

Robotics @ PRISMA Lab

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www.prisma.unina.it



E.T.S. de ENXENEIROS
INDUSTRIAIS
de VIGO

18 February 2010

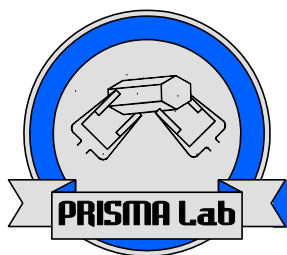
■ City

- 1,200,000 inhabitants
- Pole of Mediterranean culture
- Historical and holiday sites
- 5 universities + several science institutions

■ University

- Founded in 1224 by Emperor Federico II (3rd oldest after Bologna and Padova)
- 100,000 students
- School of Engineering founded in 1811 by King Murat (oldest in Italy)
 - 15,000 students (4,500 graduate)





The PRISMA Team

Robotics @ PRISMA Lab

3/20

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



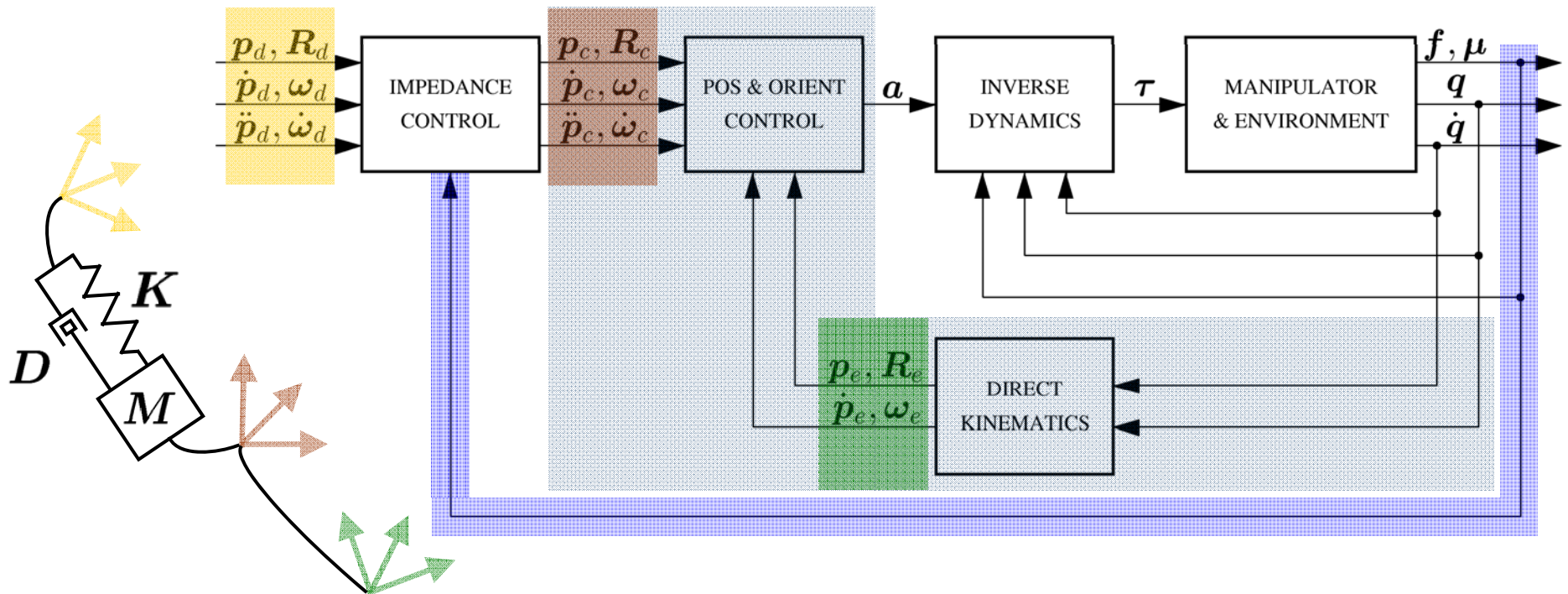
- 4 Professors + 5 Associate Professors + 3 Assistant Professors
- 6 PostDoc + 20 PhD + 20 MS + 3 TechEng
- 25 years of research activity
- 500 KEuro financial support a year
- Collaboration with 30 foreign institutions
- 120 seminars and invited talks
- 12 books + 15 volumes + 160 journal papers + 500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





