Ponuka na diplomové práce

Igor Farkaš (+ spolupracovníci)
KAI FMFI UK
farkas@fmph.uniba.sk
8.10.2014

Project 1: Development of biologically plausible representation of proprioceptive inputs for the iCub humanoid robot **(proprio map)**

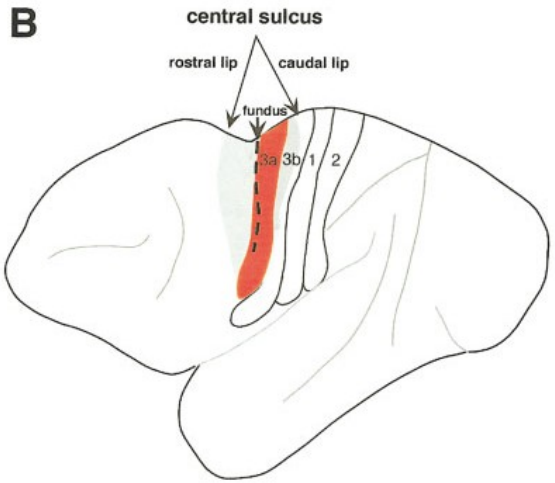
Supervisors:
prof. Igor Farkaš
Centre for Cognitive Sci. / Dept. of Applied Informatics; FMFI UK

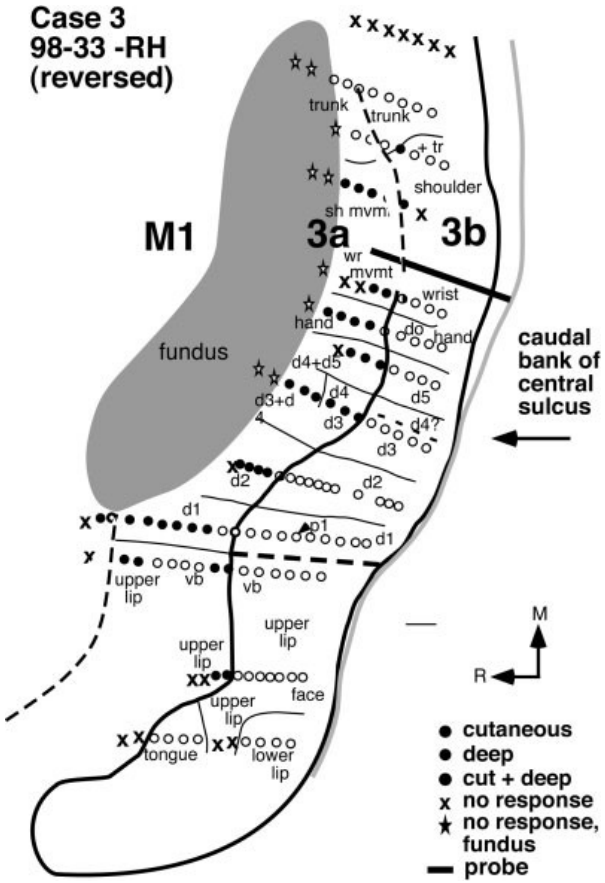
Mgr. Matěj Hoffmann, PhD
iCub Facility, Italian Institute of Technology, Genoa, Italy
https://sites.google.com/site/matejhof/home

