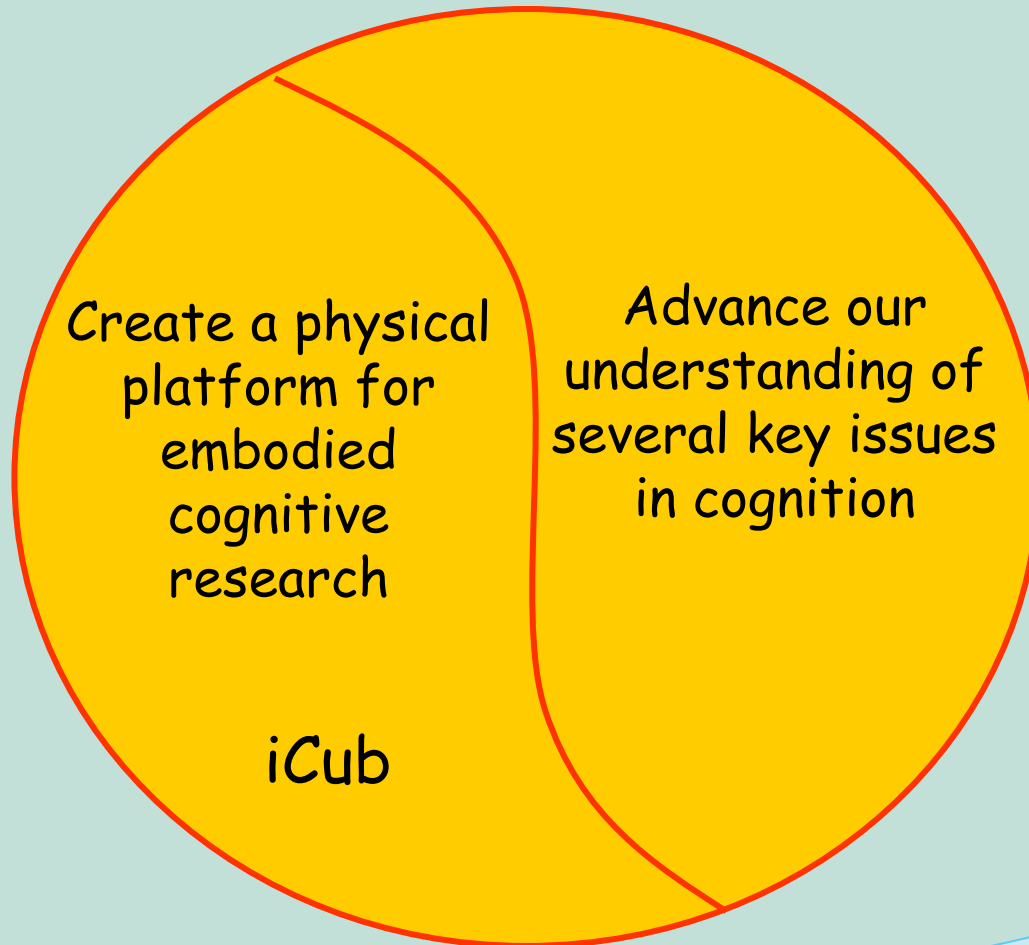# Robot-Cub Outline

Robotcub 1ˢᵗ Open Day
Genova July 14, 2005

Main Keywords

- Cognition (manipulation)
- Human Development
- Embodiment
- Community Building

Two Goals or a two-fold Goal?

RobotCub

Create a physical platform for embodied cognitive research

Advance our understanding of several key issues in cognition

iCub

Cogsys
Cognitive Systems

Main Figures

- RobotCub is a **5** years projects
- Presently the consortium is composed of **16** Partners, **11** from Europe, **3** from Japan and **2** from the USA.
- Total Funding is **8.5** M€ and total effort is **1,651** person-months (138 person-years)
- Coordinator is the LIRA-Lab of the University of Genova: Giulio Sandini, Giorgio Metta and David Vernon