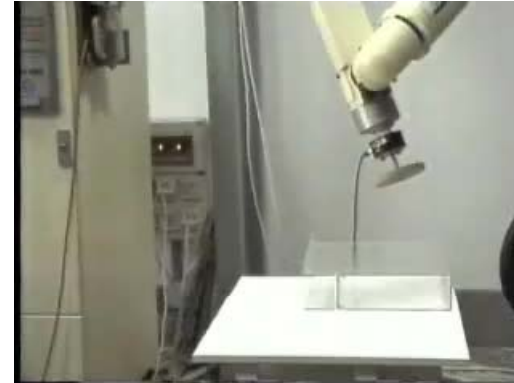
- Dual-Arm/Hand Manipulation
- Dynamic Parameter Identification
- Fault Diagnosis and Fault Tolerant Control
- Force Control
- Human–Robot Interaction
- Lightweight Flexible Arms
- Mobile Multirobot Systems
- Mobile Robots
- Novel Actuation and Sensing Systems for Robotic Applications
- Redundant Manipulators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

- Impedance control with inner motion control loop
 - Force/torque measurements for linear and decoupled impedance
 - Compliant frame between desired and EE frame (disturbance rejection)



■ Set-up

- COMAU Smart 3-S robot
- Open control architecture
- ATI force/torque sensor
- 6-DOF spatial impedance



