

TecFOr 2010, 18 Maggio, Fiera di Roma
Conferenza SELEX Sistemi Integrati & AFCEA Capitolo di Roma
"Tecnologie Abilitanti e Sistemi per la Sicurezza: il contributo delle Università e dei Centri di Ricerca"



Robotics @ PRISMA Lab

Bruno Siciliano • Luigi Villani
Dipartimento di Informatica e Sistemistica
Università di Napoli Federico II
www.prisma.unina.it



The PRISMA Team

Robotics @ PRISMA Lab

2/13

- 6 Research groups (Napoli, Cassino, Salerno, Basilicata, Napoli 2, Roma 3)



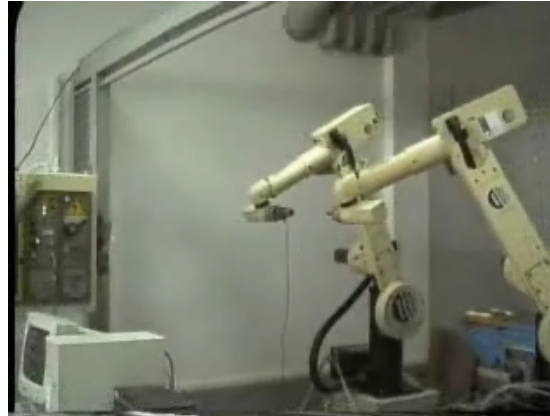
- 4 Professors + 5 Associate Professors + 3 Assistant Professors
- 6 PostDoc + 20 PhD + 20 MS + 3 TechEng
- 25 years of research activity
- 500 KEuro financial support a year
- Collaboration with 30 foreign institutions
- 120 seminars and invited talks
- 12 books + 15 volumes + 160 journal papers + 500 conference papers



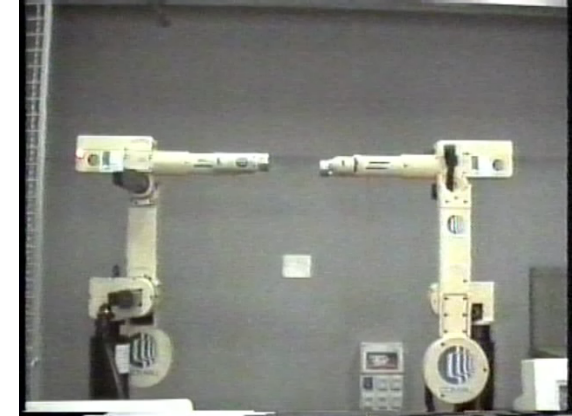


- Dual-Arm/Hand Manipulation
- Dynamic Parameter Identification
- Fault Diagnosis and Fault Tolerant Control
- Force Control
- Human–Robot Interaction
- Lightweight Flexible Arms
- Mobile Multirobot Systems
- Mobile Robots
- Novel Actuation and Sensing Systems for Robotic Applications
- Redundant Manipulators
- Service Robotics
- Simulation Control Theory of Discrete Event Systems
- Supervisory Control Theory of Petri Nets and Implementation
- Underwater Robotics
- Visual Servoing

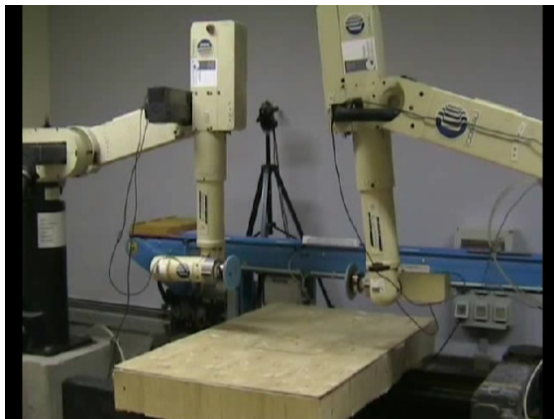
- Dual-arm set-up
 - 6ax robot
 - 7ax robot



peg-in-hole assembly
6-DOF impedance



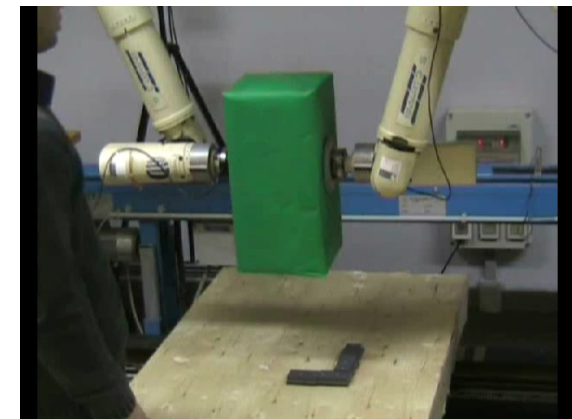
control of absolute motion
and internal forces