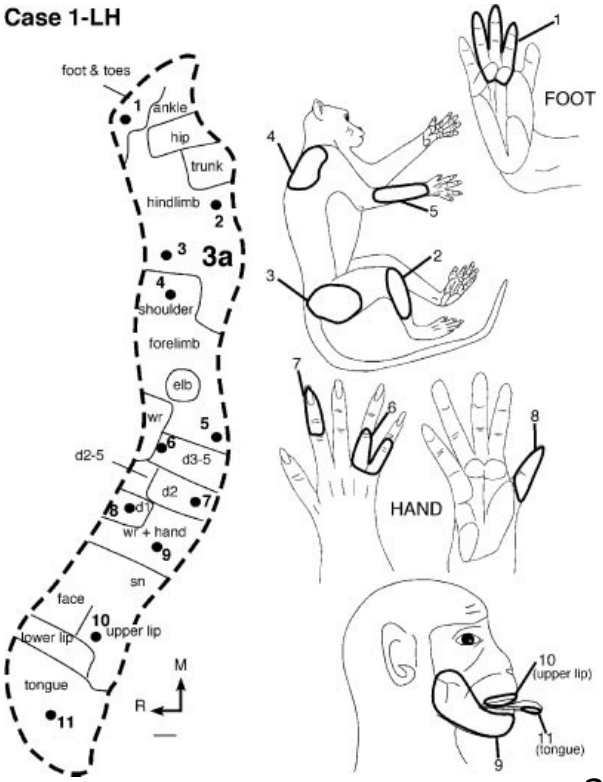
Ideal candidate: Computer scientist with an interest in computational neuroscience. Programming skills in C++ (iCub robot) will be an advantage.

Proprioceptive inputs in the macaque brain

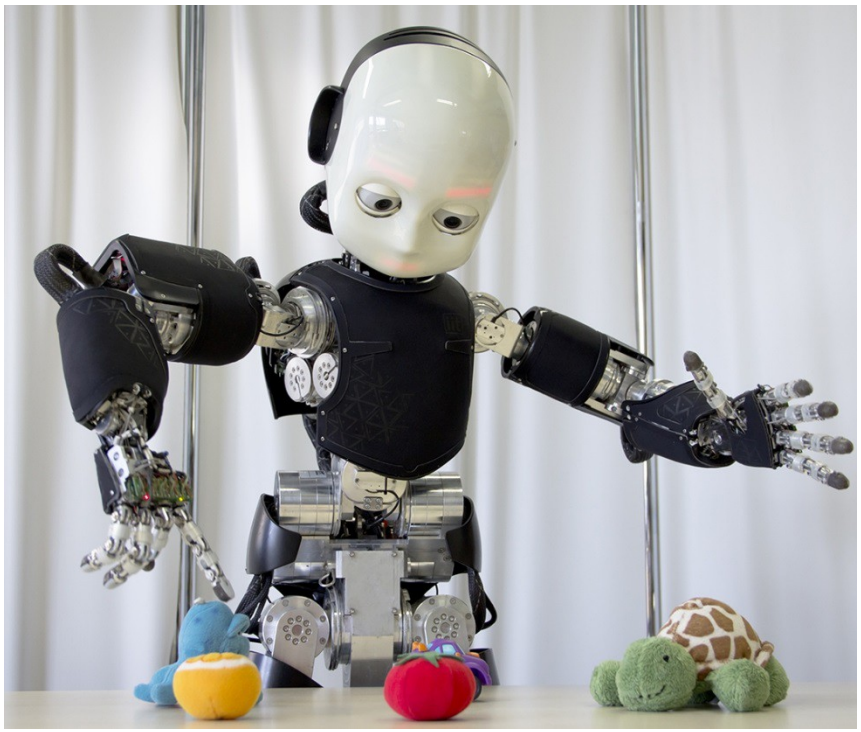
Macaca mulatta, from Krubitzer et al. (2004)

