

# Robots Moving Closer to Humans

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 **DIE** **UNIVERSITA'** **DEGLI STUDI DI**  
**TI.** **NA** **POLI FEDERICO II**  
**DIPARTIMENTO DI INGEGNERIA ELETTRICA**  
**E TECNOLOGIE DELL'INFORMAZIONE**

[www.prisma.unina.it](http://www.prisma.unina.it)

## ■ City

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

## ■ University

- Founded in 1224 by Emperor Frederick II (oldest public laic university in the world)
- 100,000 students
- School of Engineering founded by King Murat (oldest in Italy)
  - 15,000 students (5,000 graduate)



Foto: DANIELE PIZZO



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 Andrea Fontanelli • Valeria Federico • Jonathan van der Meer





# Our Research Portfolio

Robots Moving Closer to Humans 4/21

Aerial  
Assist  
Cognit



Dual-  
Force  
Human



Inspe  
Light  
Mobil



Motion Generation and Biomechanical Analysis  
for Human Figures

Redundant Manipulators

Robotic Surgery Technology

Sensory-Motor Synergies of Anthropomorphic

Serv

Visual



Funding of 8.5 M€

European  
Robotics  
Challenges



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Manufacturing industry needs competitive solutions  
to maintain leadership in products and services



Shop Floor Logistics  
and Manipulation

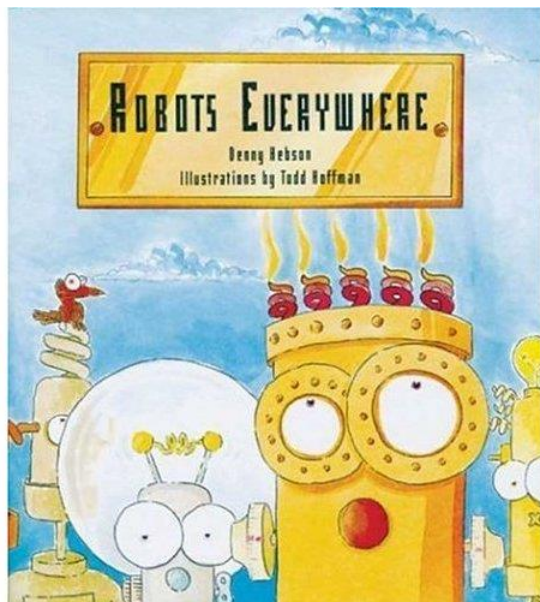


Plant Inspection  
and Servicing

Manufacturing Cell



Collision detection and safe reaction



Today

Mars  
Oceans  
Hospitals  
Factories  
Schools  
Homes

...

Intelligent  
Personal  
Pervasive  
Disappearing  
Ubiquitous

Tomorrow



- Robot (mythology)
- One of the first robots (mythology)
- Commonly known as a robot (science fiction)
- The robot (reality)