Current Consortium

No	Name	Short Name	Main Expertise in Project
1	University of Genova – DIST (Giulio Sandini, David Vernon, Giorgio Metta)	UGDIST	Cognitive Robotics – Vision and Manipulation
2	Scuola S. Anna – Pisa (Paolo Dario)	SSSUP	Cognitive Robotics – Manipulation Hardware
3	University of Zurich (Rolf Pfeifer)	UNIZH	Cognitive Robotics – Audition and Touch
4	University of Uppsala (Claes von Hofsten)	UNIUP	Cognitive development of manipulation skills in humans
5	University of Ferrara (Luciano Fadiga)	UNIFE	Physiology of Manipulation control in humans
6	University of Hertfordshire (Kerstin Dautenhahn)	UH	Cognitive Behavior and Interaction
7	IST Lisbon (Jose Santos-Victor)	IST	Cognitive Robotics – Eye-head coordination
8	University of Salford (Darwin Caldwell, John Gray)	UNISAL	Robotics – Locomotion
9	Ecole Polytechnique Federal de Lausanne - (Aude Billard, Auke Ijspeert)	EPFL	Cognitive Behavior and Interaction (Billard - ASL) Locomotion (Ijspeert - LSL)
10	Telerobot S.r.l. (Francesco Becchi, David Corsini)	TLR	Mechanical design and manufacturing
11	European Brain Research Institute (Emilio BIzzi)	EBRI	Sensorimotor Coordination and motor cognition
12	MIT Computer Science and Artificial Intelligence Laboratory (Rod Brooks)	CSAIL	Cognitive Humanoid Robotics
13	University of Minnesota - Dept. of Neurology (Juergen Konkzak)	UNIMN	Developmental Psychology
14	Communications Research Laboratory, Japan (Hideki Kozima)	CRL	Humanoid Robotics and Development
15	Universty of Tokyo - Department of Mechano-Informatics, (Yasuo Kuniyoshi)	UNITK	Humanoid Robotics
16	ATR Computational Neuroscience Laboratories – Kyoto – (Gordon Cheng)	ATR	Neuroscience and Humanoid Robotics

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An *open* system!

Robot-Cub **engineering goal** is to build a humanoid platform whose design is open to the scientific community and can be duplicated and improved by the community of its users.

Clearly stated in our Consortium Agreement

We are looking for other projects willing to join RobotCub with the same open attitude.

Seeking International Collaboration

1. Joining effort with on-going project (and contribute to new proposals)
2. Directly support projects on "Cognition" based on iCub platform

Joining effort with ongoing projects

- Contacts with NSF to establish links with projects with similar goals
- Concrete plan for joint-labs with Japanese Laboratories
- National Bilateral Agreements with international labs (e.g. UNIGE-MIT)
- Contributing to new proposals (e.g. CA euCognition)
- …any further ideas for extending the community…

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Direct Support to projects

1. Establish a research and training facility for the, fabrication, use and maintenance of iCub (start september 2006)

2. Launch of competitive calls for

    1. Projects based on the use of iCub in cognitive related research.

    2. 10 iCub-Kits

2 M€ of the RobotCub budget have been set aside for these activities (Call on March 2007)

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Main Objectives (60 months)

1. ..a professionally documented, reproducible **open platform** shaped like a child-humanoid

2. ..the understanding through real-world implementation of exploratory and **manipulation-based cognitive** skills

3. ..the study and implementation of the initial period of human **cognitive development** in an embodied artificial system

4. ..building of an **international scientific community**

…which rest on several props

- Unity of cognition: body and mind-ware co-design:
  - Requirements: hands, dexterity, etc.
- Exploiting holistic design:
  - Complex bodies requires global optimization
- Cost effectiveness:
  - An open system can lead to a more efficient design/exploitation process

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Science-wise

- Manipulation as a link between action and perception
- Manipulation from grasping to gesture production with communicative intents
- From tool use to the creation of tool-ware

ROBOT CUB
A NEW KIND OF MANIPULATION

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RobotCub
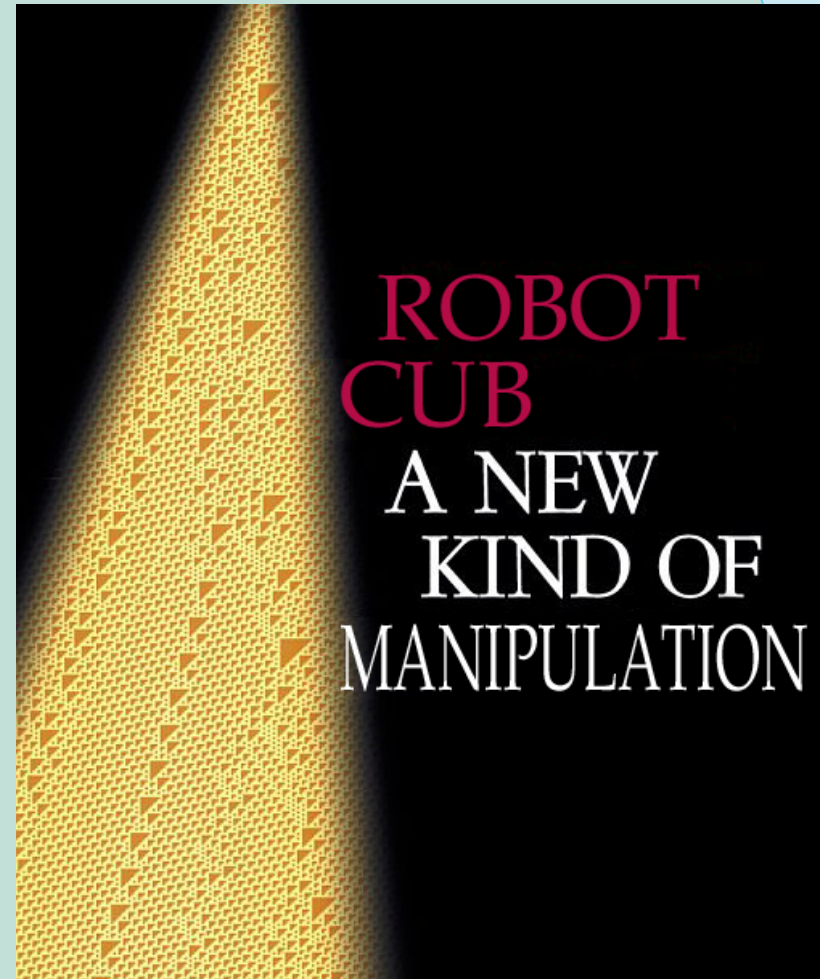
General layout (60 months)