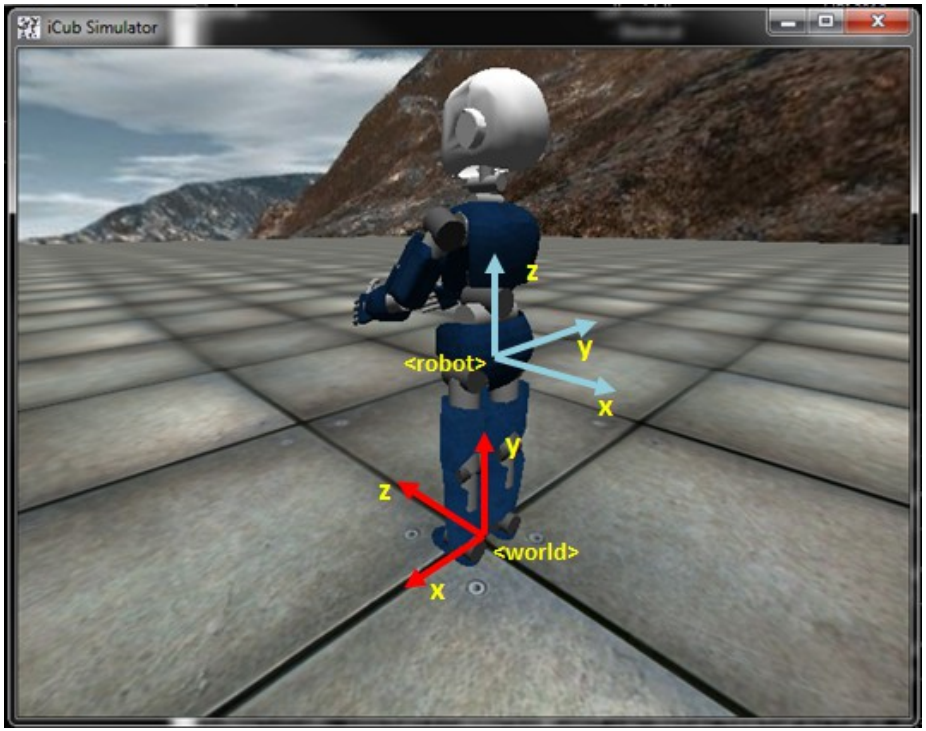


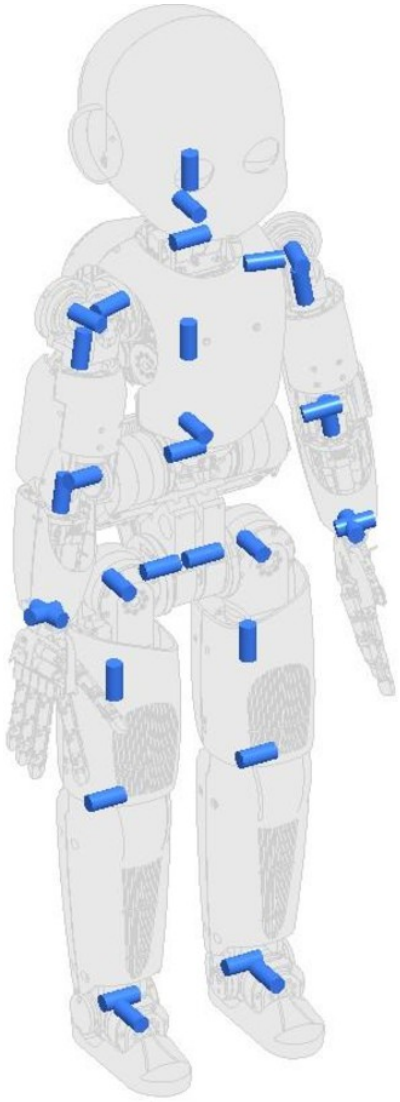




The iCub robot and iCub simulator







Size of a 4 year old child

Motor / proprioception (joint angles) 53 DOF

Tactile information

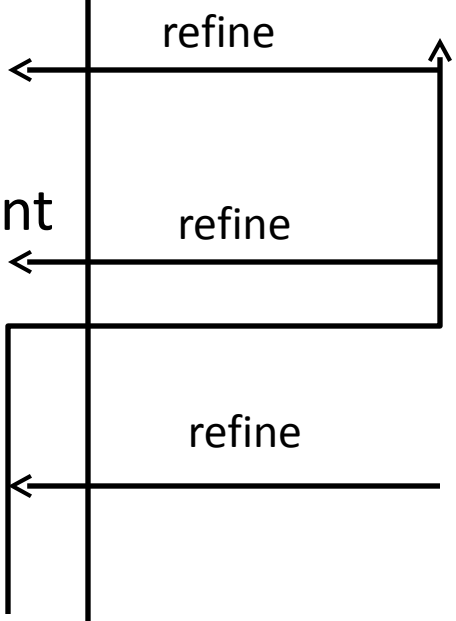
cca 4000 tactile elements (taxels) on the whole body

