SIXTH FRAMEWORK PROGRAMME
PRIORITY 2
Information Society Technologies IST

SPECIFIC TARGETED RESEARCH OR INNOVATION PROJECT

Project Fact Sheet

Project acronym: **PHRIENDS**

Project full title:
Physical Human-Robot Interaction: DepENDability and Safety

Contract no.: 045359

Duration: 1 October 2006 — 30 September 2009

Total cost: EUR 3.549.814

Commission funding: EUR 2.158.000

Coordinator: Centro “E. Piaggio”, Università di Pisa, Italy
Prof. Antonio Bicchi <bicchi@ing.unipi.it>

Partners: Institute of Robotics and Mechatronics, DLR, Germany
Dr. Alin Albu-Schaeffer <alin.albu-schaeffer@dlr.de>

KUKA Roboter GmbH, Germany
Dr. Rainer Bischoff <rainerbischoff@kuka-roboter.de>

LAAS, CNRS, France
Dr. Rachid Alami <rachid.alami@laas.fr>

DIS, Università di Roma “La Sapienza”, Italy
Prof. Alessandro De Luca <deluca@dis.uniroma1.it>

PRISMA Lab/DIS, Università di Napoli Federico II, Italy
Prof. Bruno Siciliano <siciliano@unina.it>

Website: www.phriends.eu www.phriends.org

Goal

This project aims at developing robots that can co-exist and co-operate with people, enabling a physical human-robot interaction which is dependable and safe: in a word, to make robots and humans **PHRIENDS**.

Key Issues

PHRIENDS is about **developing key components of the next generation of robots**, ranging from industrial robots to assist devices (in particular, robots for the emerging market of non-industrial applications, e.g. for service, health-care, and entertainment), designed to share the environment and to physically interact with people. Such machines have to **meet the strictest safety standards, yet also to deliver useful performance**: this poses new challenges to the design of all components of the robot, including mechanics, control, planning algorithms and supervision systems. We propose an integrated approach to the co-design of robots for safe physical interaction with humans, which revolutionizes the classical approach for designing industrial robots – rigid design for accuracy, active control for safety – by creating a new paradigm: **design robots that are intrinsically safe, and control them to deliver performance.**

Technical Approach

Although the scope of this project cannot encompass the integration of complete robot systems, **PHRIENDS will create and deliver new actuator concepts and prototypes, new dependable algorithms for supervision and planning, new control algorithms for handling safe human-robot physical interaction and for fault-tolerant behaviour, and will integrate these components in meaningful subsystems for experimental testing, quantitative evaluation and optimization**. The project will also contribute significantly to the ongoing effort of international bodies towards the establishment of new standards for collaborative human-robot operation.

Expected Impact

Safe and dependable human-centered robotics is not only ethical: it also pays off. Results of this project will deeply impact applications where successful task completion requires people and robots to collaborate directly in a shared workspace. In fact, market pressures are about to topple some of the barriers separating robots and people. The project is expected to have an important potential for **exploitation**. Our primary exploitation policy is straightforward and unequivocal: the adoption of part of our results in new products or product components by the industrial partner, KUKA Roboter GmbH. The DLR Institute of Robotics and Mechatronics and KUKA have currently a technology transfer cooperation for the commercialization of the DLR light-weight robot technology. The light-weight robot, with its mechatronic design and force-torque sensing and control along the entire robot structure will be the first robot dedicatedly designed and programmed for human-robot interaction in industrial environments, as a robot assistant. It is expected that it will have **a very high impact on enlarging the industrial and service robot applicability**. It could easily envisaged that even todays standard robots could be equipped with advanced control hardware and software, so that the impact of the project is not only limited to the before-mentioned light-weight robot technology. In particular, new prototypes of compact and efficient variable impedance actuators to be used as joints of lightweight arms will be developed. The interest from potential customers from industry and academia who clearly see the benefits from applying and using such robots, is very high already. While turning research prototypes into products, one of the major topics to be addressed is to ensure to the highest level possible the safety of the humans which are using these robots.