absolute & relative impedance



absolute impedance



human-object interaction

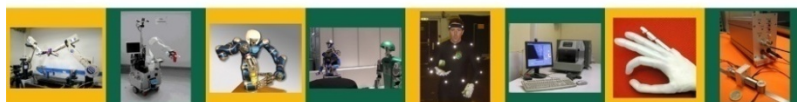
www.dexmart.eu



DEXterous and autonomous dual-arm/hand robotic manipulation with sMART sensory-motor skills: A bridge from natural to artificial cognition



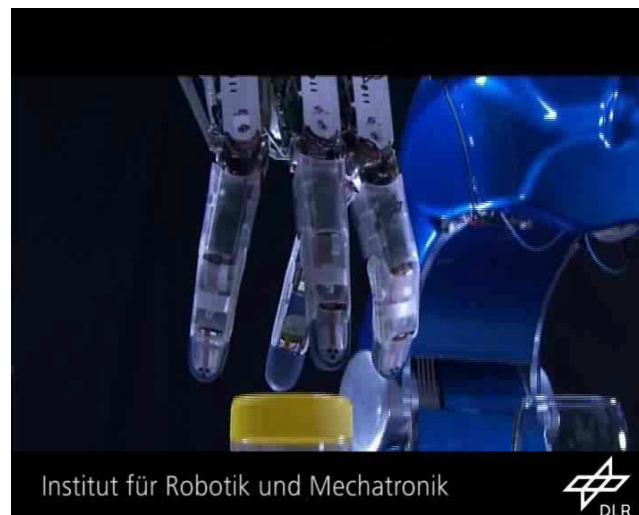
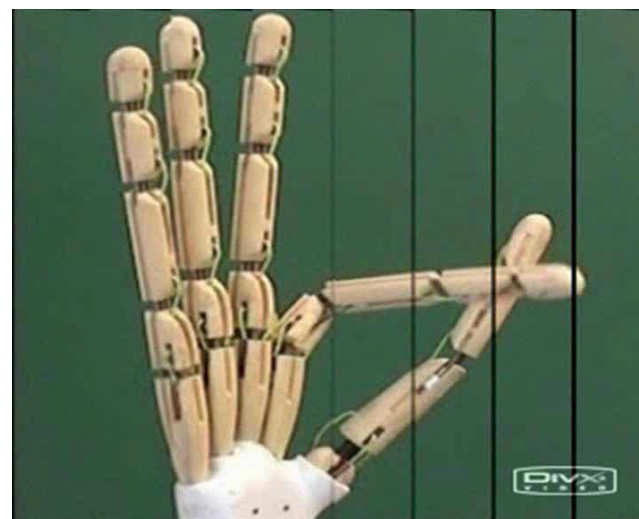
Large-scale integrating project ICT-216239 supported by the European Commission under the 7th Framework Programme (01.02.2008 – 31.01.2012)



DEXMART has the ambition to fill the gap between the use of robots in industrial environments and the use of future robots in everyday human and unstructured environments, contributing to reinforce European competitiveness in all those domains of personal and service robotics where dexterous and autonomous dual-hand manipulation capabilities are required.

 PRISMA Lab/DIS & DSF, Università di Napoli Federico II, Italy Prof. Bruno Siciliano bruno.siciliano@unina.it	 Institut für Robotik und Mechatronik, DLR, Germany Dr. Gerhard Grunwald gerhard.grunwald@dlr.de	 OMG plc, United Kingdom Dr. Andrew Stoddart a.stoddart@omg3d.com	 DEIS & DIEM, Alma Mater Studiorum Università di Bologna, Italy Prof. Claudio Melchiorri claudio.melchiorri@unibo.it
 LAAS, CNRS, France Dr. Daniel Sidobre daniel.sidobre@laas.fr	 Forschungszentrum Informatik an der Universität Karlsruhe, Germany Dr. J. Marius Zöllner zollner@fzi.de	 DII, Seconda Università di Napoli, Italy Prof. Giuseppe De Maria giuseppe.demaria@unina2.it	 LPA & EPO, Universität des Saarlandes, Germany Mr. Chris May c.may@lpa.uni-saarland.de

www.dexmart.org



Institut für Robotik und Mechatronik



- Risks for robots interacting with humans
 - Heavy moving parts and objects transported
 - Sensory data reliability
 - Level of autonomy/unpredictable behaviours
- Solutions for collaborative human-robot operation
 - Design of non-conventional actuators (passive safety)
 - Interaction control (active safety)
 - Dependable algorithms for supervision and planning
 - Fault tolerance
 - Need for quantitative metrics



www.phriends.eu

www.phriends.eu



Physical Human-Robot Interaction: DepENDability and Safety

Specific Targeted Research or Innovation Project IST-045359 supported
by the European Commission under the 6th Framework Programme
(01.10.2006 — 30.09.2009)