Vision

2 standard cameras and biomimetic DOF setup (pan, tilt, vergence)

Project outline

1. Data collection phase
   a) Develop a “body babbling” strategy to move the robot
   b) Collect proprioceptive (to start with: joint angle) information
2. Learning the representation
   a) Feed data into Self-Organizing Map (SOM) and train
3. Compare with data from primate brain



Scientific questions asked

- Is it possible to develop a representation of proprioceptive information similar to the one in the cortex just by randomly moving a robot and collecting encoder information?
  - What are the necessary conditions/constraints on
    - The “body babbling” strategy
    - Information recorded –> other than joint angle info needed?
    - Initial conditions – innate structure
- What information do the BA3a neurons code?

Project 2: Skin emulation in the iCub humanoid robot simulator and autonomous body exploration **(Skin)**

Supervisors:

prof. Ing. Igor Farkaš, Dr.

Centre for Cognitive Sci. / Dept. of Applied Informatics; FMFI UK

Mgr. Matěj Hoffmann, PhD

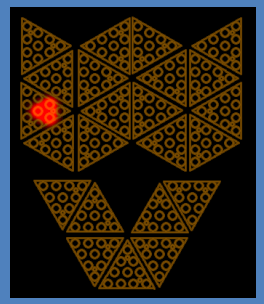
iCub Facility, Italian Institute of Technology, Genoa, Italy

https://sites.google.com/site/matejhof/home

Ideal candidate: Computer scientist. Good C++ skills will be required.