surface contact



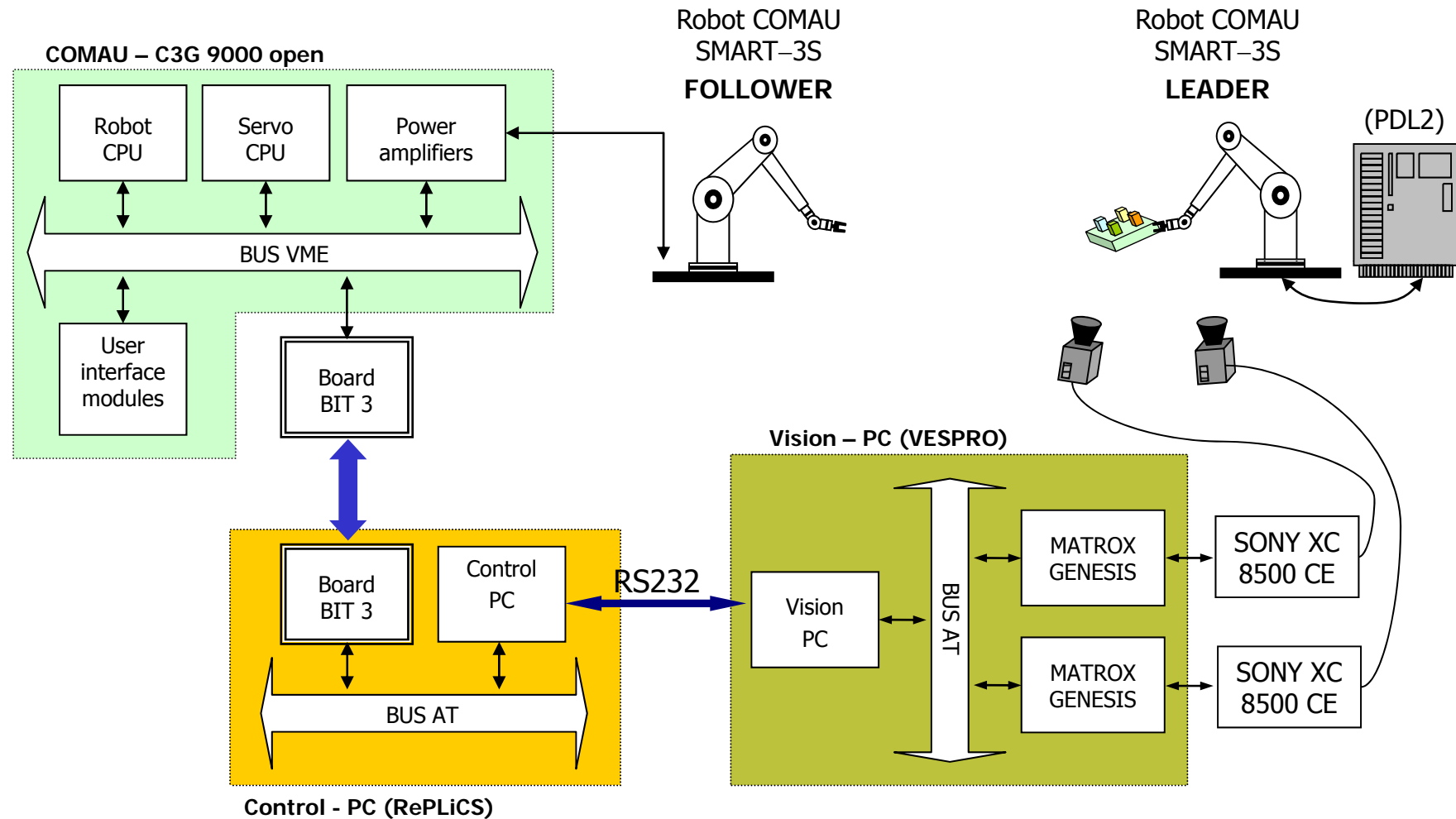
low compliance
high damping



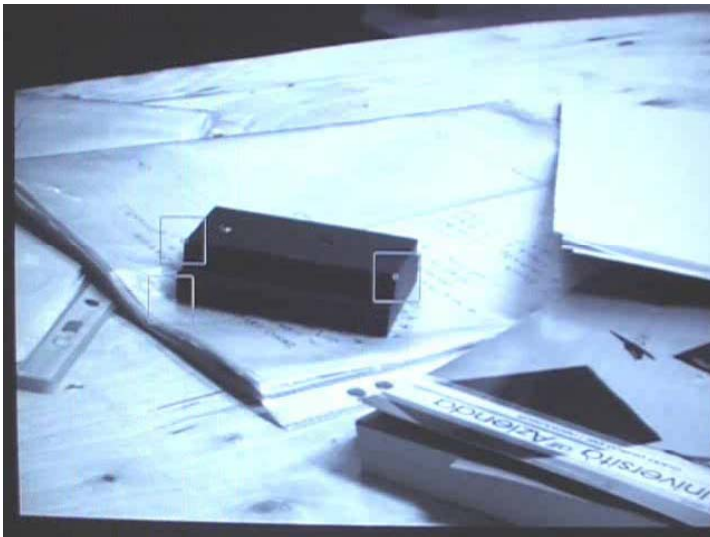
high compliance
low damping



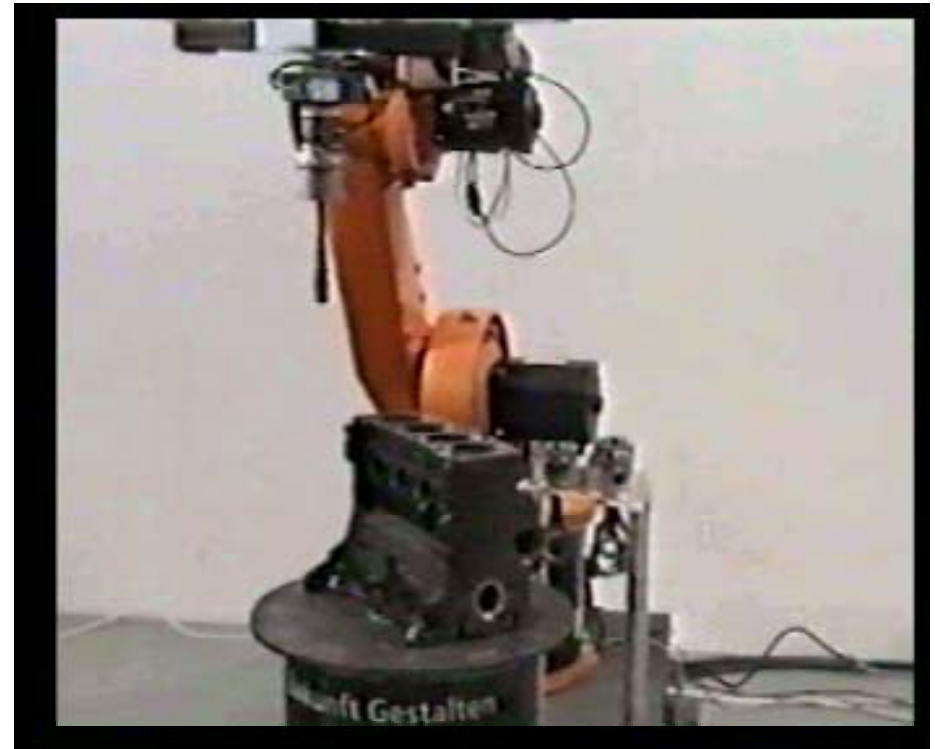
high compliance
high damping

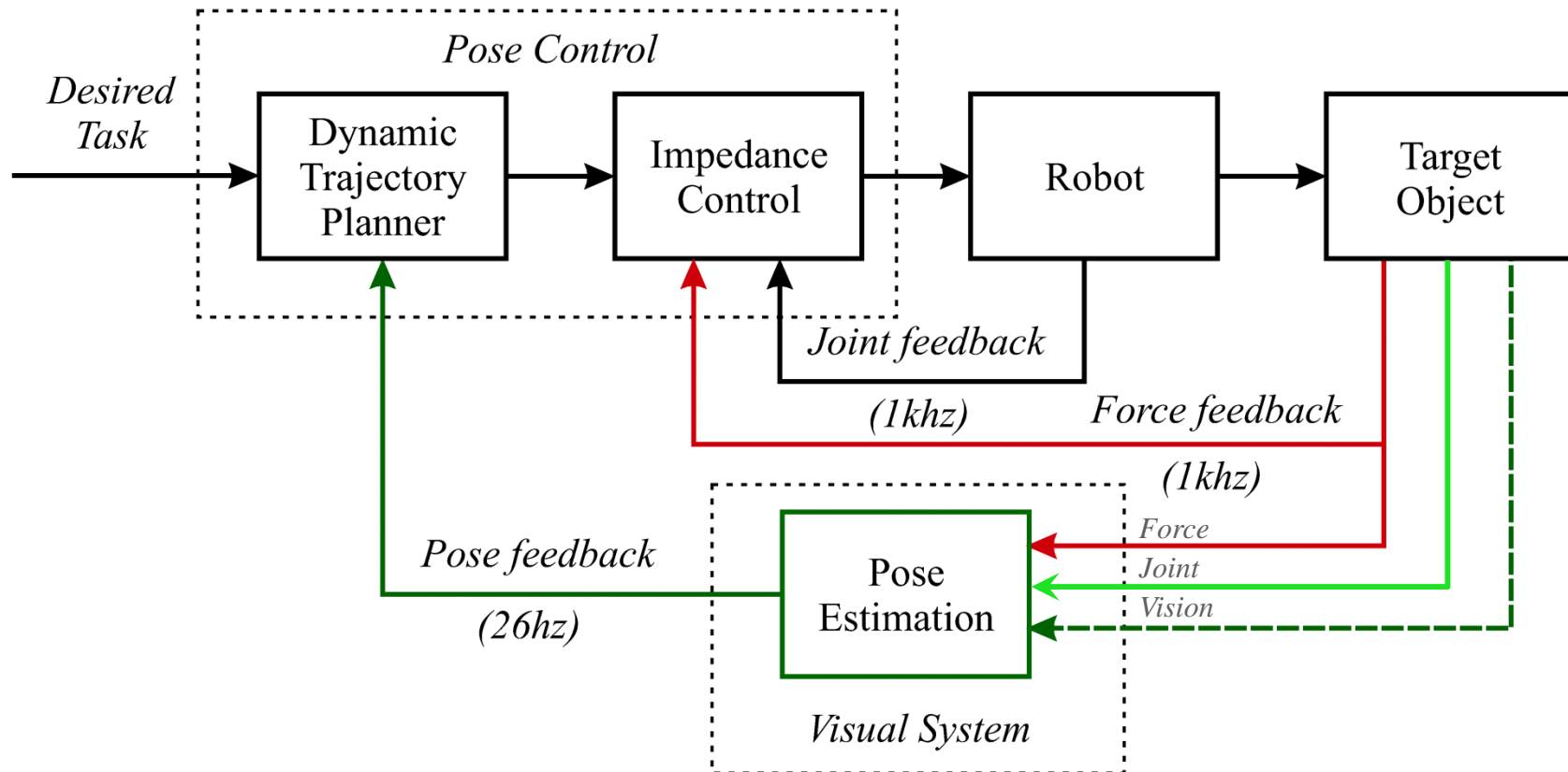


- Visually guided grasping
 - Object in unstructured environment
 - Visual servoing
 - Tracking of object motion
 - Good reaction to uncertainties



- Set-up @ DLR
 - KUKA robot with force sensor and camera embedded in the gripper
- Integration of vision and force
 - Visual feedback in gross motion
 - Force feedback in fine motion





- 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



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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**

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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.

