SERVICE ROBOTS

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Abstract: The term Service Robots appears at the end of 80s as the necessity of development machines and equipments able to work in environments different to manufacturing. Service Robots must be work in non structural environments, in changing ambient conditions and with close interaction with humans. The IEEE Robotics and Automation Society created in 1995 the Technical Committee on Service Robots which defined in 2000 the fields of applications of Service Robots which can be divided in two big groups: 1) non manufacturing production sectors such as construction, agriculture, ship making, mining, medicine, etc. and 2) service sector itself: assistance and personal, cleaning, surveillance, education, entertainment, etc. In this work brief revision of main concepts and applications of service robots had been presented. *Copyright © 2008 CEA-IFAC.*

Keywords: Service robots, autonomous robots, field robots, educational and entertainment robots, walking robots, humanoid robots.

TELEMANIPULATION AND LOCOMOTION BASED ON SELF-CONFIGURABLE MODULAR ROBOTS FOR SEMI-STRUCTURED ENVIRONMENTS

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Abstract: This paper is focused on the application of modular robots in semi-structured environments. Manipulation and displacement capabilities are the main advantages of this self-configurable system. Control architecture for modular systems has been specifically designed. Modules are ensemble in order to become more complex mechanisms, called molecules. Molecules work in a similar manner as a common robot and can change their configuration according to task requirements. This system, called RobMAT, includes an advanced interface for teleoperation. It allows guiding modules and molecules, and also calibrating remote environments. Experiments have highlighted the relevance of module synchronization and trajectory control. Synchronization is a critical point for module cooperation, whereas specific trajectory control is required for improving guidance performance. *Copyright © 2008 CEA-IFAC.*

Keywords: telemanipulation, modular robots, telerobotics, semi-structured environment

AUTONOMOUS MULTIPURPOSE MANIPULATION WITH THE JAUME-2 SERVICE ROBOT

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Abstract: This paper presents a modular control architecture that enables a mobile manipulator to compliantly perform manipulation tasks in partially-known everyday human environments. An impedance velocity/force controller that allows the execution of a great variety of tasks under the Task Frame Formalism (TFF) is implemented.
Tasks are represented as a net of basic abilities which are performed by the robot using the impedance controller. Mechanisms for switching between abilities according to the robot's perceptual state are defined.
We show the validity of our approach on the UJI Service Robot, making it to perform a common daily task such as opening a door. Finally, we apply this framework to make progress on the new version of the UJI Librarian Robot, making a great step forward in the way the robot manipulates books. *Copyright © 2008 CEA-IFAC*.

Keywords: Manipulation; Control Architectures; Service Robotics.

THE ROBOTIC WHEELCHAIR SENA. A HUMAN-MACHINE INTERACTIVE APPROACH

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Abstract: In our society, the number of physically impaired people who need some type of mechanical aid for mobility is quickly increasing over time. Advances in technology have permitted the development of robotic wheelchairs which are able to relieve users from tedious operations, like manually controlling the wheelchair along corridors or crowded areas.
This paper presents the robotic wheelchair SENA which is the result of a long-term research project at the University of Málaga (Spain). SENA is based on a commercial powered wheelchair that has been endowed with a variety of sensors and devices managed by the user's laptop. Other features of the SENA prototype are the ability for autonomous navigation within office-like scenarios and high-level human-vehicle interaction and cooperation, that is based on a specific software architecture for assistant robotics. This paper describes technical details about both the hardware and software of SENA, illustrates its performance within real scenarios, and gives some conclusions obtained from our experience. *Copyright © 2008 CEA-IFAC*.

Keywords: Mobile Robotics, Assistant Robotics, Human-Robot Integration

PORTABLE ROBOT FOR DISABLE ASSISTANCE. CONCEPT, CONTROL ARCHITECTURE AND CLINICAL TRIALS

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Abstract: Historically the kind of technologies used in homes has been in the form of electrical appliances such as washing machines, ovens, etc. Later was introduced the classic "Home Automation" concept, which involves improvements like computer-controlled devices such as lights, alarms, different sensors, etc. This article presents a next step in home technologies inclusion. The classic devices have always been static, this means they are installed in the house and stay there during all their useful life doing always the same task. ASIBOT robot is a "mobile white appliance" different to traditional mobile robots due its ability to travel around the house between fixed or mobile stations its usefulness to assist motion impaired to perform by themselves a wide variety of tasks: eating, cooking, washing, transportation, etc. Also this paper presents the results of the clinical trials usability assessment of the prototype helping to the severely disabled in DLAs (Daily Life Activities) , developed as part of the ASIBOT Program at the Universidad Carlos III in Madrid in collaboration with the National Paraplegic Hospital in Toledo (Hospital Nacional de Parapléjicos de Toledo). *Copyright © 2008 CEA-IFAC.*