External touch vs. double touch

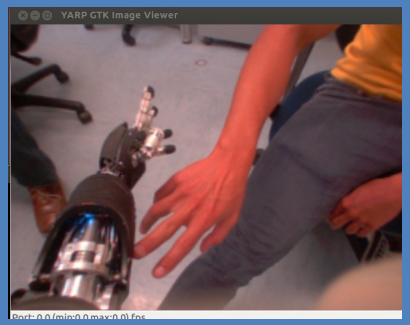
Inputs



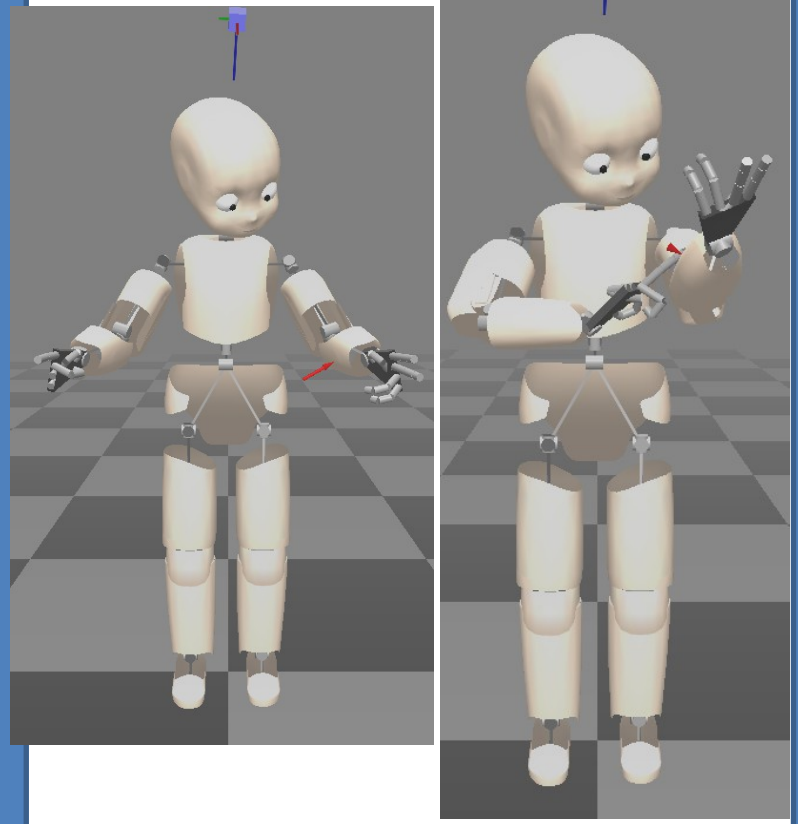
Tactile - Skin

$\theta 1 = (\theta 1, \ldots, \theta n)$

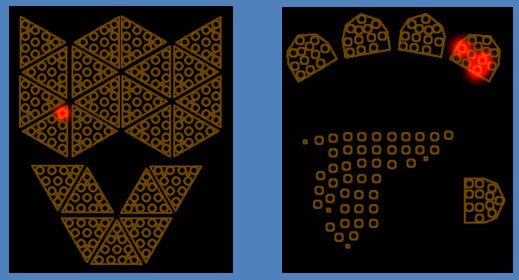
Proprioception
– joint angles



Vision - cameras



Inputs



Tactile - Skin

$\theta 2 = (\theta 1, \ldots, \theta n)$

Proprioception
– joint angles

Vision - cameras

Long-term body exploration

- Infants spend thousands of hours exploring their bodies and the corresponding “intermodal redundancies”.
- This is not realistic in the real iCub robot -> double-touch is dangerous for the robot.
- Therefore, a reliable simulator is necessary.

Project outline

1. Testing and improving newly developed skin emulation interface in the iCub simulator.
2. Developing a body self-exploration strategy that generates double-touch configurations (-> body schema)
3. Record tactile and proprioceptive data (possibly also visual)

Refine 1 and 2 to improve the yield in 3.

Project 3: Calculation of object position in various reference frames with a robotic simulator **(frames)**

