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RESÚMENES EN INGLÉS
ENGLISH ABSTRACTS

STABILITY ANALYSIS OF FUZZY SYSTEMS

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Abstract: This paper presents a survey on the state of the art of analysis of the stability of fuzzy systems. The difficulties in the analysis of stability of fuzzy systems which are due to the nonlinearity of such systems, are analyzed. The typical stability approaches such as the circle stability criteron, phase plane method, coniciy method, stability indices and Popov method, are discussed. Lyapunov stability technique is also commented. Attention will be paid to stability analysis based upon the Takagi–Sugeno fuzzy models. Finally, a detailed review will be focused on the stabilty analysis based on piecwise quadratic Lyapunov function using linear matrix inequalities (LMIs). *Copyright © 2007 CEA-IFAC.*

Keywords: Global stability, Discrete fuzzy systems, Takagi-Sugeno Affine model, linear matrix inequalities.

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NEURO-FUZZY APPROACH FOR IDENTIFICATION OF TRAFFIC SIGNS BY INFRARED TECHNOLOGY.

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Abstract: In this paper, a system incorporated to a vehicle in order to detect and classify horizontal traffic signs is presented. This prototype is based on infrared technology and a classification tool based on a Neuro-Fuzzy system. Different additional processes are applied in order to improve the resultant Fuzzy system. Several trials have been done, using experimental data provided by the prototype. The obtained results are explained adequately, making especial emphasis on the design of new rules and the improvement in the rules obtained automatically by the proposed methods. Satisfactory results in the experiments have been achieved. *Copyright © 2007 CEA-IFAC.*

Keywords: Robotics, Robot Navigation, Neuro-Fuzzy systems

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DYNAMIC SYSTEMS IDENTIFICATION USING RBF NEURAL NETWORKS

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Abstract: The identification of complex and non-linear plants plays an important role in the overall architecture of neurocontrol techniques as for example inverse control, direct and indirect neural adaptive control, etc. It is common within those approaches to use a Feedforward Neural Network (FNN) with Tapped Delay Line (TDL) or recurrent networks (Elman o Jordan) trained off-line to capture the system's dynamics (direct or inverse) and use it in the control loop. In this paper, we present an identification schema based on Radial Basis Function (RBF) neural networks that is trained on-line and dynamically modify his number of nodes in the hidden layer, allowing a real-time implementation of the identifier in the control loop.

Keywords: systems identification, neurocontrol, neural networks

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OPTIMIZATION OF AIRCRAFTS TRAJECTORIES TO MINIMIZE THE ACOUSTIC ANNOYANCE MODELLED THROUGH FUZZY LOGIC

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Abstract: The sustained increase of the air traffic in the last decades and the growth of numerous urbanized areas around the airports make very important to take actions to mitigate the noises generated by the airplanes. This work presents a strategy, based on fuzzy logic and lexicographic multi-objective optimization, to design trajectories of take-off or landing in a specific airport and for a specific model of airship to reducing the noise exposure of the population living around the airports.

Keywords: Optimal control, multi-objective optimization, noise, fuzzy logic, generation of trajectories.

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FAULT-TOLERANT NONLINEAR IMC CONTROL

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Abstract: In this paper nonlinear IMC control and a method for achieving fault tolerant control in that framework is addressed. Nonlinear IMC control is attained by means of plant and plant-inverse nonlinear models. Both models are implemented using ANFIS neurofuzzy nets. Fault tolerance to abrupt and incipient faults is accomplished by adding a compensating control signal. This signal is computed using an online trained neural network. The training is performed minimising the control error. Simulation results in a pH control plant are presented.

Keywords: IMC, neural networks, nonlinear control, fault-tolerant control.