ROBOTICS IN DISABILITY. DEVELOPMENT OF THE MANUS-HAND DEXTROUS UPPER-LIMB PROSTHESIS

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Abstract: Disability and ageing in current societies represent a number of requirements that need to be addressed by personal and collective solutions adapted to maintain care and welfare. The primal roles of science and technology are now accepted as the pillars to improve the human activities and autonomy (Assistive Technologies). In this regard, robotics is beginning to play a main role in diverse human activities and in particular in respect to mobility and manipulation.
In this paper, such assistive robotic systems are analyzed in a wide sense, discussing their interaction with the user. Next, as results of a European project (MANUS-HAND), the design and development of an upper limb prosthesis with high dexterity, modularity and feedback capabilities, are presented.
This work proposes complementary approaches; a control system based on the use of myoelectic signals, adapted to the remaining capabilities of the user; the movements of the artificial fingers coordinated according to four global modes of grasping, complemented by the feedback on the amputee by means of force sensors and a vibratory output, covering the 90% of the natural manipulation abilities. From a mechanical point of view, a specific structure has been developed with three active fingers in flexo-extension and pronosupination of the wrist, including for this different types of actuators (DC motors and ultrasonic) governed with a single EMG channel. All systems are controlled by a distributed a hierarchical electronic architecture.
A training and evaluation platform of the user capabilities completes the system, enabling the customization of the prosthesis by adapting the parameters to the particular capabilities of the amputee.
 The system has been tested following an ad hoc protocol with amputees, demonstrating the feasibility of the concepts developed in the project. *Copyright © 2008 CEA-IFAC.*

"ARISCO" A SOCIAL ROBOT WITH INTERACTION CAPABILITY, MOTIVATION AND LEARNING

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Abstract: In this paper, the architecture of "Arisco" social robot is described, with particular stress on its interaction, motivation, planning and learning system. Arisco is a mechatronic head with interaction capacity, which includes: large expressivity through gestures, voice recognition and synthesis, visual tracking, information retrieval from Internet, and a learning and motivation system. *Copyright © 2008 CEA-IFAC.*

Keywords: Social robot, learning, interaction, artificial vision, sound localization.

DESIGN, DEVELOPMENT AND VALIDATION OF A PATHOLOGIC TREMOR SUPPRESSION ROBOTIC DEVICE

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Abstract: The application of robot in the assistance of humans is an active field. There are several factors contributing to increase the activity in this field, such as the ageing of Western population and the demand of adequate medical assistance to disable people. This paper describes the development of an upper limb exoskeleton for monitoring and suppressing pathologic tremor. The device was clinically validated in patients in two hospitals. *Copyright © 2008 CEA-IFAC.*

Keywords: Rehabilitation robotics, tremor, Human machine interaction, orthotic tremor suppression.

EXPERIENCES IN THE DEVELOPMENT OF A ROBOTIC APPLICATION WITH FORCE CONTROL FOR BONE DRILLING

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Abstract: In computer assisted orthopedic surgery (CAOS), bone drilling performed during long bone fracture repair (in order to stabilize it with plates, screws, or pins) is a complex task that requires a high accuracy while avoiding excessive heating of the bone tissue. Previous work on robot-assisted surgery has mainly used industrial robots (Robodoc, Caspar, Crigos) adapted for surgical environments in order to enhance surgeon capabilities and provide safety and accuracy in performing surgical tasks. The bone drilling process control should take into account several aspects such as bone heating, cutting speed, feed rate and applied forces and torques.
The development of control algorithms that allow to correctly perform a bone drilling task by using a robot, while guaranteeing that the related parameters, previously mentioned, take optimal values under surgeon control, should be very useful.
However, the control architecture of most industrial robots is a closed one, preventing the implementation of external algorithms based on multisensorial feedback (vision, force) for task control.
In this paper we present the design and implementation of a control architecture "build on top" of the existing controller platform of a Staubli robot, that allows for the implementation of force feedback control algorithms suitable for controlling bone drilling tasks. Force feedback is used to provide precision and safety during the bone drilling process. The on-line measured forces and torques are used as input to modify the drilling feed rate and to guarantee that force-defined thresholds are not exceeded during the drilling process. Initial experimental results are obtained under laboratory conditions with a manipulating robot equipped with a force/torque sensor attached to the wrist and a surgical tool (a drill) placed below the force sensor. *Copyright © 2008 CEA-IFAC.*

Keywords: force/torque sensor, force control, surgical robot, human-manipulator cooperation.

COMPONENT ORIENTED DEVELOPMENT OF ROBOT CONTROL UNITS: SERVICE ROBOTS FOR HULL CLEANING APPLICATIONS

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Abstract: A critical operation in the ship maintenance is the hull blasting before it is repainted. In the last decade several solutions have appeared in the market that pretends to solve this problem.They are focused on robotizing this operation. Despite it, the hull cleaning operations are usually being carried out by manual means in shipyards. This article presents a robot family that supposes a good solution for the outlined problem.It reasonably satisfies all the requirements related to operatibility, efficiency, safety and environmental protection. For the design of the control systems we have followed an approach based on components, in order to reuse the code and to minimize the development times. The work here presented has been developed inside the EFTCoR project, funded by VFP of the EU. *Copyright © 2008 CEA-IFAC.*

Keywords: Service robots, teleoperated robots, software architectures, component based development.