facts

can speak,  
ans

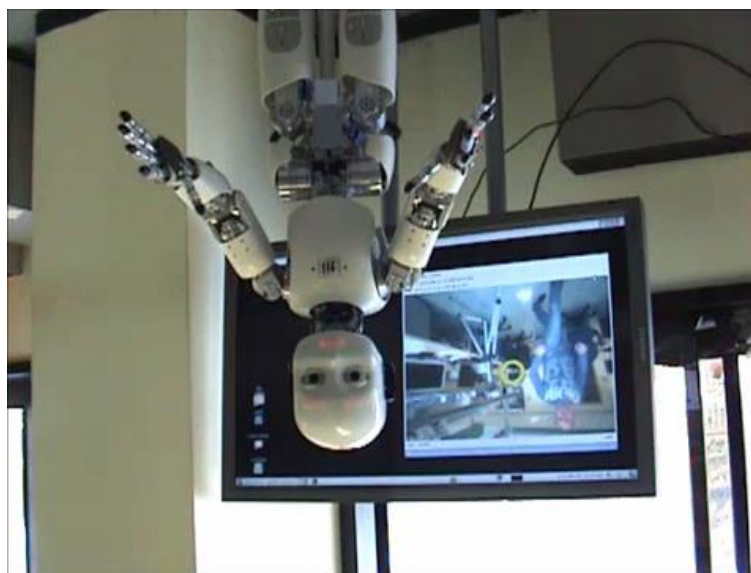
able to  
our



object recognition capabilities of a  
2-year-old child



social understanding of an  
8-year-old child

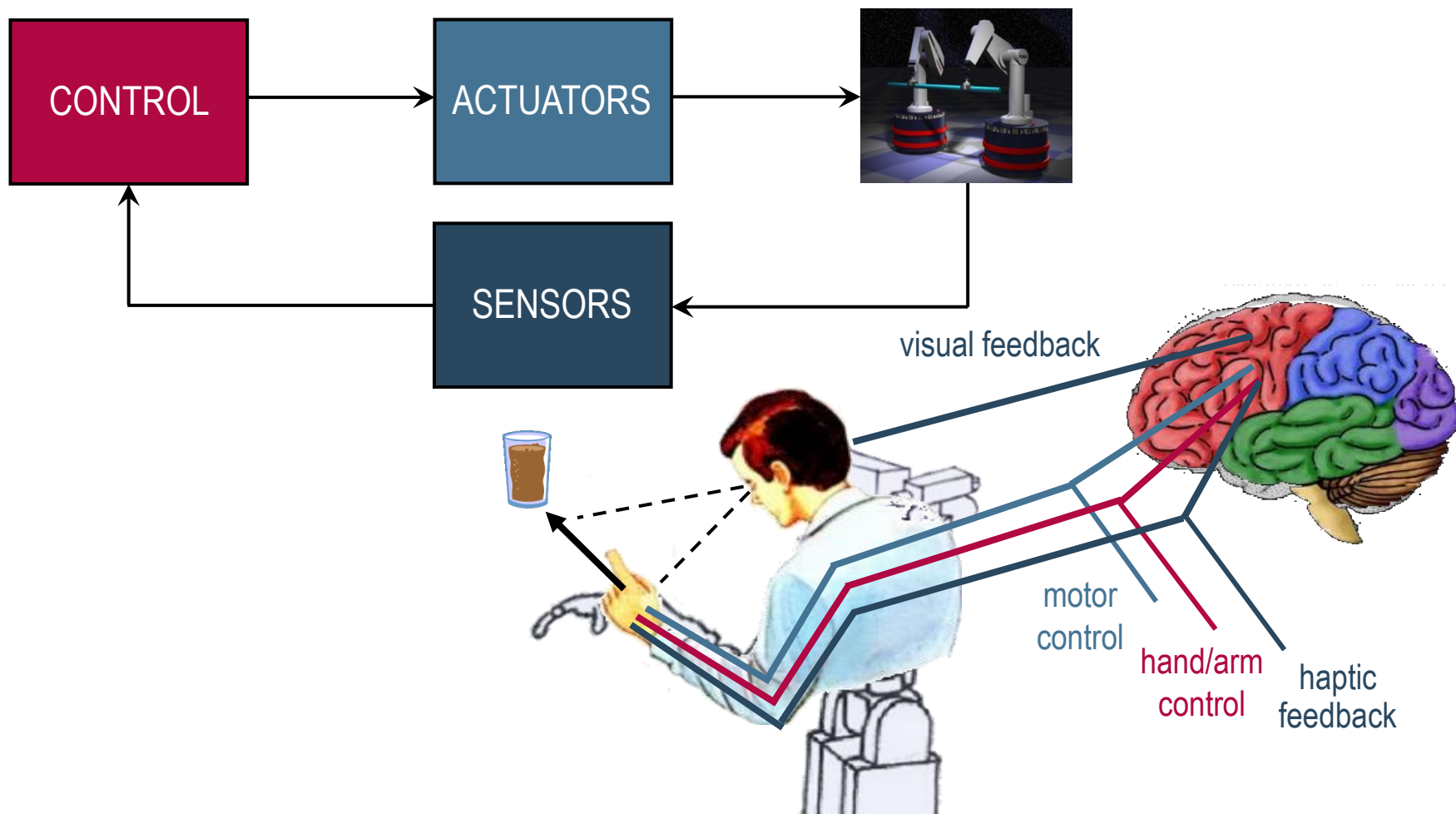


manual dexterity of a  
6-year-old child

language capabilities of a  
4-year-old child



**intelligent connection** between **perception** and **action**





Humans' DREAM of replicating themselves

NEED for useful machines

1960-1980

