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Resúmenes en Inglés
English Abstracts

Lyapunov-based Stability of nonlinear systems

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Abstract: The dynamical behavior of nonlinear systems is much richer than the one of linear systems and their analysis is much more involved. Lyapunov-based techniques stand out among the methods for stability analysis. In this paper, part of this theory is reviewed including techniques for estimation of the domain of attraction. Recent results about application of sum of squares optimization to this field are also examined. Copyright © 2009 CEA.

Keywords: Liapunov stability, stability analysis, attraction domain, numerical analysis, optimization problems.

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A Multivariable Interaction Measure in the Time and Frequency Domains.

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Abstract: In this paper we consider the analysis of multiple-input multiple-output systems using the Participation Matrix, which provides a tool both for interaction measure and controller structure selection. For this matrix we present novel interpretations in the time and in the frequency domain, based on definition of Hilbert-Schmidt-Hankel norm. Moreover, the time domain interpretation is exploited to obtain an empirical estimate of the participation matrix directly from input-output data of the multivariable system. Copyright © 2009 CEA.

Keywords: MIMO systems, decentralized control, Gramians, Hilbert-Schmidt-Hankel norm.

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Reducing Distance Between Fuzzy and Nonlinear Control: Lights and Shadows.

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Abstract: Even if fuzzy control was born as an heuristic methodology, the linear matrix inequality formulations became the most used tool since the 1990's. Many nonlinear systems can be modeled as fuzzy systems (with the sector-nonlinearity technique) so fuzzy control can be considered a generic non-linear control technique. Even if significant results have been obtained, some sources of conservativeness appear when fuzzy approaches are compared to other non-linear control strategies. This article discusses some of such conservativeness issues (shadows) and outlines some ideas to solve them (lights). Copyright © 2009 CEA.

Keywords: fuzzy control, intelligent control, linear matrix inequalities.

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Fuzzy Modelling and Control for Air Management in Diesel Engines.

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Abstract: Modelling and control for air management in diesel engines is a major challenge from the control point of view, because of the high nonlinear behaviour of this system. For this reason, classic control techniques are unable to provide the required performance, and nonlinear controllers are used instead. This article discusses two fundamental steps when designing a control system. Firstly, a methodology to identify a nonlinear system with a fuzzy model in a Takagi-Sugeno (T-S) structure using experimental data is proposed. Secondly, the design of a fuzzy controller in PDC structure (Parallel Distributed Compensation) is presented. The parameters of this controller are obtained from a minimization problem that is subject to LMIs (Linear Matrix Inequalities). Copyright © 2009 CEA.

Keywords: Fuzzy Sistems, Identification, LMIs, Non-linear Control, Diesel Motors.

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Development of an Experimental Test Bench by Means of Force Control in an Industrial Robot for the Analysis of the Mechanical Response in Car Seats

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Abstract: In this work the design of an experimental test platform for analysis of the mechanical behavior of car seats during passenger ingress and egress is presented. This development has been performed in two steps: the first step is data acquisition, by means of a mat sensorized with a pressure gauge net and a photogrammetry system so as to acquire the movements performed by a human during ingress and egress. The second step consists in reproducing these movements automatically by means of a dummy held by a robot, controlling the force applied by the dummy on the seat.
This development must allow applying different force control strategies with industrial robots, therefore using a test platform consisting in an ABB IRB140 robot and a JR3 industrial force sensor with 6 degrees of freedom. As control architecture, two alternatives are presented. The first one uses the ABB WebWare SDK software application. In the second one, the original S4CPlus controller has been modified, providing an open control architecture that allows the implementation of new motion and force control algorithms in the industrial robot.
With this application, the process performed by a human during ingress and egress is simulated, monitoring and controlling the force applied by the dummy on the seat in order to ensure the same conditions as in a real situation. The developed system has several practical applications, namely allowing the analysis of the wearing produced in the seat upholstery.

Keywords: force control, robot control, simulation of human movements, computer control, digital applications of computation, manipulator robots.

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Two-Degrees-of-Freedom (2-DoF) applied to the "Benchmark" systems for PID controllers.

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Abstract: This paper shows the application of Two-Degree-of-Freedom (2-DoF) PID controllers to a set of systems showing broad and diverse dynamics representative of common industrial systems. This type of control structure allows to simultaneously tackle load disturbances as well as set-point changes specifications. The paper presents different alternatives that can be pursued when adressing these control goals as well as to minimize specific performance indices that take into account the error performance and the control effort. As a particular application the approach is applied to to solve the problem stated within the Control Engineering Group of CEA as "Benchmark" systems for PID controllers. Copyright © 2009 CEA.

Keywords: PID Control, Two-Degree-of-Freedom systems, Process Control, Control Systems.

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Space Vector Modulation for Diode-Clamped Multilevel Inverters with Capacitors Voltage Balance.

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Abstract: In this work, a modulation algorithm for the Diode Clamped Multilevel Inverter with DC bus voltage balancing capability is presented. Space Vector modulation technique for the multilevel inverter is described, jointly with a DC bus voltage balancing algorithm that takes advantage from converter's redundancy. The algorithm can be generalized to an arbitrary number of levels and takes into account two important cases: presence or absence of a DC voltage source on the DC bus. The performance of the presented algorithm is evaluated by means of computer simulations. Copyright © 2009 CEA.

Keywords: Multilevel converters, modulation, space vector.

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Navigation of Mobile Robots in non-Structured Environments by using Linear Algebra.

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Abstract: A new approach for navigation of mobile robots in dynamic environments by using Linear Algebra Theory, Numerical Methods, and a modification of the Force Field Method is presented in this paper. The controller design is based on the dynamic model of a unicycle-like nonholonomic mobile robot. Previous studies very often ignore the dynamics of mobile robots and suffer from algorithmic singularities. Simulation and experimentation results confirm the feasibility and the effectiveness of the proposed controller and the advantages of the dynamic model use. By using this new strategy, the robot is able to adapt its behavior at the available knowing level and it can navigate in a safe way, minimizing the tracking error. Copyright © 2009 CEA.

Keywords: linear algebra, collision avoidance, force field method, dynamic model, mobile robot.

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Elimination of Harmonic Interference for Fault Detection on Electric Motors

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Abstract: Several techniques for removing harmonic interference from the measurement signals for fault detection on electric motors are presented.
The objective is to eliminate from the signal spectrum, such components produced by the electric supply, but leaving only the components needed for the fault diagnostic.
The design of frequency domain filters (comb filters) and time domain (multirate) techniques is evaluated for this application. Copyright © 2009 CEA.

Keywords: Harmonic Interference, Comb Filters, Multirate Filters, Electric Motors.

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Robust Identification of Wiener and Hammerstein Models

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Abstract: Block oriented models have been useful as nonlinear representations for a vast number of applications. They are described as a cascade of linear dynamic and nonlinear static blocks. The main features of these models are their simplicity and the property of being valid over a larger operating region than a LTI model.

This paper deals with the identification process of block oriented models in the presence of uncertainty.

We focus at two special and widely used types of uncertain Block oriented models: Hammerstein and Wiener models given as parametric representations. The approach herein followed allows describing the uncertainty as a set of parameters that are obtained by solving an optimization problem. The identification method is illustrated through various examples.

Keywords: Wiener, Hammerstein, Identification, Uncertainty, Optimization.

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