

Praktikum: „Virtual Neurorobotic in the Human Brain Project“

WS 2018

Vorbesprechung

2018.11.30

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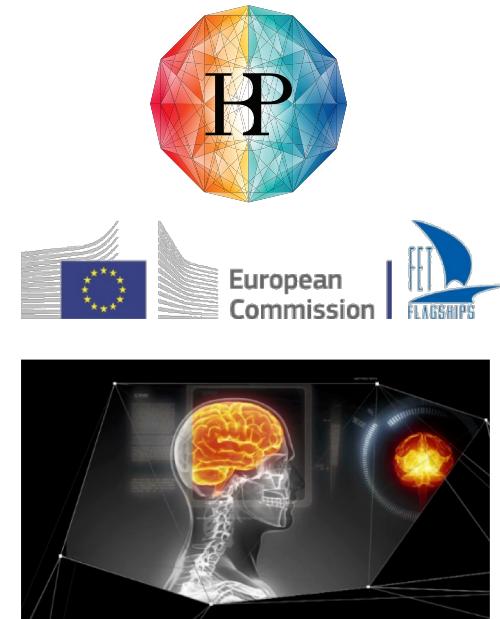
Daniel Reichard

NEUROROBOTICS AND THE HUMAN BRAIN PROJECT

The Human Brain Project



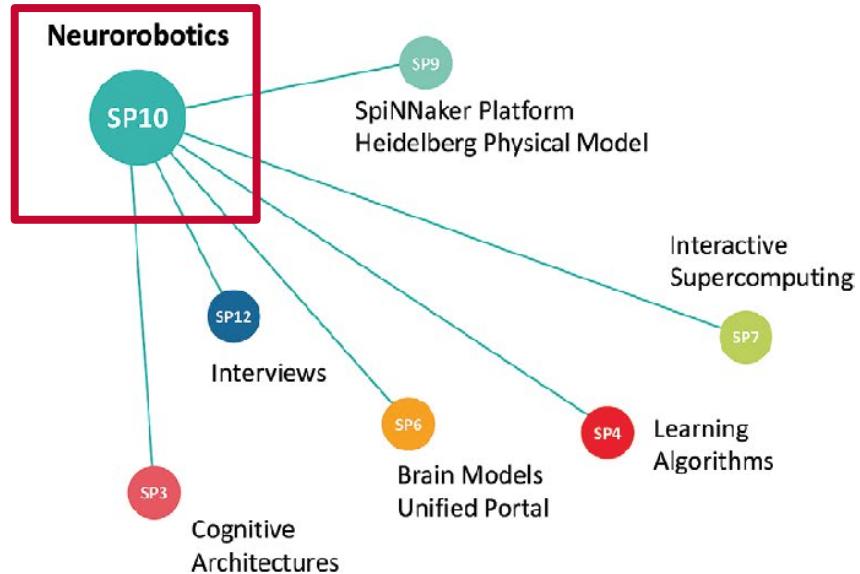
- Overview
 - Future and Emerging Technologies (FET) flagship programme, start in 2013
 - 112 Partner institutions from 24 nations
- Idea:
 - Neuro-scientific data and interdisciplinary methods
 - Neuro-sciences and Medicine
 - Information technologies and Engineering
- General Goals
 - Fundamental understanding of the human brain
 - New therapies for brain diseases
 - Development of innovative, biologically inspired computing technologies