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DEVELOPMENT OF A MULTIVARIABLE FUZZY CONTROLLER FOR SITE-SPECIFIC HERBICIDE APPLICATIONS IN PRECISION AGRICULTURE

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Abstract: A multivariable fuzzy controller for a multisection agricultural sprayer has been developed, making possible the site-specific management of crops, one of the fundamental goals in Precision Agriculture. The controller adjusts the herbicide dosage to be sprayed by opening/closing each independent section of the pulverization equipment, regulating the herbicide flow, and acting over the tractor velocity. The needed dosage at each point has been calculated using the information captured into two input maps: a) weed coverage map and b) state of growth map. The maps have been constructed by taking pictures in the field, at each sampling point of a predetermined grid spacing, and assessing the images in the laboratory. An artificial vision system has been developed to aid the user to compute, at each image, the percentages of pixels representing weed, crop and soil and obtain the maps. The controller has been implemented and tested using Matlab. The results indicate that, with the proposed approach, significant amounts of herbicide could be saved without losing efficacy on weed treatments.

Keywords: Fuzzy Control, Multivariable Control, Precision Agriculture, Expert Knowledge

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FUZZY FAULT DETECTION SCHEME BASED ON THE ACCURATE AND LINGUISTIC MODELLING OF AN INDUCTION MOTOR

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Abstract: This paper presents a fuzzy models bank to detect and to identify faults using the multimodel technique, calculating a non-linear fuzzy model for each operation mode of the system. A comparison amongst the output of each model with the actual plant data isolates the faults, i.e., the operation mode of the system (normal or faulty one). Each of the considered fuzzy models is defined by a set of fuzzy rules that explain the system behaviour. These fuzzy models obtained from experimental data can be improved, through the fuzzy rules, in order to use all the characteristics of the fuzzy logic in terms of linguistic capacity (linguistic modelling). The fuzzy models are improved using similarity measurements, reducing the number of rules, eliminating incoherencies, redundancies and increasing their interpretability capacity. This method has been applied to an induction motor, in order to illustrate its behaviour and its applicability. The results shown that this method is able to detect and to identify faults even after the simplification of the models. *Copyright © 2007 CEA-IFAC.*

Keywords: fuzzy models, fuzzy similarity measurements, fault detection and isolation, multimodel method, induction motors.

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MULTIVARIABLE FUZZY CONTROL SYSTEM BASED ON HEURISTIC. A PRACTICAL SUBJECT: CONTAINER CRANE CONTROL

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Abstract: In this work, the design of a fuzzy controller based on heuristic is introduced: the knowledge of the plant and the incorporation of the knowledge of an expert (crane operator) allow automating the process of load containers to ships. The plant (container crane) is a nonlinear complex system that, in respect of its fuzzy control, is formed like a multivariable system with 2 input variables and 5 output variables. The advantage of this design methodology is that there is no need to know the mathematical plant model. Simulations display that the closed loop system performance is satisfactory. *Copyright © 2007 CEA-IFAC.*

Keywords: fuzzy control, container crane, heuristic, expert, nonlinear system.

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NEURAL PREDICTIVE CONTROL BY INSTANTANEOUS LINEARIZATION

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Abstract: A Generalized Predictive Control scheme (GPC) is developed, based on a neural model of the process, and then applied on a laboratory neutralization reactor. The neural model, which is obtained previously by identification, is linearized at each iteration of the control algorithm. Hence, the learning capacity of the neural networks and the computer efficiency of the GPC are combined, producing a system with the advantages of a predictive controller extended to non-linear systems, that shows good precision and transient response performance.

Keywords: Neural Control, Predictive Control, Neural Networks, Instantaneous Linearization, pH Control.

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CONTROLLER DESIGN FOR A CLASS OF AFFINE MIMO TAKAGI-SUGENO MODELS

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Abstract: When controlling Takagi-Sugeno fuzzy systems, verification of some sector conditions is usually assumed. However, setpoint changes may alter the sector bounds. Alternatively, setpoint changes may be considered as an offset addition in many cases, and hence affine Takagi-Sugeno models may be better suited to this problem. This work discusses a nonconstant change of variable in order to carry out offset-elimination in a class of MIMO canonical affine Takagi-Sugeno models. Once the offset is cancelled, standard fuzzy control design techniques can be applied for arbitrary setpoints. The canonical models studied use as state representation a set of basic variables and their derivatives.

Keywords: Fuzzy control, affine Takagi-Sugeno models, local models, LMI, setpoint change.

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