Industrial Robotics

Manufacturing Applications

1980-2000

Field Robotics

Spatial Applications

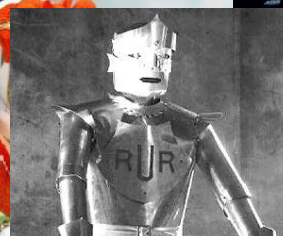
1990-2010

Service Robotics

Medical Applications

2000-2020

Personal Robotics



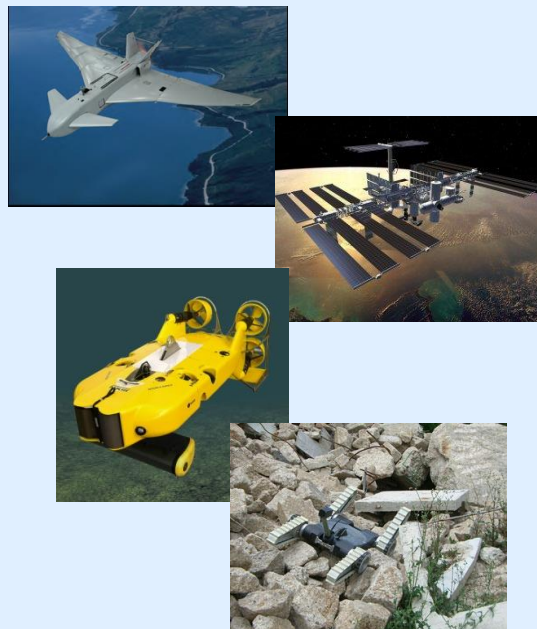


## Industry



Automotive  
Chemical  
Electronics  
Food

## Field



Aerial  
Space  
Underwater  
Search and rescue

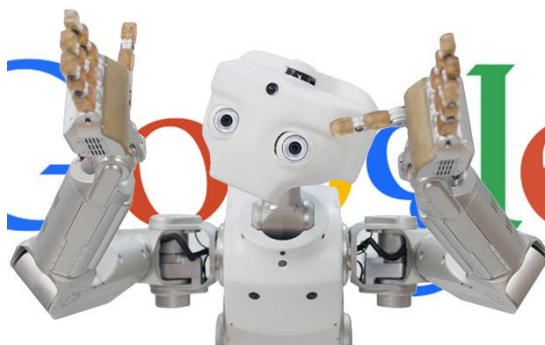
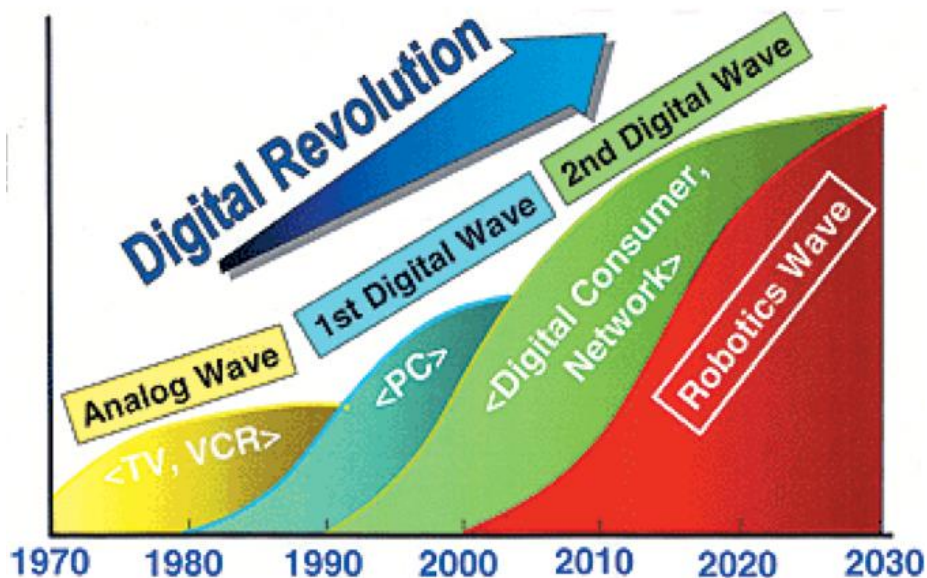
## Service