Human Brain – Subproject Structure

Main Collaborating Subprojects

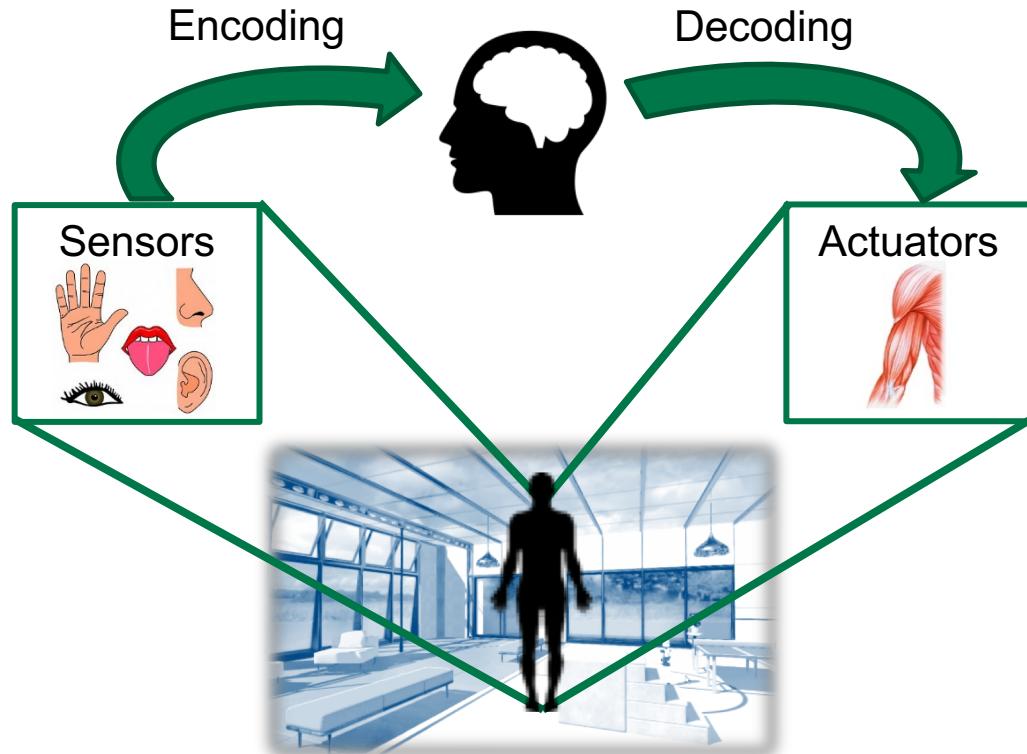
- SP3 Systems and Cognitive Neuroscience
- SP4 Theoretical Neuroscience
- SP6 Brain Simulation Platform
- SP7 High Performance Analytics and Computing Platform
- SP9 Neuromorphic Computing Platform
- SP12 Ethics and Society



Neurorobotics : A strategic pillar of the Human Brain Project, 2016

Closed-Loop Neurorobotics

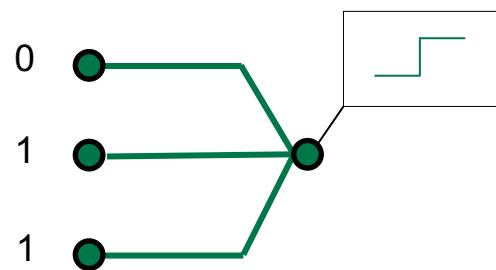
- brain (neural network)
- embodiment
 - sensors
 - actuators
- environment interaction



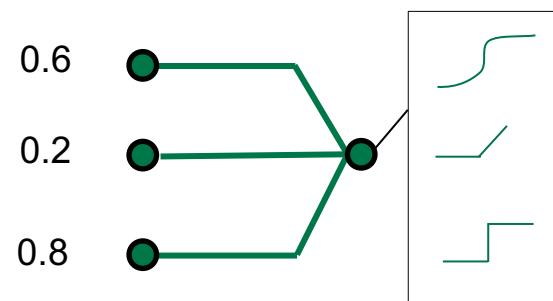
Artificial Neural Networks



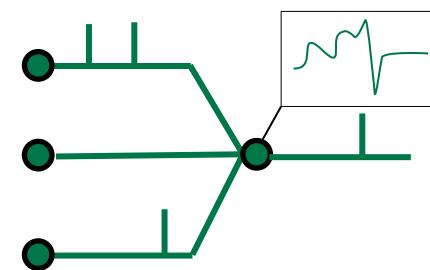
Binary
Generation 1



Analog
Generation 2



Spiking
Generation 3



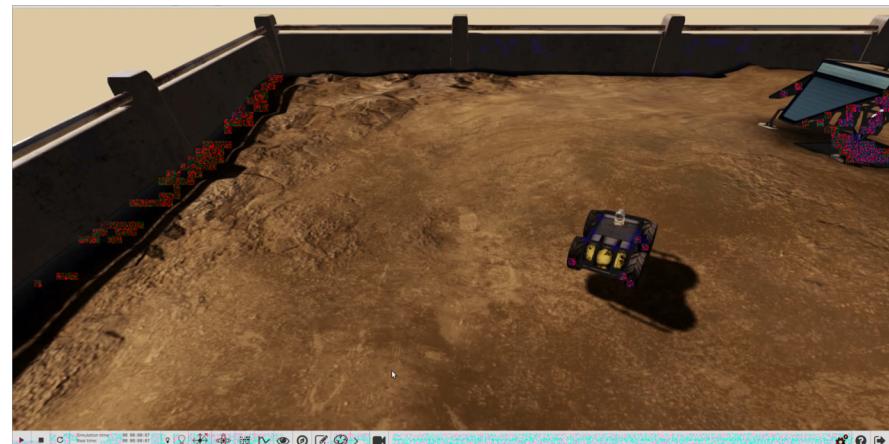
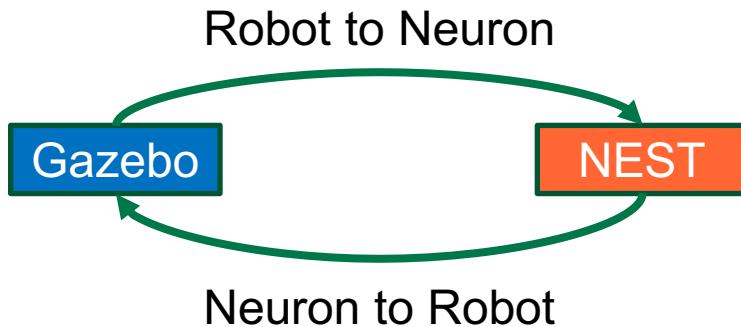
- Neurons & synapses are modeled as dynamical systems

