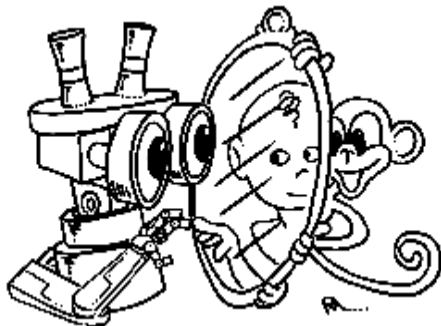


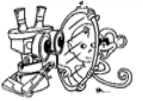
# MIRROR Project IST-2000-28159

Leuven – December 3, 2002





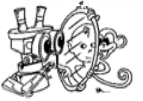
# Consortium



- LIRA-Lab, DIST, University of Genova – Italy:  
G. Sandini, G. Metta,
- Dept. of Biomedical Sciences University of Ferrara – Italy:  
Luciano Fadiga, Laila Craighero
- Instituto Superior Técnico – Lisbon, Portugal:  
José Santos-Victor, Alex Bernardino
- Dept. of Psychology – University of Uppsala – Sweden:  
Claes Von Hofsten, Kerstin Rosander

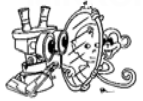


# Scientific Framework



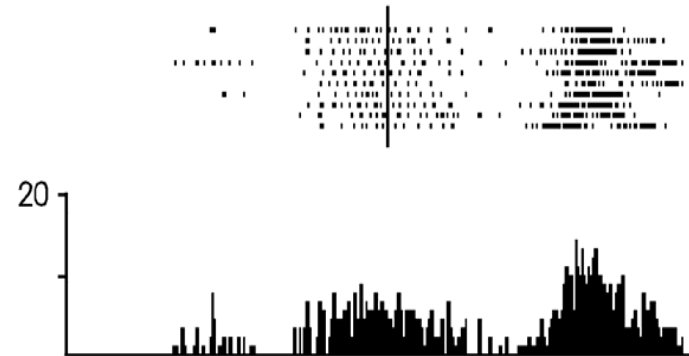
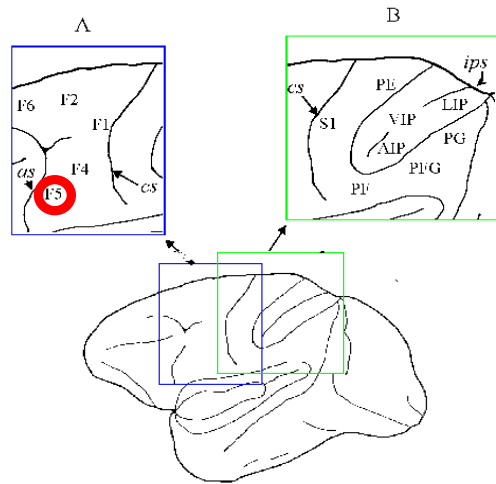
The project investigates the association between visual information and motor commands in the learning, representation and understanding of complex manipulative gestures.

Inspiration from.....



# Mirror Neurons

A

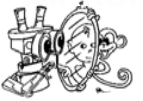


The neuron is activated by “seeing” someone else’s hand performing a manipulative action **and** while the monkey is performing the same action

**A mirror neuron is a motor neuron that “recognizes” gestures**



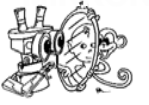
# Projects Objectives



- Realize an artificial system (artefact) able to interpret human gestures (hand grasping) by means of a *mirror system*
- Study the development of the *mirror system*

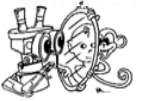


# Developmental Approach



...in order to interpret/imitate someone else's action, humans are facilitated by **being able to perform that action**