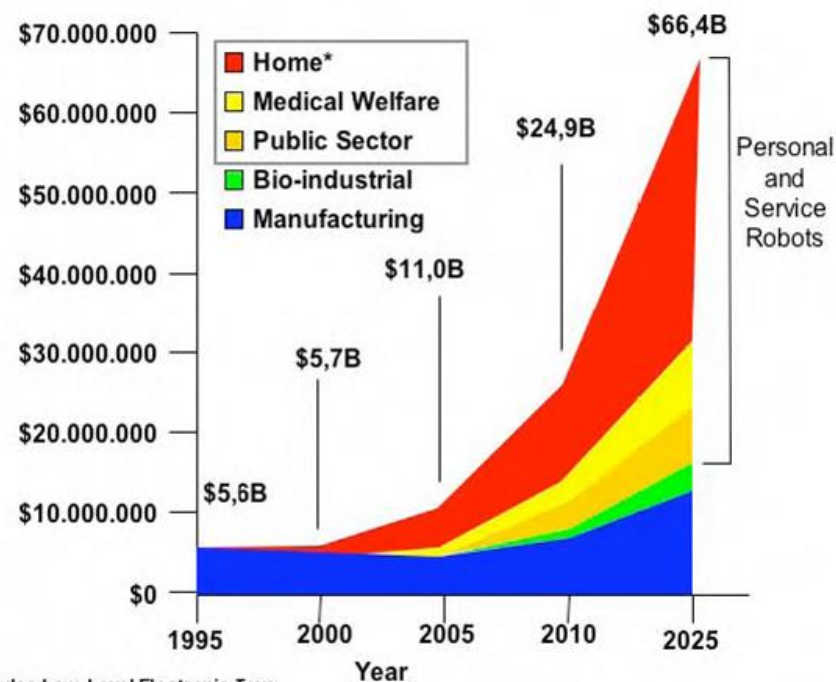
Domestic  
Edutainment  
Rehabilitation  
Medical

Level of Autonomy





Market Size (\$1.000)



\* Excludes Low Level Electronic Toys

Source : Japan Robotics Association

- By dawn of new millennium, robotics has undergone a major transformation in scope and dimensions
  - Maturity of field and advances in its related technologies
- Expansion into challenges of human world (**human-centered and life-like robotics**)
  - New generation of robots expected to safely and dependably co-habitat with humans in homes, workplaces, and communities, providing support in services, entertainment, education, healthcare, manufacturing, and assistance



- Intelligent machines working in contact with humans (**human augmentation**)
  - Haptic interfaces and teleoperators
  - Cooperative material handling
  - Power extenders
  - Rehabilitation and physical training
  - Entertainment
- Advanced industrial robotics
  - Traditionally segmented workspace for machines and humans
  - **Safe** and productive **human-aware space-sharing robot** (cooperative, no fences)
- Human-Robot Interaction (HRI)
  - Cognitive issues [cHRI]: perception, awareness, mental models
  - **Physical issues [pHRI]: safety, dependability, dexterity**
  - Ethical issues: motivations and critics about HRI, acceptability