„Network of spiking neurons: the third generation of neural network models“, Maass W, *Neural Networks*, 1997

THE NEUROROBOTICS PLATFORM

The Neurorobotics Platform

- Robot simulator with spiking network simulator
- Interactive mode to develop experiments
- Non-interactive mode for optimizations (virtual coach)



How can I install it?



Local install

- Download sources/compile
- **Benefit:**
 - Works from anywhere
 - All running on your computer

FZI install

- NRP pre-installed on lxd container
 - Connect with ssh
 - <http://ids-neurorobotics.fzi.de>
-
- **Benefit:**
 - Easier to get started
 - Simulations running on remote

Important User Knowledge

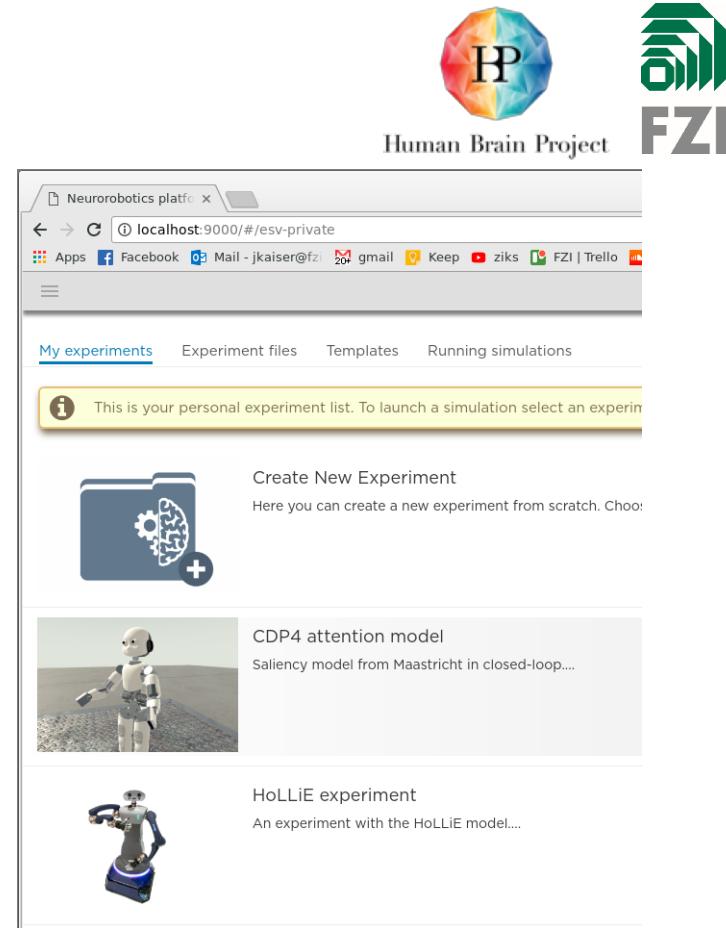
- The NRP is a web platform
- Internally, the NRP communicates with ROS (<http://www.ros.org/>)
- Important user folders:
 - **Models/**: contain the **robot models** (sdf/urdf), **environments** and **brain scripts** (PyNN)
 - **GazeboRosPackages/**: ROS-nodes, plugins for Gazebo - sensor simulations, controllers
 - **Experiments/**: Each sub-folder is an **experiment**. It contains **transfer functions** and **state machines**
 - **~/.opt/nrpStorage/**: Local cloned experiment files
 - **-> This are the files modified when editing from the web interface**

Using the NRP - Workflow

1. Start the NRP with two commands in your terminal

```
cle-nginx  
cle-start  
# cle-kill to kill the nrp
```

2. Connect to the web interface at <http://ip:9000/#/esv-private>
the ip address is either "localhost " or your lxd container