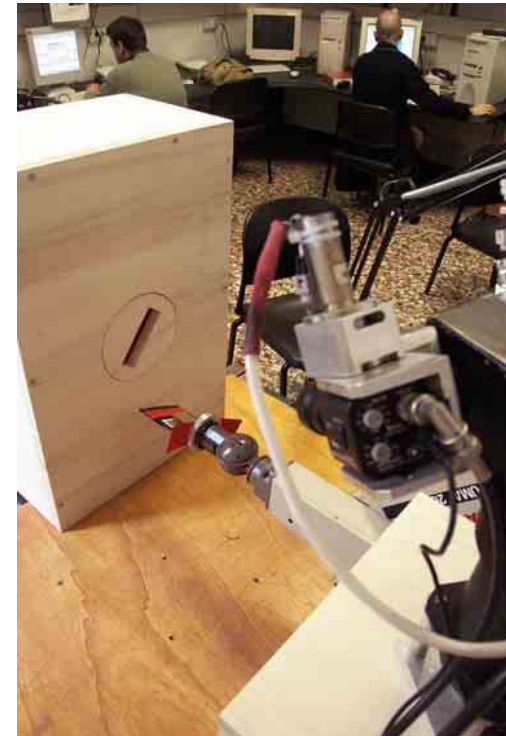
(in other words a person's ability to interpret and/or imitate motor acts is facilitated by having learned how to perform that action (or a close one) while observing, **visually and "motorically"**, his/her own body).



# First Steps of “grasping”

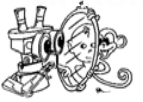


Rotating rod experiment  
(When does grasping appear?)

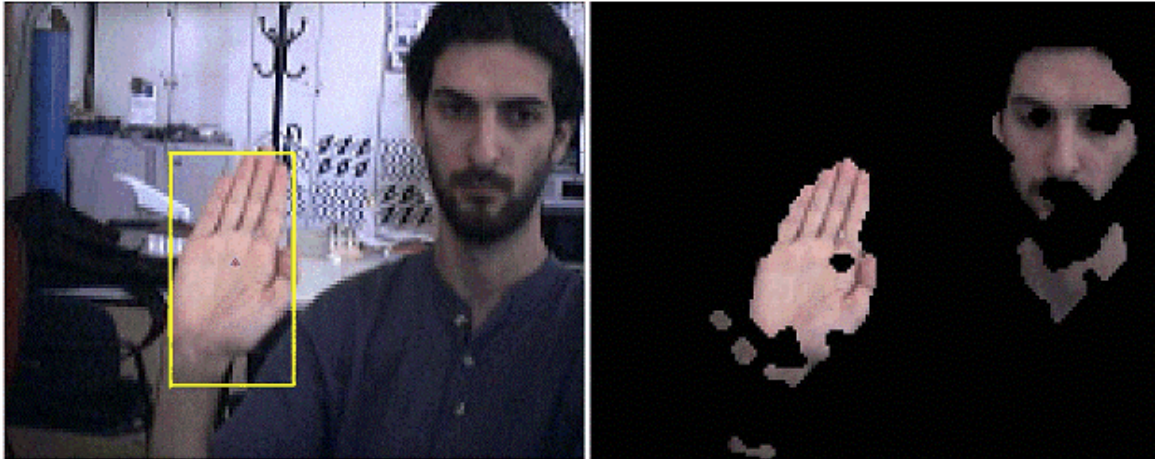


Video Clip

*Posting* task  
(integrate reach and grasp)