Time	Activities
9/2004	Start of activities on specific aspects of cognition (several parallel activities), start the design of the CUB, start internationalization activities, start open source support
3/2006	First evaluation of cognitive investigation Mechanical design of iCub / Prototypes
3/2007	Launch of competitive call for proposals
9/2007	New investigation starts using the open platform
8/2009	Integration of the mindware developed during the five years

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Activity allocation

$$\frac{1}{3}$$ $$\frac{1}{3}$$ $$\frac{1}{3}$$

Building the robotic platform

Doing a lot of science

Building a community

Activities

RobotCub

ACT 1: Mind (Cognitive Neuroscience)

Learning and Development

RC 1.1
Eye-Head-Hand Coordination

RC 1.2
Bimanual Coordination

RC 1.3
Interaction and Affordance

RC 1.4
Interaction and Imitation

RC 1.5
Interaction and Communication

ACT 2: Body (Cognitive Robotics)

RC 2.1
Head-eye and Vision

RC 2.2
Arm-Hand and Touch

RC 2.3
Spine-Legs and Walk

RC 2.4
Electronics and Control

RC 2.5
Enabling Technologies

ACT 3: Open System (Dissemination)

RC 3.1
Mechanical Drawings

RC 3.2
Electronic Drawings

RC 3.3
Firmware and Software

RC 3.4
CUB Manufacture

RC 3.5
Internationalization

RC 3.6
Maintenance and Update

Community Building

Workpackage Breakdown

Work Packages	Responsible Partner	Responsible Person
WP-1 Management	UGDIST	Giulio Sandini
WP2 Cognitive Development	UNIUP	Claes von Hofsten
WP3 Sensorimotor Coordinat.	UNIFE	Luciano Fadiga
WP4 Object's Affordance	UGDIST	Giorgio Metta
WP5 Imitation Behaviors	EPFL	Aude Billard
WP6 Gesture Communication	UH	Kerstin Dautenhahn
WP7 Mechatronics	TLR	Francesco Becchi
WP8 Infrastructure of Open System (CUB)	UGDIST	David Vernon
WP9 Community Building and Assessment	UGDIST	Giulio Sandini

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Child-like, how much?

243mm

369mm

Approx 934mm

439mm

Avg. 14Kg - 30.8 lb

Goals of the Open Day

- Present the project's scientific framework and the activities carried out so far
- Get the involvement of more scientists in the practical as well as scientific issues
- Present our next events

RobotCub Training

Brain Development and Cognition in Human Infants,
 Acquafredda di Maratea, Italy, 1-6 October 2005
From Action to Cognition
Chairperson: Professor Claes von Hofsten, Sweden
Vice chair: Professor Janette Atkinson, UK

Maratea Workshop is an official training activity of
Robot-Cub **(10K€ support for student's travel)**

