with respect to the time varying parameters. When the LPV model has been identified, it is possible to design, in turn, a linear controller with parameters that vary in time in order to control the non-linear system. This identification and control methodology will then be applied to a non-linear turbocharged diesel engine.

Keywords: Identification, non-linear systems, linear systems with time varying parameters, equations in partial derivatives, internal combustion engines..

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SATELLITE TIME OF FLIGHT MINIMIZATION USING DYNAMIC PROGRAMMING.

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Abstract: In this paper the authors offer a solution to the problem of satellite time of flight minimization when a manoeuvre is carried out to change its position. Despite the standard procedures, based on the variational calculus or the Maximum Principle, the main result of the paper is derived using the Dynamic Programming principle. The authors also explained the algorithm that allows the computation of such minimum time of flight. The achieved solution is almost globally optimal. An example showing the use of the method in a typical satellite manoeuvring scenario is also included.

Keywords: Dynamic Programming, Optimal Control, Aerospace Sciences.

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FRACTAL ANALYSIS OF THE AUTONOMIC CONTROL OF THE HEART RATE DURING CORONARY OCCLUSION

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Abstract: The autonomic nervous system through its sympathetic (excitation) and parasympathetic (inhibition) limbs regulates numerous physiological variables including the heart rate. In this work, the heart-rate regulation system response is analyzed during transitory myocardial ischemia, using fractal characteristics of R-R signal (represents duration between two consecutive beats -R waves- over time), obtained from electrocardiographic records. The ischemia model was obtained during coronary occlusion of more than 3 minutes in 50 patients. The complexity of the heart rate is characterized by the fractal behaviour given by the slope beta in bi-logarithmic scale of the power spectral density of R-R signal versus the frequency and by the alpha_1 index obtained from detrended fluctuation analysis of the same signal. More negative beta values during coronary occlusion and different alpha_1 magnitudes depending on the site of the occlusion were found. The obtained results can infer that there is a loss of complexity of the control system during myocardial ischemia.

Keywords: Bio-control, biomedical control, fractals, complex systems, nonlinear systems

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