

Resúmenes en Inglés *English Abstracts*

Artificial pancreas: automatic control of insulin infusion in type 1 diabetes mellitus

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Abstract: Type 1 diabetes mellitus is a chronic disease that affects approximately to 30 million people worldwide and is characterized by high blood glucose concentration levels produced by an absolute deficiency of insulin. That produces numerous long-term complications like retinopathy, nephropathy and neuropathy among others. Current therapies based on the exogenous delivery of insulin (through injections or an insulin pump), do not manage to normalize the glucose levels efficiently. Technological advances in the last decade in continuous glucose monitoring and insulin infusion have been a springboard for the development of the artificial pancreas, or automatic control of insulin infusion. In this work, the past, present and future of this technology, so long awaited by the diabetic patient, will be presented in the form of a tutorial. Current technology for sensorization and actuation will be reviewed, as well as main challenges from the control point of view, different “schools of thought” and clinical studies for controllers performance evaluation, and tools for the validation of controllers through simulation. Due to the complexity of the problem, the development of the artificial pancreas will be staggered, resulting progressively in an improvement of the patient’s quality of life. The big advances during last five years foresee a close horizon for a first generation of artificial pancreas. Copyright © 2010 CEA.

Keywords: Biomedical systems, Closed-loop control, PID control, Predictive control, Physiological models.

RIAI, Vol. 7, Num. 2, April 2010, pp. 5-20.

Sliding Mode Control Design and Analysis for Systems with Finite Pole Assignment Predictors

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Abstract: A method to control input or output delayed systems is presented using sliding modes and Smith like predictors, known as finite pole assignment. Using predictors avoids chattering caused by delay in input or output. A design means for the sliding surface with this kind of predictors is introduced, the proposed method is analyzed as well as the issues to be solved due to uncertainties in parameters estimation. Also, some numerical examples are given to illustrate the method and some aspects of the developed analysis. Copyright © 2010 CEA.

Keywords: predictor, sliding modes, chattering, robustness, finite pole assignment, uncertainties, disturbances.

RIAI, Vol. 7, Num. 2, April 2010, pp. 21-30.

Constant High-Gain Observer for a class of Triangular-Form Nonlinear System

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Abstract: In this article a continuous-discrete high-gain observer is presented to estimate the molar compositions in a distillation column for the Ethanol-Water mixture, by using the measurements of the temperatures in its plates. One of the main advantages of this observer is its constant gain, which is why its tuning depends only on choosing constant parameters that must satisfy some simple algebraic inequalities. The continuous-discrete observer presents a good pursuit of the process dynamics in spite of using less data than a purely discrete observer. The effectiveness of the proposed method is demonstrated using experimental data. Copyright © 2010 CEA.

Keywords: Nonlinear systems, distillation column, continuous-discrete observer.

RIAI, Vol. 7, Num. 2, April 2010, pp. 31-38.

Robot Modeling and Dynamic Parameter Identification. Inverse Dynamic Problem Resolution in Real Time

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Abstract: This work presents the development and validation of a methodology allowing dynamic parameter identification in robotic manipulators. The dynamic equations of the robot are based on the Gibbs-Appell equations of motion, yielding well structured equations which can be computed in real time and make the model easily expandable, which allows including the actuator dynamic effect and the friction phenomenon.

This paper also deals with dynamic modeling identification in robotic manipulators. Two different methods are proposed and validated on an industrial robotic system: a PUMA 560 provided with an open control architecture based on an industrial personal computer. Finally, using the dynamic parameters identified, the inverse dynamic equations have been obtained and implemented in real time. Copyright © 2010 CEA.

Keywords: Dynamic parameter identification, Gibbs-Appell equations, friction models, inverse dynamic.

RIAI, Vol. 7, Num. 2, April 2010, pp. 39-48.

Fusion of Optical Flow and Inertial Sensors for Four-Rotor Rotorcraft Stabilization

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Abstract: This paper addresses the hover flight stabilization problems of a four-rotor rotorcraft using fusion of visual information given by a single camera and inertial information obtained from an Inertial Measurement Unit. We use the optical flow in combination with the integration of gyro measurement to estimate the linear and rotational yaw velocities as well as the position and velocity of a UAV. Experimental results show a satisfactory flight performance of the four-rotor rotorcraft platform. Copyright © 2010 CEA.

Keywords: Aircraft Control, Computer Vision, Robot Navigation.

RIAI, Vol. 7, Num. 2, April 2010, pp. 49-56.