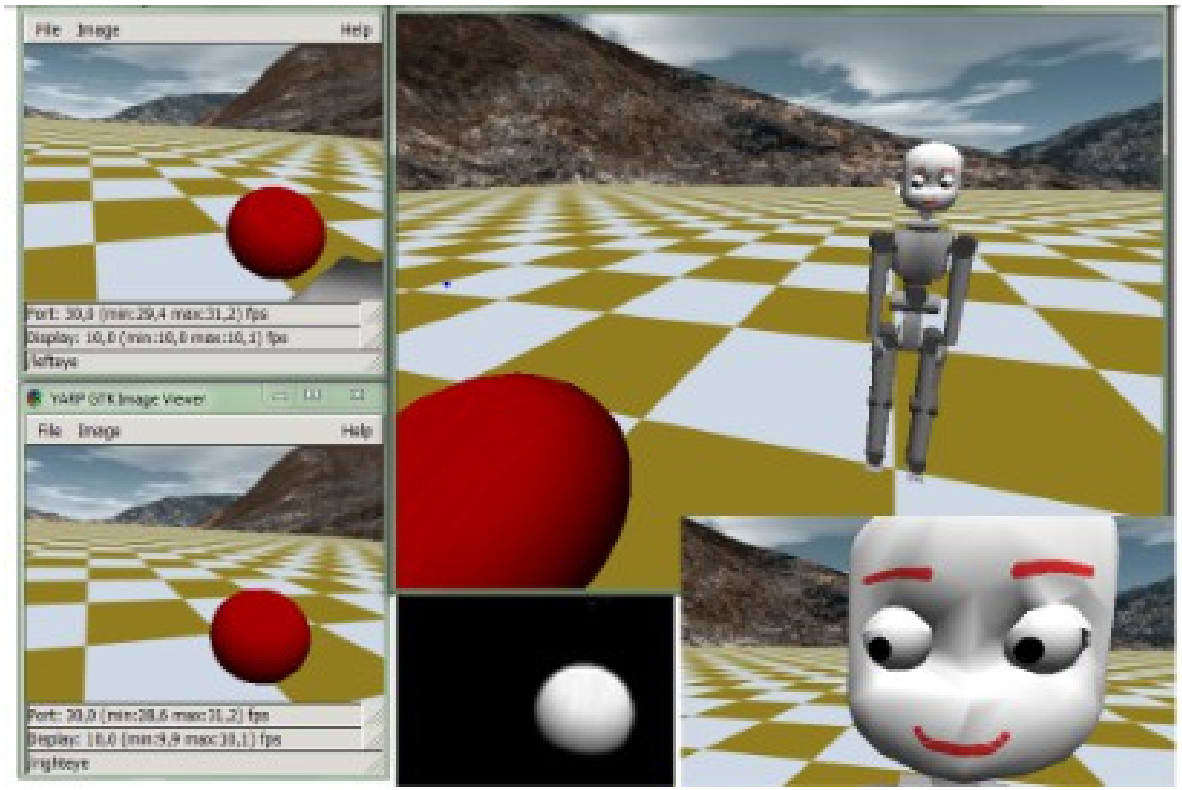
Supervisor: prof. Igor Farkaš

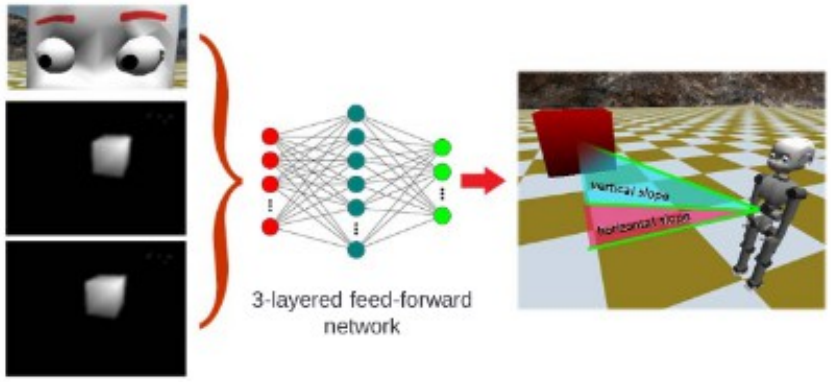
Centre for Cognitive Sci. / Dept. of Applied Informatics; FMFI UK

Thesis: (1) Data collection from simulated iCub, (2) Using a neural network toolbox, train a model performing coordinates transformation, (3) Analyze the model.

(continuation of master thesis by Švec, 2014)

Knowledge of Matlab is an advantage.


File Image Help
Port: 30,0 (min:29,4 max:31,2) fps
Display: 10,0 (min:10,0 max:10,1) fps
lefteye
YARP GTK Image Viewer
File Image Help
Port: 30,0 (min:28,6 max:31,2) fps
Display: 10,0 (min:9,9 max:10,1) fps
righteye


3-layered feed-forward
network

Project 4: Effects of sleep disturbances on day-time neurocognitive performance in patients with stroke **(SleepCog)**

Supervisor: Mgr. Ing. Roman Rosipal, PhD.