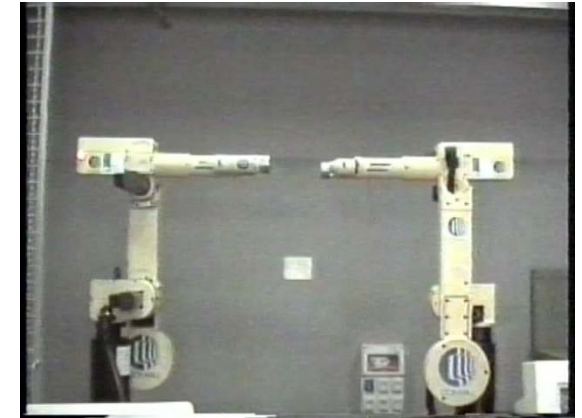
Isaac Asimov - The Caves Of Steel, p. 177-179, 1942

- Dual-arm set-up

- 6ax robot
- 7ax robot



peg-in-hole assembly
6-DOF impedance



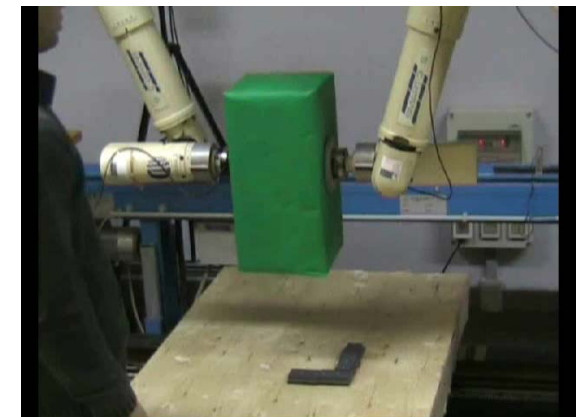
control of absolute motion
and internal forces



absolute & relative impedance



absolute impedance



human-object interaction

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



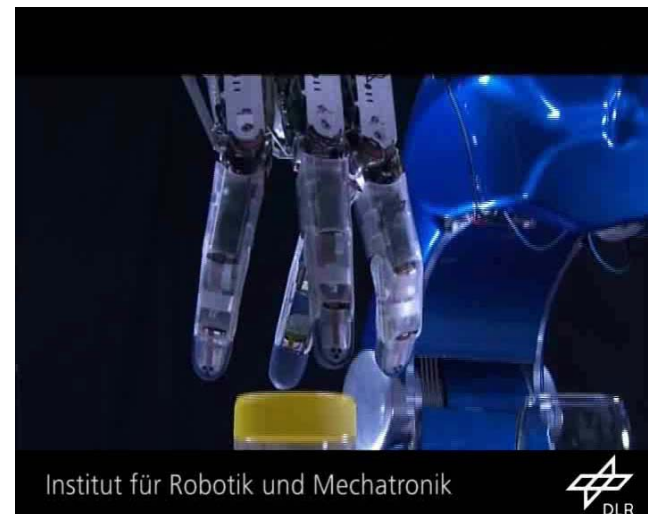
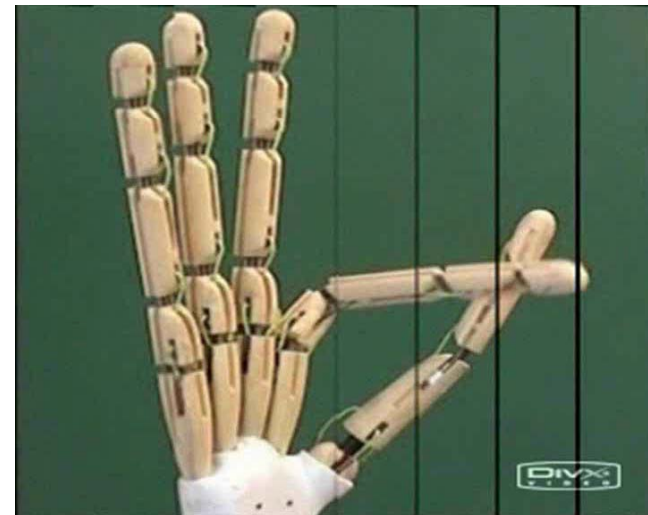
Large-scale integrating project ICT-216239 supported by the European Commission under the 7th Framework Programme (01.02.2008 – 31.01.2012)



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.