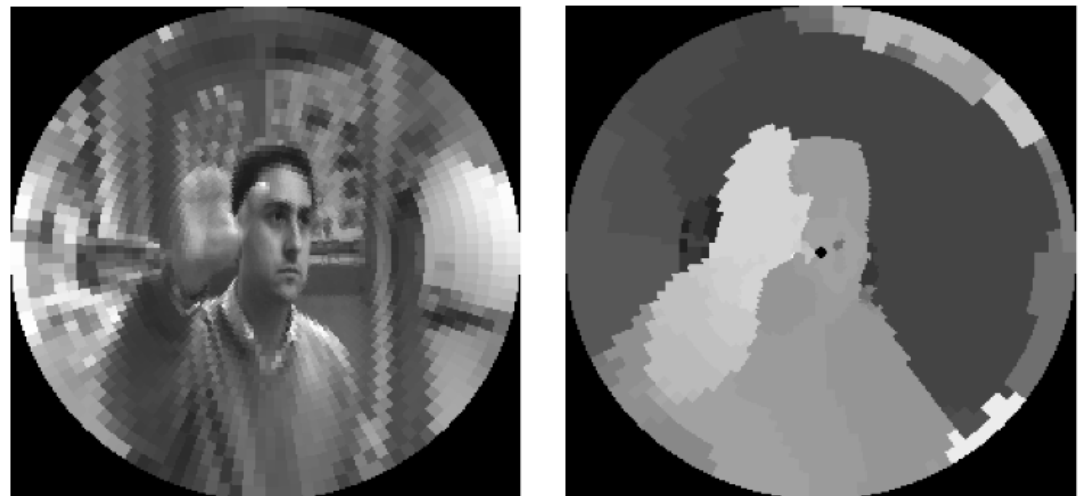


# Grasp-related visual data

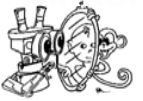


Viewpoint Transformation and segmentation

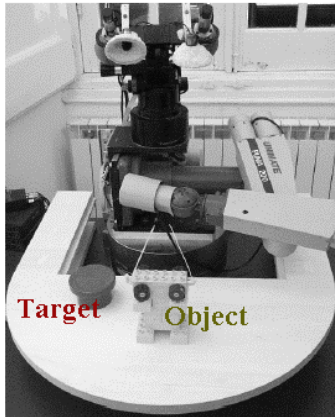
*Retina-like Stereo*



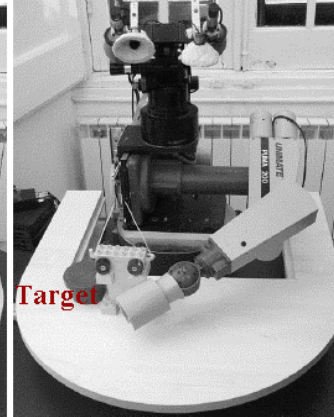
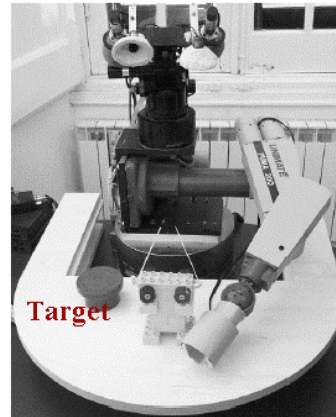