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**

Centro "E. Piaggio",
Università di Pisa,
Italy

Prof. Antonio Bicchi
bicchi@ing.unipi.it

Institute of Robotics and
Mechatronics, DLR,
Germany

Dr. Alin Albu-Schaeffer
alin.albu-schaeffer@dlr.de

KUKA Roboters 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



Three Laws of Robotics

1. A robot may not injure a human being or, through inaction, allow a human being to come to harm.
2. A robot must obey orders given it by human beings except where such orders would conflict with the First Law.
3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

Isaac Asimov - The Caves of Steel, p. 177-179, 1942

www.phriends.org

www.phriends.org

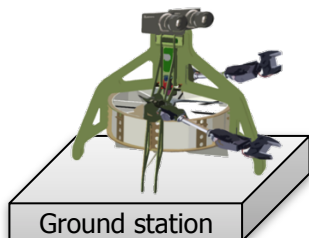
- Develop a new generation of aerial service robots able to
 - support human beings in all activities requiring the ability to interact actively and safely with environments not constrained on ground
 - accomplish a large variety of applications, such as inspection of buildings and large infrastructures, sample picking, aerial remote manipulation
- The aerial platform is remotely supervised by the operator with the use of haptic devices
 - force and visual feedback strategies exploited to transform the aerial platform in a "flying hand" suitable for aerial manipulation



Service on a power plant

Way-points

Takeoff



Landing



Stand close

Docking and inspection



Interaction with teleoperation

- European Clearing House for Open Robotics Development
 - Target-oriented research and technology transfer with tangible results
 - Small-scale experiments (12–18 months) proposed by industry, academia, or both
 - Short proposals (max ~25 pages, including all administrative data)
 - Quick evaluation and negotiation
 - Equipment can be bought from a list with special prices
 - Lower the entrance barriers (industry and integrators of SME size)
 - Reduce the “fear of contact” with funding organisations

www.echord.info





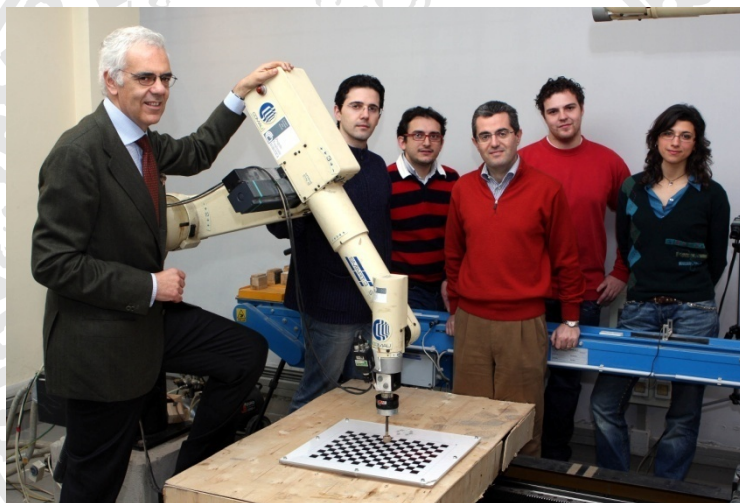
- Corso di Master Universitario di II Livello in **Robotics and Intelligent Systems**
 - Facoltà di Ingegneria – Dipartimento di Informatica e Sistemistica
 - Facoltà di Scienze Matematiche, Fisiche e Naturali – Dipartimento di Scienze Fisiche
- Iscrizione
 - min 10 — max 25
 - costo **4000 Euro**
- Attivazione
 - Anno accademico 2010/2011
- Aziende sponsor
 - Ansaldo, M31, Schunk, Telespazio,





- Progettazione, integrazione, pianificazione e gestione di **dispositivi robotici e sistemi intelligenti**
- Metodologie e tecnologie dell'**ingegneria** (automatica, informatica, elettronica, meccanica) e contenuti di **scienze cognitive**
- Formazione di **professionisti** che ricopriranno ruoli di responsabilità in svariati ambiti
 - automazione di processi produttivi
 - **sorveglianza e sicurezza**
 - sistemi di trasporto
 - medico e riabilitativo
 - applicazioni domestiche

Grazie per l'attenzione 😊



www.prisma.unina.it