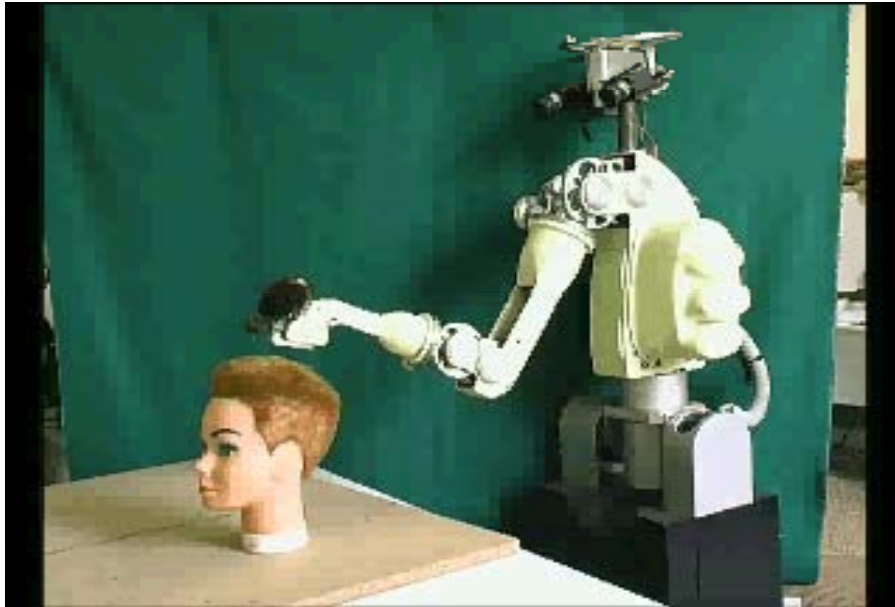
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www.dexmart.org



Institut für Robotik und Mechatronik





assisting disabled person



fire-fighting robot

- 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



Service on a power plant

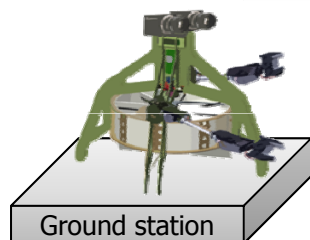
Way-points

Takeoff



Unexpected risks!

Landing



Stand close

Docking and inspection



Interaction with teleoperation

- Recent successful coordination activities within academic and industrial robotics communities (EURON and EUROP)



euRobotics

- Goals
 - Improvement of cooperation between industry and academia
 - Enhancement of public perception of robotics
- Impact
 - Defining and implementing activities involving all relevant stakeholders
 - Allowing European robotics to maintain its strong position and to gain worldwide leadership
- Forthcoming meeting @ San Sebastian (10–12 March)

A

Robotics
Foundations
(D. Orin)

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B

Robot
Structures
(F. Park)

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C

Sensing and
Perception
(H. Christensen)

7

D

Manipulation and
Interfaces
(M. Kaneko)

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E

Mobile and
Distributed Robotics
(R. Chatila)

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F

Field and
Service Robotics
(A. Zelinsky)

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G

Human-Centered and
Life-Like Robotics
(D. Rus)

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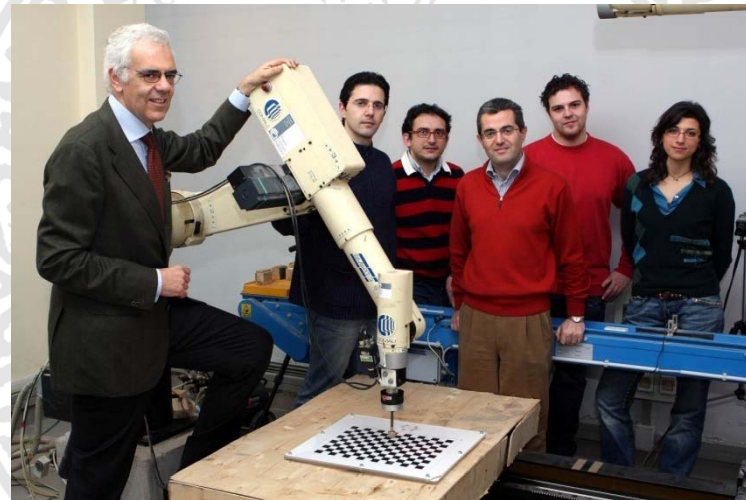
■ B. Siciliano, O. Khatib (Editors)

- Electronic content (Internet, DVD)
- Unveiled @ ICRA'08 May, Pasadena, CA
- 6 years of work
- 7 parts
- 64 chapters
- 165 authors
- 10000+ emails
- 1600 pages
- 950 illustrations
- 5500 references

- Bestselling engineering title in 2008
- PROSE Awards for Physical Science & Maths + Engineering & Technology



Muchas gracias por su dedicada atención 😊



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