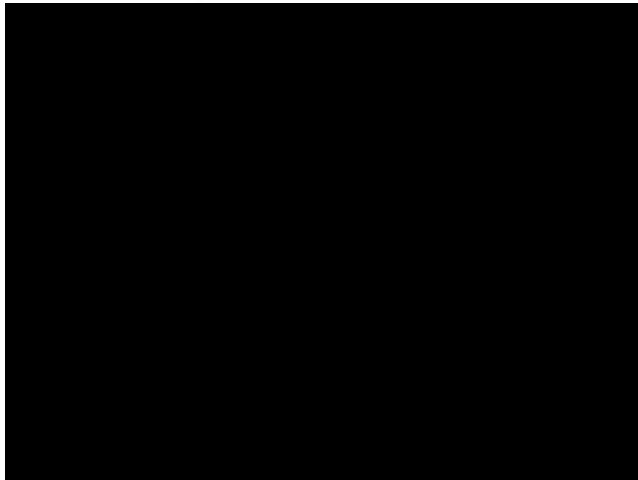
# Learn from (self) observations



Babybot



CoG





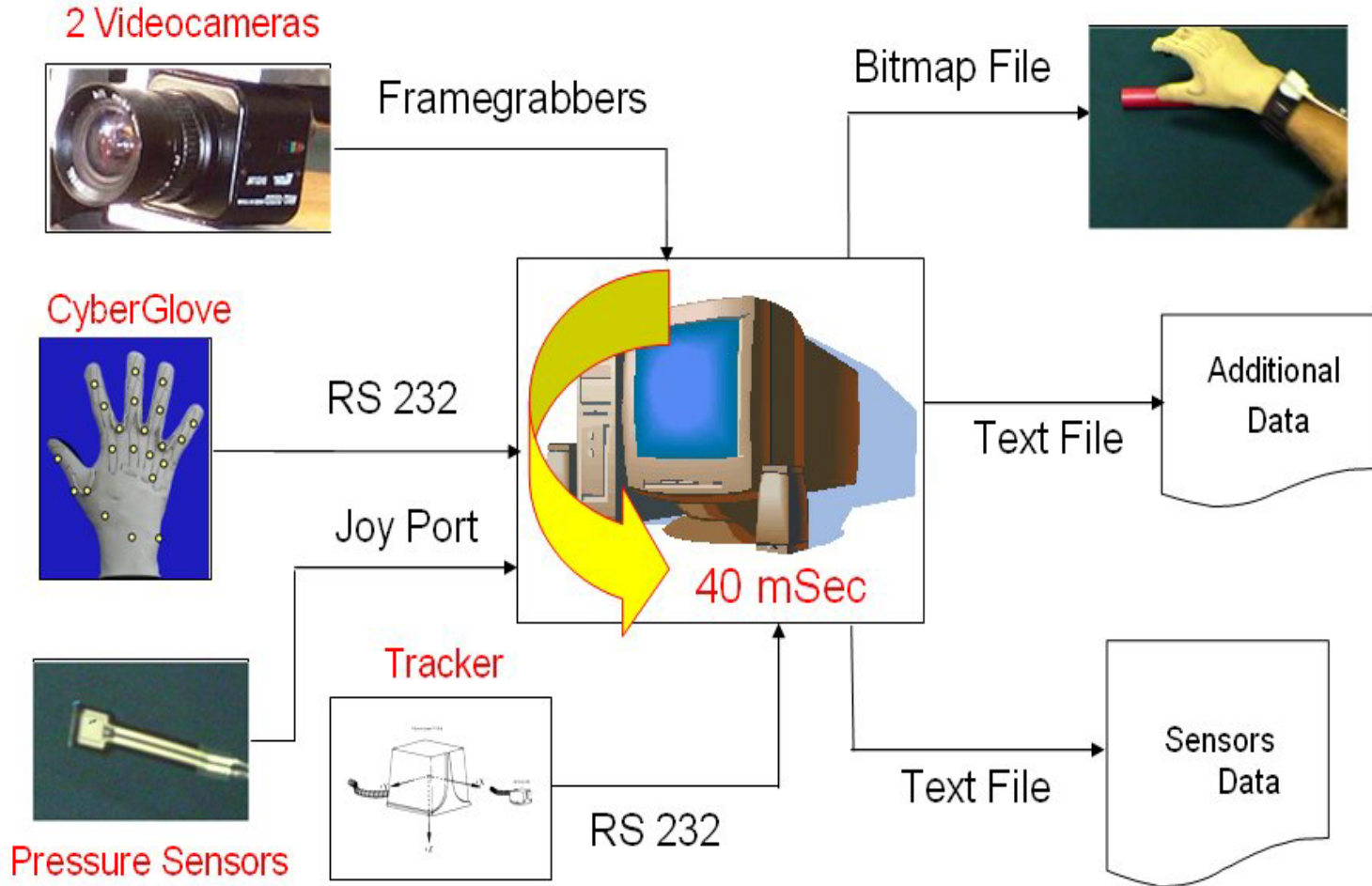
# Tools that can be shared



- Visuo-motor data acquisition setup
- Setup for experiments on primates
- Robot Hand

