HBP SCIENCE MARKET

NEUROROBOTICS PLATFORM

SP10

What we do

The human brain is one of the most astonishing, complex and tremendously powerful creations of nature. But what makes is so efficient, so flexible, so intelligent? We know it's not just the sophisticated "design", but also the ability to constantly learn. The brain makes the body perform an action, then the body perceives the results of this action, and finally the brain interprets the results and changes its behaviour accordingly, to make the next action more effective.

In our SP we create an opportunity to give any simulated brain model its own robotic "body" — virtual or real —, thus making it capable of performing appropriate actions, gathering perceptions and learning. Our team has developed tools to create very detailed simulated environments — "virtual realities" — in which to test brain models and robots. These tools are collected in our Neurorobotics Platform, which is online and publically available to all researchers who wish to test their brain models or build brain-inspired robots. The Neurorobotics Platform is constantly evolving, thanks to inputs from researchers all over the world. Our team is collaborating with them to help implement their experiments using the Platform. The virtual experiments show that robots equipped with the ability to perceive their surroundings can construct their own effective, powerful learning rules, almost like living creatures. We are in the process of creating a complete virtual mouse, with eyes, whiskers, skin, a brain and a body, bones and muscles that function like those of its natural counterpart.

How we are organised

WP10.1 CLOSED-LOOP EXPERIMENTS (DATA-DRIVEN BRAIN MODELS). This WP develops strategic closed-loop experiments chosen to reconstruct the sensory motor loops (between brain and body models) for the most important systems.

WP10.2 CLOSED-LOOP EXPERIMENTS (FUNCTIONAL/CONTROL MODELS). This WP focuses on top-down models of sensory-motor processing to control virtual and physical robots.

WP10.3 COMPONENTS OF CLOSED-LOOP EXPERIMENTS. This WP provides all components (robots, bodies, sensors, actuators, environments) needed in the closed-loop experiments of WPs 10.1 and 10.2 as well as in the Co-Design Projects.

WP10.4 TRANSLATIONAL NEUROROBOTICS. This WP translates virtual robots and brain-derived controllers to physical prototypes to contribute to future robotics research. Unlike WPs 10.1 and 10.2, WP10.4 tries to transfer results from brain research and neurorobotics to future robotics.

WP10.5 SIMULATION AND VISUALIZATION TOOLS FOR NEUROROBOTICS. This WP aims to build a suite of tools and workflows to plan, run and analyse in silico experiments with Neurorobotics Systems.

WP10.6 NEUROROBOTICS PLATFORM. This WP is building a collection of Apps, application programming interfaces and Platform foundation software that supports collaborative approaches to building and sharing neurorobotic models.

WP10.7 SCIENTIFIC COORDINATION AND COMMUNITY OUTREACH. This WP coordinates quality assurance, organisation of meetings and workshops, as well as reporting, within SP10 and its interactions with the wider scientific community within and outside the HBP.

SP LEADER Alois KNOLL

DEPUTY SP LEADER Marc-Oliver GEWALTIG

WORK PACKAGE LEADERS

- WP10.1 Closed-loop experiments (data-driven brain models): Marc-Oliver GEWALTIG
- WP10.2 Closed-loop experiments (functional/control models): Cecilia LASCHI
- WP10.3 Components of closed-loop experiments: Rüdiger DILLMANN
- WP10.4 Translational Neurorobotics: Jörg CONRADT
- WP10.5 Simulation and visualization tools for neurorobotics: Axel VON ARNIM
- WP10.6 Neurobotics Platform: Alois KNOLL
- WP10.7 Scientific coordination and community outreach: Florian RÖHRBEIN
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SP MANAGER Florian RÖHRBEIN

Publication highlights

Knoll A, Gewaltig M. ***Neurorobotics: A strategic pillar of the Human Brain Project.*** Science Booklet, 354(6318):1445-1445

Falotico E et al. (2017). ***Connecting artificial brains to robots in a comprehensive simulation framework: The neurorobotics platform.*** Frontiers in Neurorobotics, 11.

Francis G, Manassi M, Herzog M (2017). ***Neural Dynamics of Grouping and Segmentation Explain Properties of Visual Crowding.*** Psychological Review.

Ojeda I *et al.* (2017). ***A Scalable Neuro-inspired Robot Controller Integrating a Machine Learning Algorithm and a Spiking Cerebellar-like Network.***Living Machines.

Kaiser J *et al*. (2017). ***Scaling up liquid state machines to predict over address events from dynamic vision sensors.*** Bioinspiration & Biomimetics, Special issue on NeuroRobotics: Brain-inspired models for robot control and behavior.