Experiments for the Praktikum



1. Tutorial Baseball

- Practice with the NRP
- Follow the ipython notebook in *Experiments/tutorial_baseball_exercise*
- Only 2 weeks to solve it

2. Praktikum Challenge

- Solve the challenge at https://github.com/HBPNeurorobotics/hbprak_2018_throwing
- Fork the github repo
- Symbolic link to `~/opt/nrpStorage`

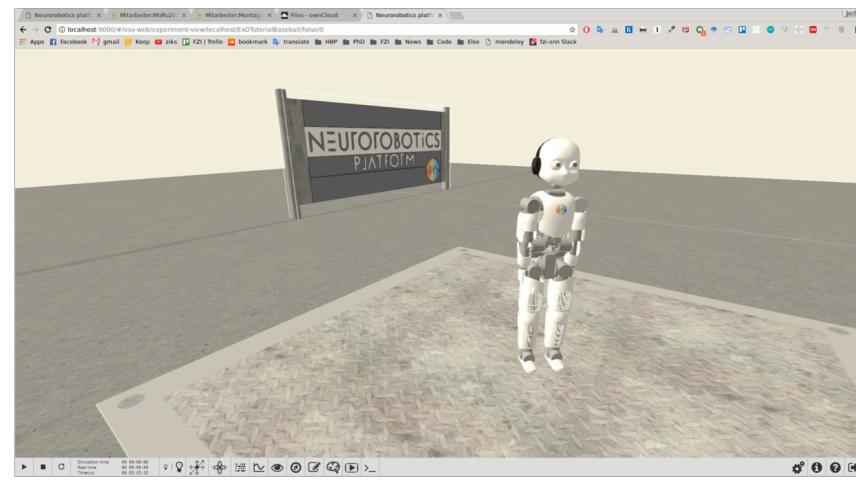
2 Weeks

Learning how to use the NRP: tutorial experiment

Reality



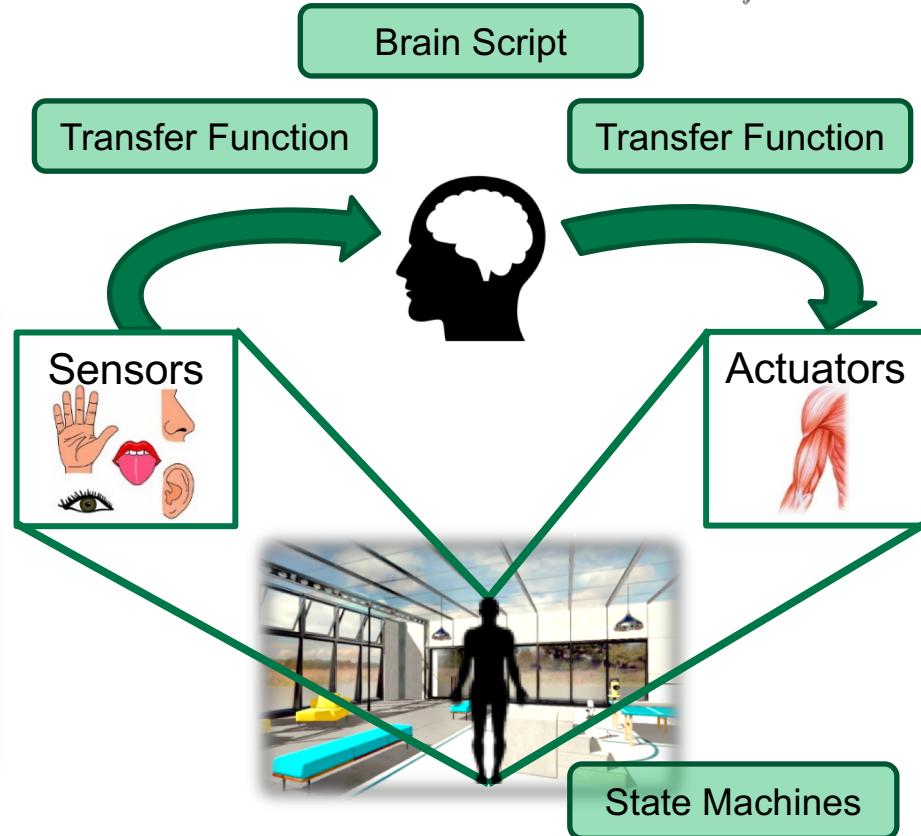
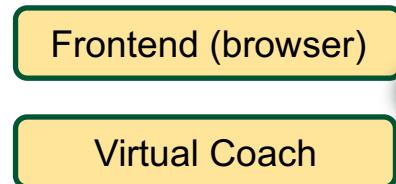
NRP Simulation