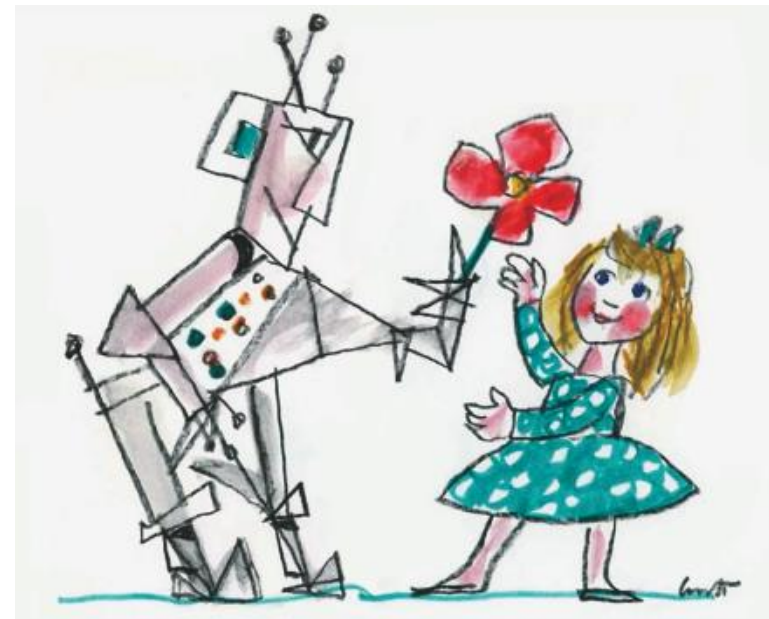


## ■ Research challenges

- Biomechanics
- Haptics
- Neurosciences
- Machine learning
- Virtual prototyping
- Animation
- Surgery
- Sensor networks
- ...

## Roboethics

Human-centered ethics guiding design, construction and use of robots



- Foreseen scenario
  - Robots “disappear”
  - Robotics technology becomes **ubiquitous**, distributed and/or “embedded” into smart environments and thinking things ... just like computers which have become more and more pervasive



B. Siciliano & O. Khatib (Editors)

Reference in Physical Sciences & Mathematics + Engineering & Technology  
(February 2009)

A

Robotics  
Foundations  
(D. Orin)

9

B

Robot  
Structures  
(F. Park)

9

C

Sensing and  
Perception  
(H. Christensen)

7

D

Manipulation and  
Interfaces  
(M. Kaneko)

9

E

Mobile and  
Distributed Robotics  
(R. Chatila)

8

F

Field and  
Service Robotics  
(A. Zelinsky)

14

G

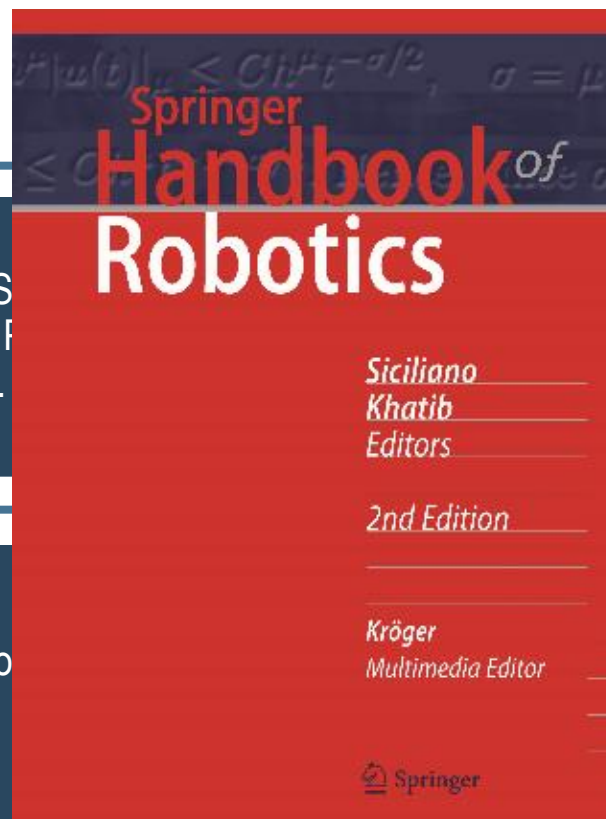
Human-Centered and  
Life-Like Robotics  
(D. Rus)

8



Published in Summer 2016

Multimedia portal:  
<http://handbookofrobotics.org>



**A**

Robotics  
Foundations  
(D. Orin)

14

**B**

Design  
(F. Park)

12

**F**

Robots at Work  
(A. Zelinsky)

13

**C**

S...  
F...  
(H. ...)

9

**G**

Robo...

**E**

Moving  
in the Environment  
(R. Chatila)

9







and among us





Thank You very much indeed  
for Your kind attention 😊  
Any questions?