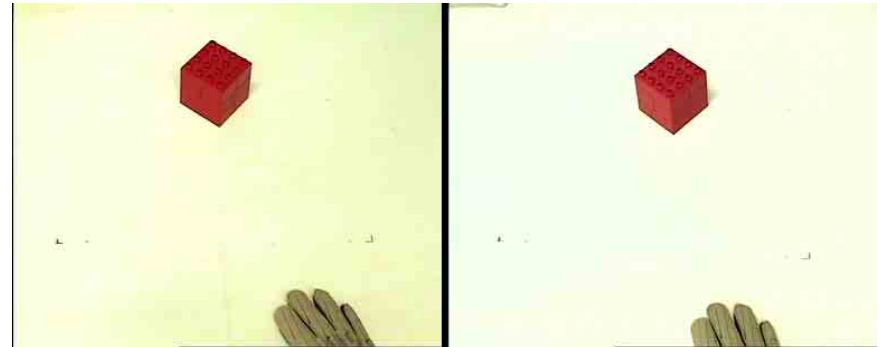


# Grasp Data Acquisition (1)



# Grasp Data Acquisition (2)

## Stereo vision



FrameNumber	HandPositionY	HandPositionZ	IndexPressure
1	23.889401	15.478011	0.373547
2	23.885006	15.482406	0.351573
3	23.889401	15.482406	0.373547
4	23.889401	15.482406	0.351573
5	23.889401	15.486801	0.351573
6	23.889401	15.482406	0.3296
7	23.885006	15.49559	0.307627
8	23.889401	15.49559	0.241707
9	23.889401	15.49559	0.175787