Getting started with the tutorial



- Open the notebook in *tutorial_baseball_exercise/*
- By following the notebook, we will learn how to use the following components:



Important links

- Ask questions on the Neurorobotics forum:
<https://forum.humanbrainproject.eu/c/neurorobotics>
- Contribute to the NRP with pull requests:
<https://bitbucket.org/hbpneurorobotics/neurorobotics-platform>
- Some of our research on Github (like DVS plugin or LSM):
<https://github.com/HBPNeurorobotics>

Materials

- Deep reinforcement learning lecture
https://www.youtube.com/playlist?list=PLkFD6_40KJznC9CDbVTjAF2oyt8_VAe3
- Learning with spiking networks:
 1. Friedemann Zenke: SuperSpike
 2. Emre Neftci: Event-Driven Random Backpropagation
 3. Wolfgang Maass: Long short-term memory and learning-to-learn
 4. OpenAI: Evolution Strategies
- Brain simulators: PyNN/NEST (hardcore for learning), Nengo, pytorch or other generic framework

PRAKTIKUM ORGANIZATION

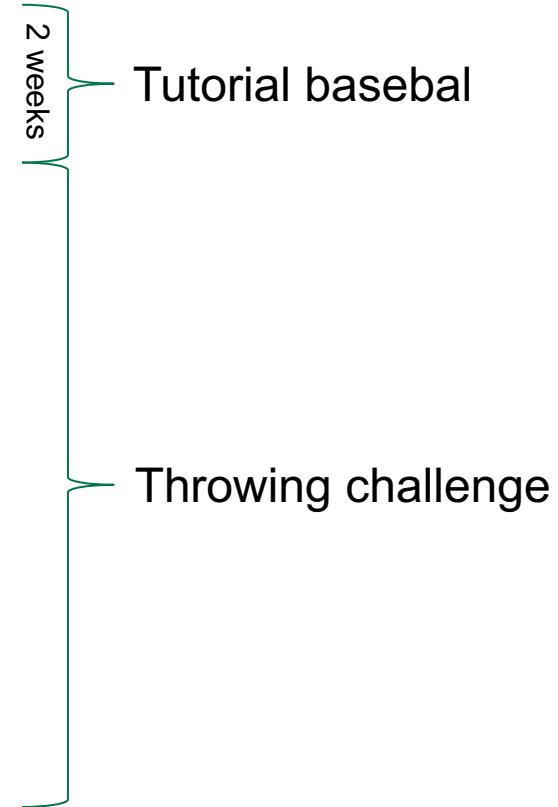
General information

- Praktikum: „Virtuelle Neurorobotik im Human Brain Project“
- 2 SWS
- 3 LP/ECT's

- Groups of 3 students

Timeline and Meetings

- Introduction meeting
(October 31) – 13:30 to 15:30 - Room Sydney
 - Group setup
- Organization meeting
(November 14) – 14:00 to 15:30 - Room Sydney
 - Tutorial baseball corrections
 - Questions on the hbpprak2018 challenge
- Mid-term progress meeting
(December 12) – 14:00 to 15:30 - Room Sydney
 - 5 min teaser per group
- Block presentation of results
(February 13) – 16:00 to 17:30 – Room Sydney
 - Presentation of all works
 - 10 min presentation + 5 min discussion per group
- Submission report 4 pages
(February 27)



Communication

- Slack
 - Group channels for collaboration
- NRP Forum
 - <https://forum.humanbrainproject.eu/c/neurorobotics>
- Consultation hour
 - Wednesday afternoon
 - **Please make an appointment (slack, email, ...)**

Advisors

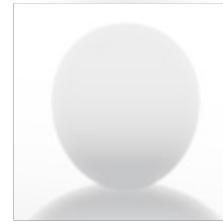
- J. Camilo Vasquez Tieck (tieck@fzi.de)



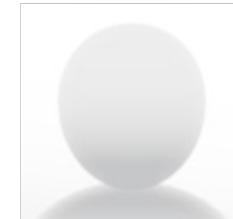
- Jacques Kaiser (jkaiser@fzi.de)



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- Martin Schulze (schulze@fzi.de)



- Daniel Reichard (daniel.reichard@fzi.de)



Thank you from SP10



www.humanbrainproject.eu



[/TheHumanBrainProject](https://www.youtube.com/TheHumanBrainProject)



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Sub-Project Leaders



Work Package Leaders



Team