Vannucci L *et al*. (2017). ***A comprehensive gaze stabilization controller based on cerebellar internal models.*** Bioinspiration & Biomimetics, Special issue on NeuroRobotics: Brain-inspired models for robot control and behavior.

Oess T, Krichmar J, Röhrbein F (2017). *A* ***Computational Model for Spatial Navigation Based on Reference Frames in the Hippocampus, Retrosplenial Cortex, and Posterior Parietal Cortex.*** Frontiers in Neurorobotics 11.

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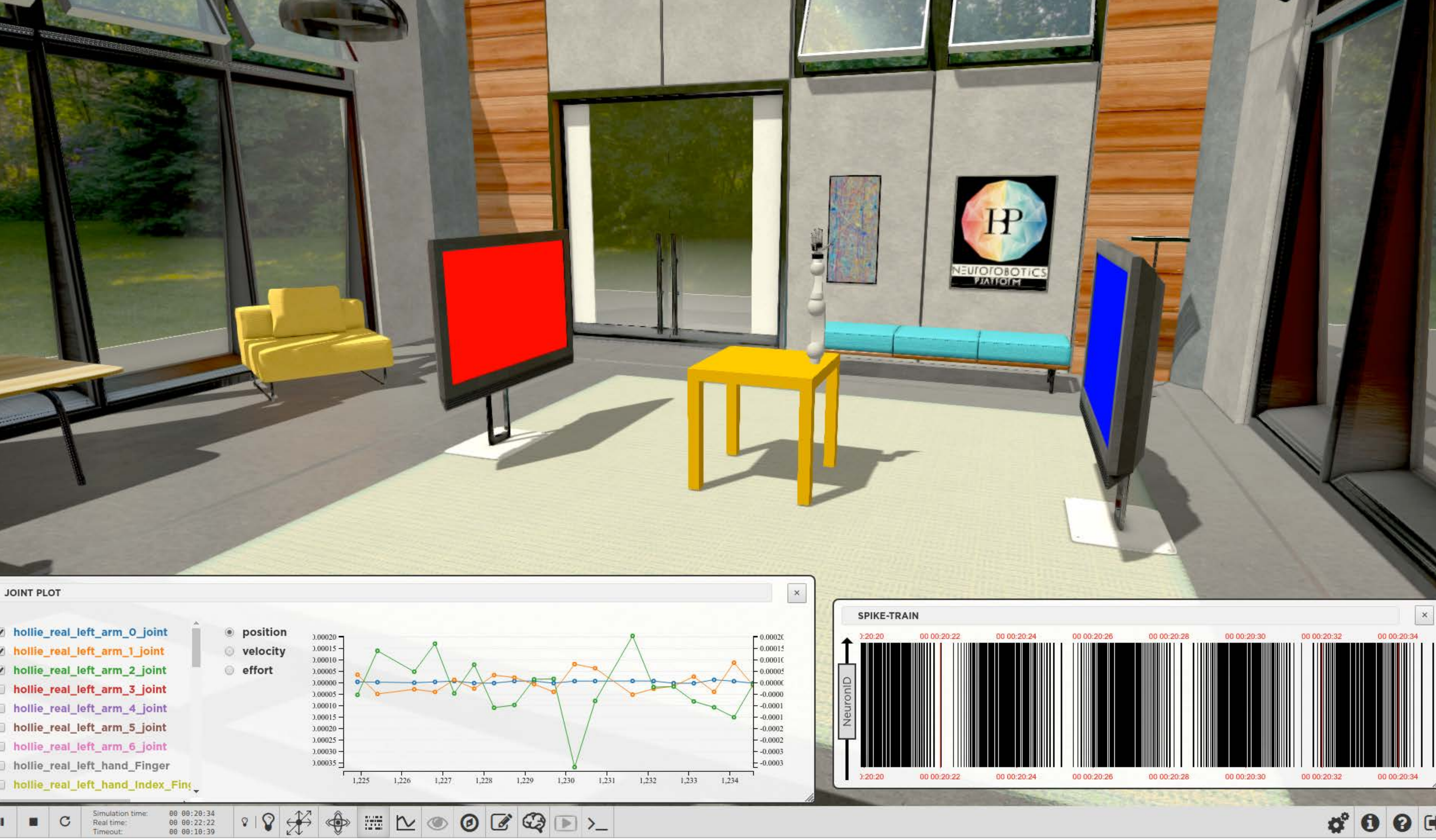
https://www.humanbrainproject.eu/en/about/project-structure/subprojects/



Human Brain Project

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