## Kinesthetic data

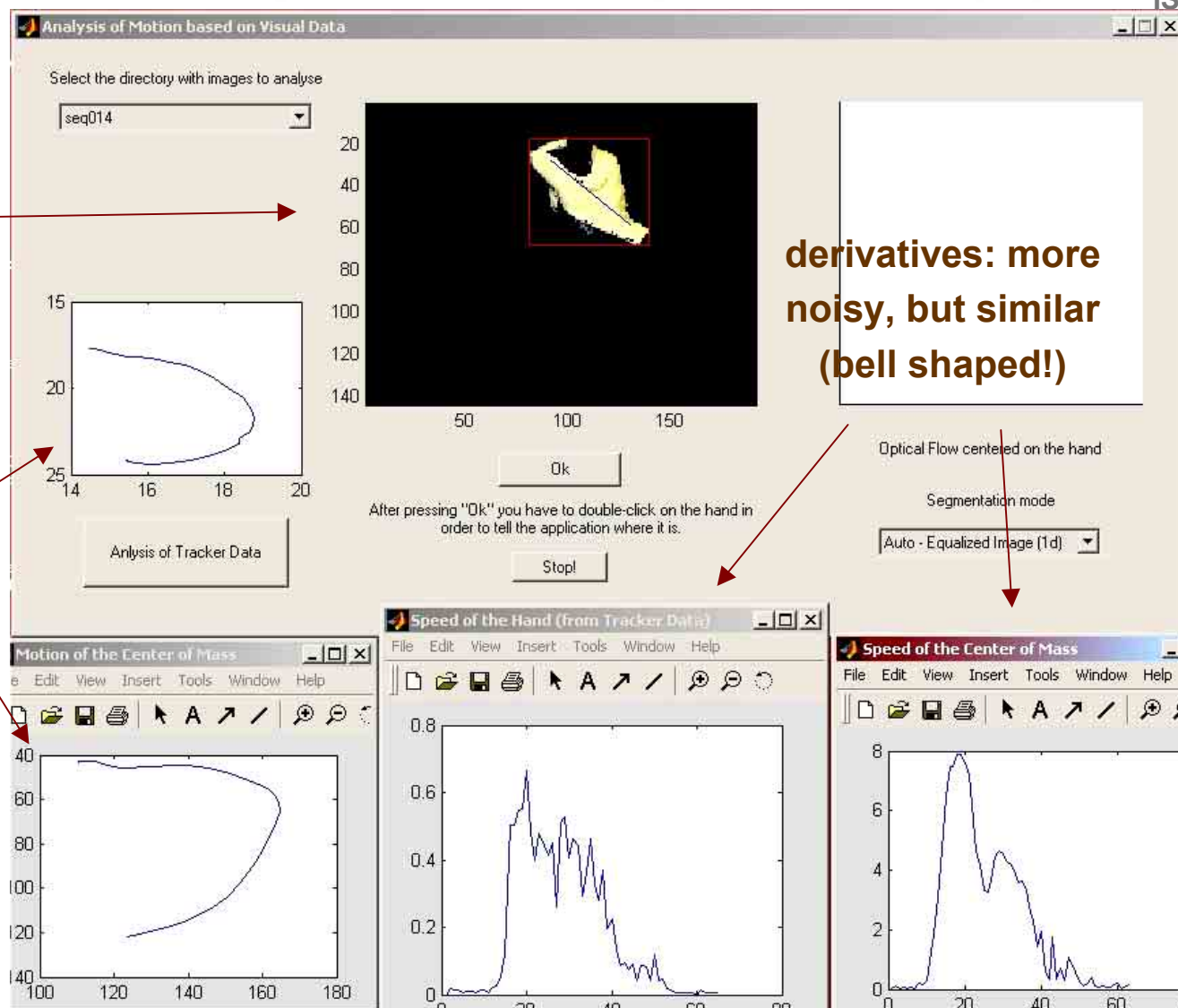


# Grasp Data Acquisition (3)

cylindrical  
Power  
grasp

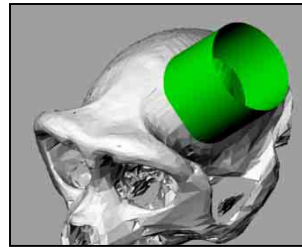
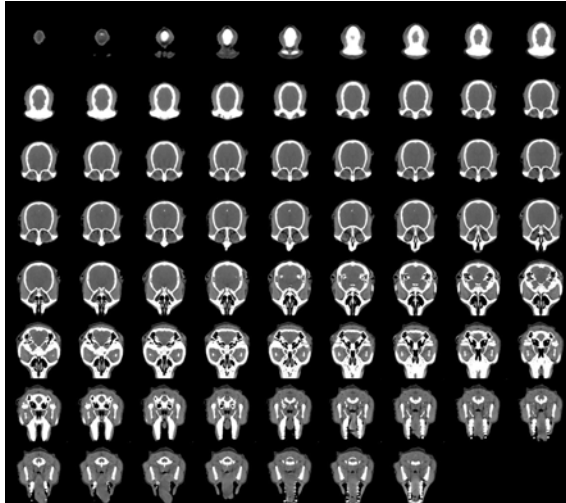
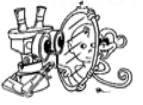
good  
matching!!

derivatives: more  
noisy, but similar  
(bell shaped!)



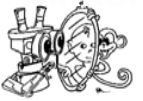


# Precise Experimental Setup



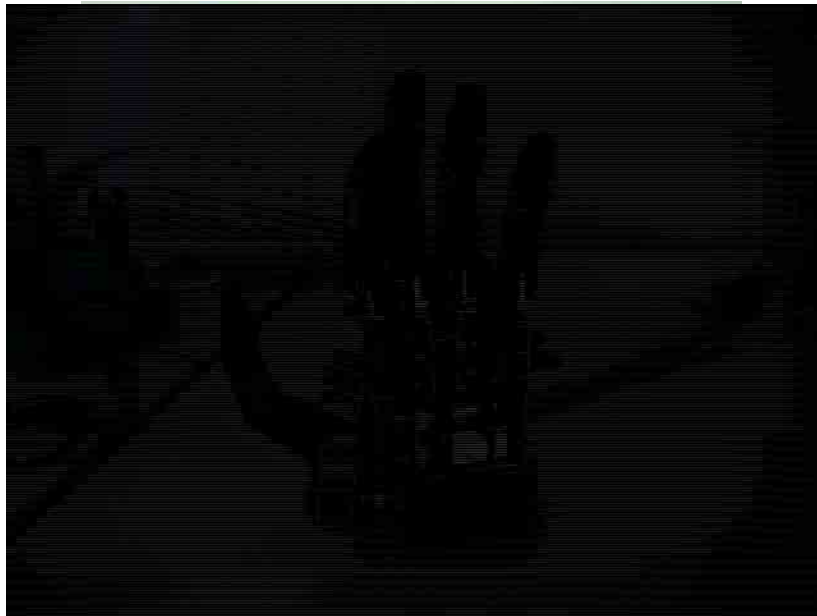
1. Precise milling and implanting of chamber for recording of single neurons.
2. Precise localization of hand through stereo vision.
3. Precise localization of stereotaxic coordinates.

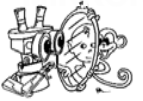




# Robot Hand

- 16 degrees joints
- 6 controlled d.o.f.
- Elastic components on all joints
- Hall sensors on all joints





[www.lira.dist.unige.it/mirror](http://www.lira.dist.unige.it/mirror)