Improving the State of the Art of Visual Control

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Abstract: This work presents a critical review of the existing control schemes for visual control and proposes a new one that improves them. Firstly, some basic schemes are introduced in order to illustrate the types of visual control and to state the framework of the research: position-based indirect visual control. Next, the previous schemes and the new one are described and treated in a unified way. In particular, the proposed scheme improves the previous approaches in several ways: ideal transfer functions, conditions for null steady-state error, stability margins, etc. All the schemes are comparatively analyzed in simulation to show the advantage obtained with the proposed scheme. Finally, some experimental results are obtained for a 3 degree-of-freedom Cartesian robot to validate the proposed approach. Copyright © 2010 CEA.

Keywords: Closed-loop control, robotics, robot control, stability margins.

RIAI, Vol. 7, Num. 2, April 2010, pp. 57-67.

Analysis of Visual Landmark Detectors and Descriptors in SLAM in Indoor and Outdoor Environments

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Abstract: The aim of this paper is to find a visual feature extractor that can be used in the process of SLAM (Simultaneous Localization and Mapping). This feature extractor is the combination of a detector which extracts significant points from the environment, and a local descriptor which characterizes those points. This paper presents the comparisons of a set of interest point detectors and local descriptors that are used as visual landmarks in a SLAM context. The comparative analysis is divided into two different steps: detection and description. We evaluate the repeatability of the detectors and the invariance of the descriptors to changes in viewpoint, scale and illumination. The experiments have been carried out with sequences of indoor (building with offices) and outdoor images, having different imaging condition changes (position and illumination). In this way, the typical environments of robot navigation tasks are represented. We consider that the results obtained in this work can be useful when selecting a suitable landmark in visual SLAM, in indoor and outdoor environments. Copyright © 2010 CEA.

Keywords: visual SLAM, visual landmarks, interest point detectors, local descriptors.

RIAI, Vol. 7, Num. 2, April 2010, pp. 68-80.

Fuzzy Mix of Filters for Vision-Based Control Tasks

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Abstract: Vision-based control is an important issue in robotics, and for this task, motion prediction algorithms are used to estimate the location of targets or visual features given by a camera. Some of the most extended filters are: Kalman filter; alpha-beta/gamma filters; AKF; SKF; etc. but only some of them are considered as real-time filters in the bibliography. In this paper, a real-time implementation of a new complex filter (called FMF) is presented, which can be used in applications with strong time requirements providing a better prediction. For this purpose, a FPGA device, parallelization and pipelining techniques are used to accomplish time requirements. The viability, robustness and feasibility of the proposed filter are validated in an experimental vision-based control application. Copyright © 2010 CEA.

Keywords: Predictive methods, Parallel algorithms, Fuzzy systems, Computer vision, Automatic control.

RIAI, Vol. 7, Num. 2, April 2010, pp. 81-90.

Vehicle Lateral Fuzzy Control Estimation

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Abstract: Autonomous driving is one of the most interesting topics inside the area of the Intelligent Transportation Systems (ITS); the automatic control of the steering wheel is one of the most important challenges which researchers face in this area. This work presents an adjustment based on genetic algorithms of fuzzy controllers capable of handling automatically the steering wheel of a conventional vehicle, reproducing attitudes of a human driver in different situations. To do that, the state of the car has been monitored while it is led by a human being and by means of genetic algorithms there has been obtained a fuzzy controller suitable for the managing of the steering wheel of the vehicle. All bearing two basic requirements in mind: the controller must be capable of handling the vehicle across a predefined route and of executing soft control actions to provide a comfortable conduction for the vehicle's occupants. Copyright © 2010 CEA.

Keywords: Autonomous Driving, Fuzzy Logic, Lateral Control, Genetic Algorithms.

RIAI, Vol. 7, Num. 2, April 2010, pp. 91-98.

Teleoperation Data Transport over IP networks. Bidirectionality and Efficiency

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Abstract: The article proposes a new transport scheme for teleoperation data flows via the Internet. An overall analysis of bilateral teleoperation data, encapsulated in IP packets is made. The analysis distinguishes between multimedia traffic, supermedia traffic and control traffic, and allows for TCPFriendly flow control systems. It presents simulation results and comparisons with other transport schemes, using the trinomial flow control algorithm, but other flow control methods are possible. The proposed scheme takes advantage of the bidirectionality of the control loop and the small size of the teleoperation data, to improve the efficiency of the transmission; it aims to serve as network contribution to the stability control efforts of teleoperation systems with variable delays. The proposed scheme presents a conformant transport header to equation-based flow control protocol, while maintaining efficiency, and provides some uses of certain IP header fields. Copyright © 2010 CEA.

Keywords: Teleoperation, Protocols, Transport delay, Simulation, Data flow analysis, Flow control, Headers.

RIAI, Vol. 7, Num. 2, April 2010, pp. 99-110.