First Open Day

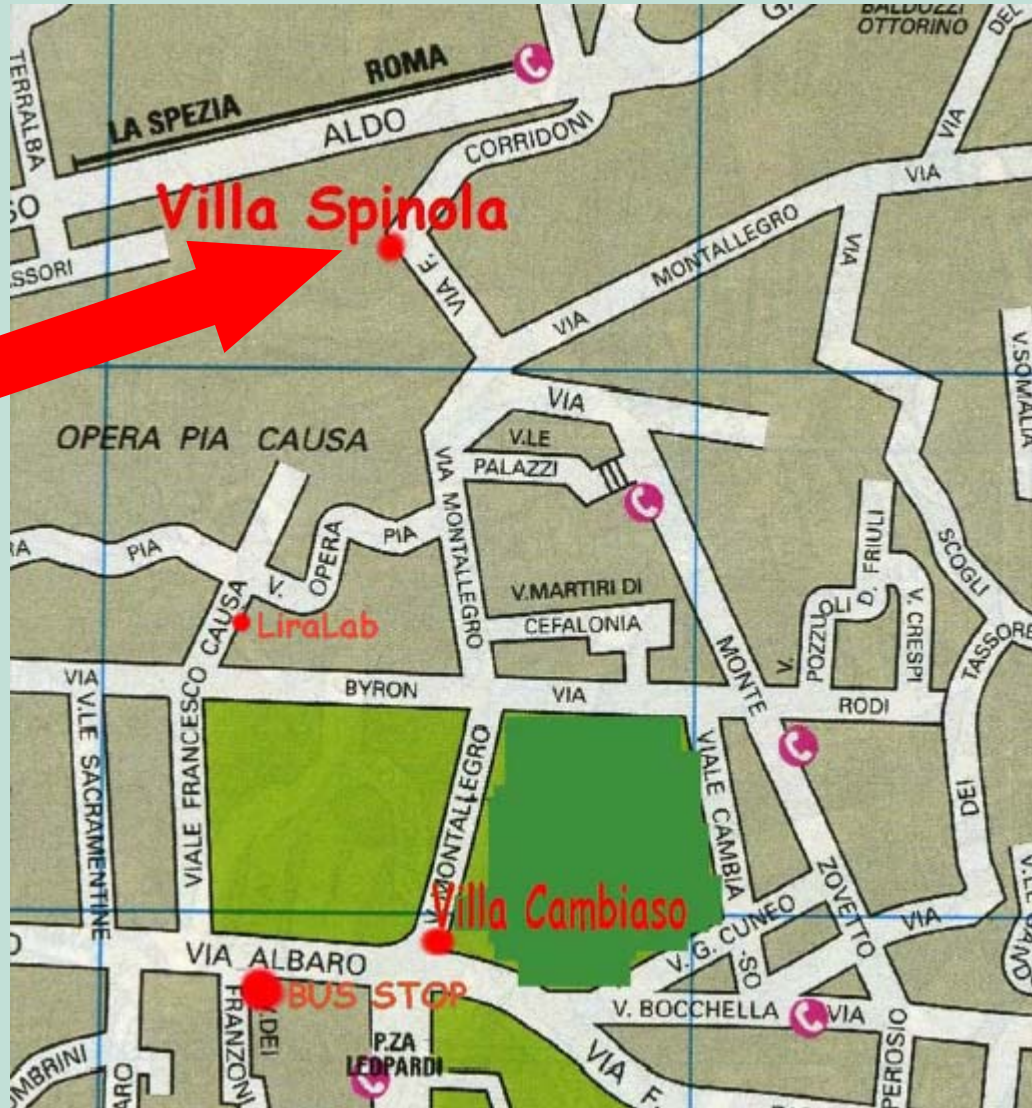## July 14, 2005

Faculty of Engineering, University of Genoa, Italy

Villa Giustiniani Cambiaso - Via Montallegro 1 - Genova

Preliminary Program

Time	Session	Session Leader	Comments
	Opening Session		
8.30	Welcome	Giulio Sandini	
	iCub Neuroscience and Cognition		
9.00	Cognitive Development Roadmap	Claes von Hofsten	Presentation of the current status of human developmental studies
9.30	Motor Representation and Motor Cognition	Luciano Fadiga	On the the importance of action in human cognition.
10.00	General Discussion		
10.30	Coffee Break		
	iCub Mechatronics		
11.00	The iCub Robot Platform	Giorgio Metta & Francesco Becchi	Summary of the current design
12.00	General Discussion		
13.00	Lunch Break		
	iCub Co-Development		
14.30	Co-development of morphology and cognitive skills	Rolf Pfeifer	Particular emphasis on (a) the co-design of the robot and the cognitive architecture and (b) the implication of co-development of physical morphology and cognitive skills.
15.00	General Discussion		
15.30	Coffee Break		
	The View from Outside		
16.00	Guest Presentation & Comments	Tom Ziemke	Integrating Cognition, Emotion and Autonomy
16.45	Guest Presentation & Comments	In So Kweon	A Hierarchical Graphical Model for Context Object Recognition
17.00	Guest Presentation & Comments	Piotr Kazmierczak and Krzysztof Luks	The humanoid robot PALADYN: construction and problems of perception
17.15	General Discussion		
18.30	End of Day 2		
20.00	Dinner	Dinner at VILLA SPINOLA (see Map)	

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Villa Spinola – Via Corridoni 5

Dinner
8 – 8.30