Institute of Measurement Science, Slovak Academy of Sciences

http://aiolos.um.savba.sk/~roman

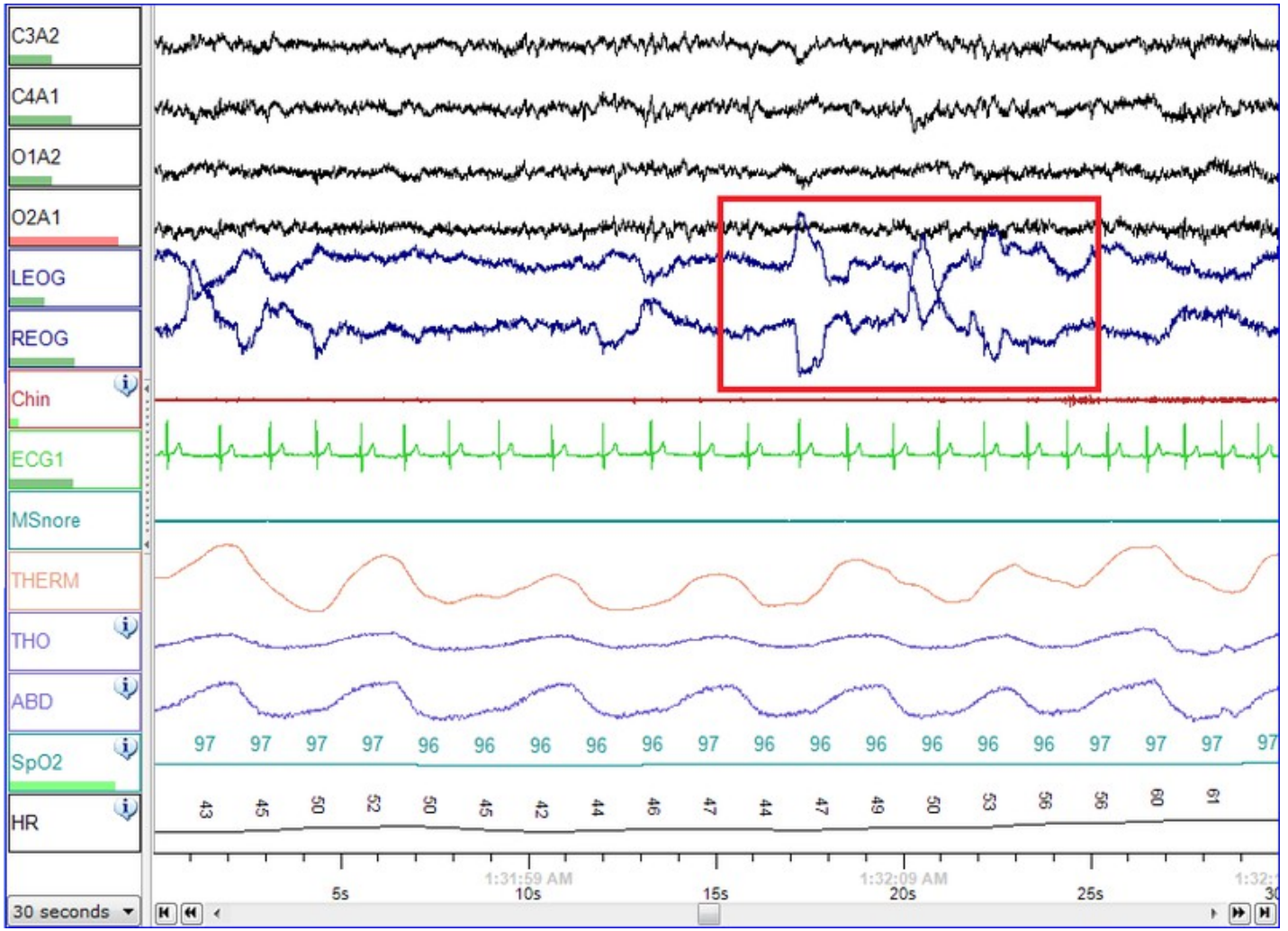
Ideal candidate: Able to work systematic ally, programming in Matlab is an advantage.

Project objectives

- Investigation and evaluation of a novel probabilistic sleep model (contains more information about sleep quality)
- Relating the sleep patterns and disturbances with a day-time cognitive performance

The thesis will focus on data analysis and evaluation (programming required). Details to be specified.

Sleep EEG data



Project 5: Brain-computer interface with robot-assisted training for rehabilitation (BCI-RAS)

Supervisor: Mgr. Ing. Roman Rosipal, PhD.

Institute of Measurement Science, Slovak Academy of Sciences

http://aiolos.um.savba.sk/~roman

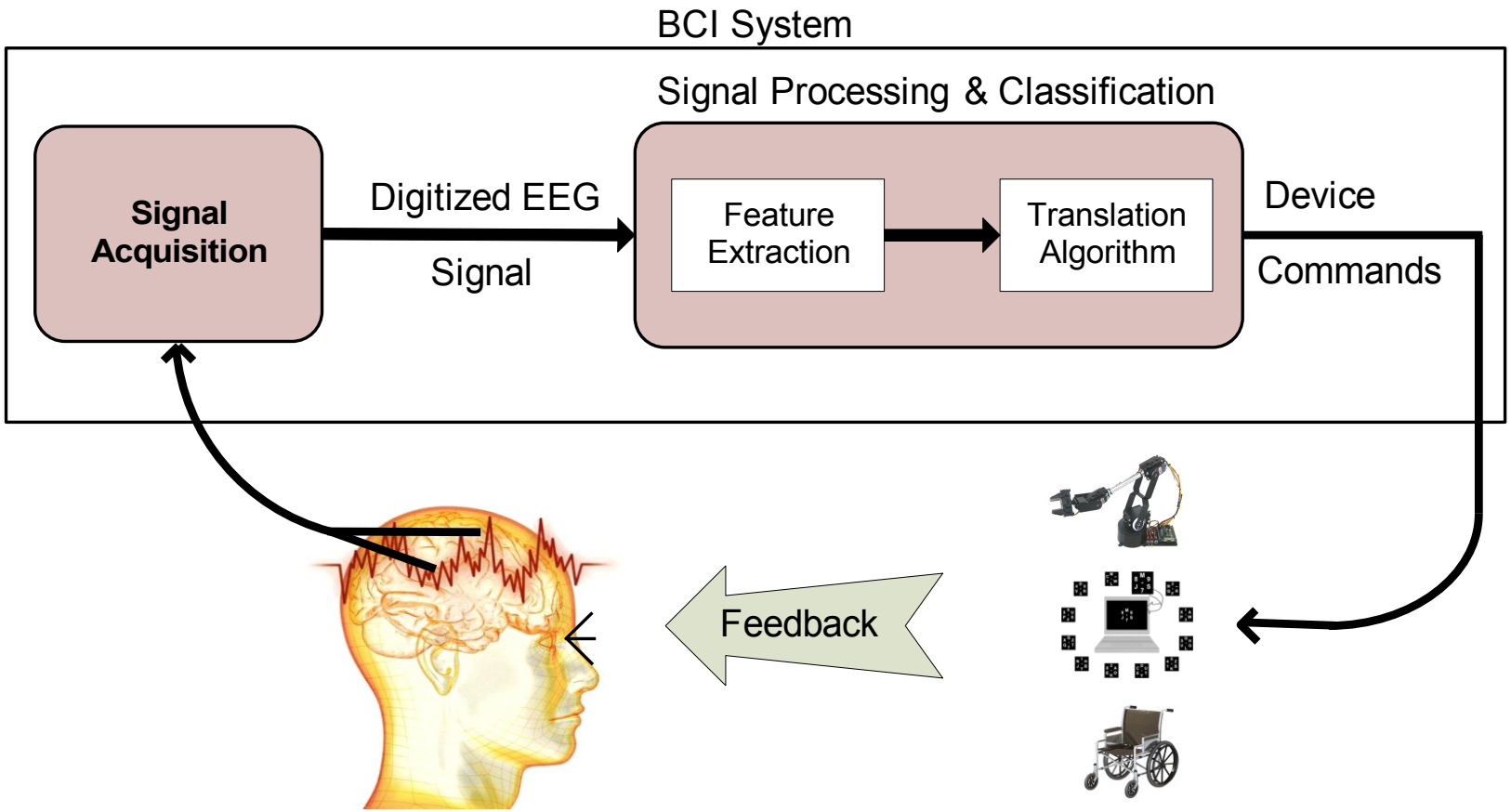
Ideal candidate: Ability to work systematic ally, programming in Matlab and C/C++ is an advantage.

Project objectives

- Construct the BCI-based robot-assisted system (BCI-RAS) for rehabilitation and restoration of hand control following stroke.
- Carry out a series of experiments with the BCI-RAS on healthy subjects and stroke patients and the adaptation of the system according to the obtained results.
- Critically evaluate results obtained during the BCI-RAS training experiments and validate the design of the system.

Thesis: will involve programming (language not yet specified, maybe C/C++ or Matlab)

BCI system


BCI System
Signal Processing & Classification
Signal Acquisition
Digitized EEG
Signal
Feature Extraction
Translation Algorithm
Device
Commands
Feedback