HBP At The Halfway Point

Andreas Mortensen
Director General - Human Brain Project

Flagships’ Board of Funders Brussels - 16 Nov. 2018
The HBP At Half-Way

<table>
<thead>
<tr>
<th>FP 7</th>
<th>Horizon 2020</th>
<th>Horizon Europe, 2021-2027</th>
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<tr>
<td>2007-2013</td>
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(revised as of Oct. 2018)

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Deepen understanding of the human brain structure and function by building a European infrastructure that harnesses multiple disciplines and computing, and advances science, ICT and medicine to the benefit of society.

Mission
• Explore the multi-level complexity of the brain in space and time.
• Transfer the acquired knowledge to brain-derived applications in health, computing, and technology.
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The Stakeholder Board: Improvements

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<th>INSTITUTION</th>
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<tr>
<td>Austria</td>
<td>Christine BRANDTLOW</td>
<td>Medical University of Innsbruck</td>
</tr>
<tr>
<td>Belgium</td>
<td>Sigrid STROBANTS</td>
<td>University of Antwerp</td>
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<tr>
<td>Denmark</td>
<td>tba</td>
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<tr>
<td>France</td>
<td>Andre SYROTA (*)</td>
<td>Institut nationale de la santé et de la recherche médicale</td>
</tr>
<tr>
<td>Germany</td>
<td>Wolfgang MARQUARDT (*)</td>
<td>Forschungszentrum Jülich</td>
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<tr>
<td>Greece</td>
<td>Michael HATZOPOLUS</td>
<td>University of Athens</td>
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<tr>
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<tr>
<td>Israel</td>
<td>Joseph KLAFTER (*)</td>
<td>Tel Aviv University</td>
</tr>
<tr>
<td>Italy</td>
<td>Eugenio GUGLIELMELLI (*)</td>
<td>University of Rome</td>
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<tr>
<td>Netherlands</td>
<td>Rob HEINSBROEK</td>
<td>Netherlands Organisation for Scientific Research</td>
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<td>University of Oslo</td>
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<tr>
<td>Norway</td>
<td>Frode VARTDAL</td>
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<tr>
<td>Portugal</td>
<td>Antonio DAMASIO</td>
<td>University of Southern California</td>
</tr>
<tr>
<td>Slovenia</td>
<td>Bernard ZENKO</td>
<td>Jozef Stefan Institute</td>
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<tr>
<td>Spain</td>
<td>Gonzalo LEÓN</td>
<td>Technical University of Madrid (UPM)</td>
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<td>Sweden</td>
<td>Gunnar LANDGREN</td>
<td>Royal Institute of Technology</td>
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<td>Switzerland</td>
<td>Martin VETTERLI (*)</td>
<td>Ecole Polytechnique Fédérale de Lausanne</td>
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<td>Turkey</td>
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(*) Steering committee of the Stakeholder Board (SCSB)

SB Chair: Matt Lambon-Ralph
AISBL-ESFRI-ERIC

- Creation of an association with the double objective of acting as coordinator of HBP and of preparing a lasting research infrastructure for brain research in Europe. The association takes the form of an AISBL (Association sans but lucratif) = “not-for-profit association” in Belgium. Foundation ≈ April 2019

- Will support HBP’s application to the ESFRI (European Strategy Forum on Research Infrastructures) roadmap (submission of proposal in August 2019)

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HBP Consortium At A Glance

Core project:
121 institutions
(+5 since May 2018)
in 19 countries
HBP Update I

- Election of the Science & Infrastructure Board (SIB) and its leaders (Katrin Amunts, Karlheinz Meier, Alois Knoll)

- Christian Fauteux appointed Executive Director of Project Coordination Office (PCO). Andreas Mortensen appointed Director General of HBP.

- Co-Design Projects (CDPs) now directly represented in the SIB (Rainer Goebel)

- High Level Support Team (HLST) of the collaboratory established, call for vouchers launched

- International Cooperation Group (INCO) renewed (led by Cyriel Pennartz)
Fenix started to establish High Performance Computing (HPC) and data infrastructure services for multiple research communities

Interactive Computing e-Infrastructure (ICEI) started within the HBP-FPA

External calls resulting in new partners: Sub Project (SP) joint calls SP1/SP2, SP8 calls, 2 new CDPs
SGA1 Review; June 2018

- “Great science and platform and technology development are shown”
- “Strong commitment to collaboration from PIs and other project members”
- “Strong improvement compared to the ramp-up phase with respect to results and integration”
- “Focus on integration beyond the science…”
- “Platforms: increase usability and accessibility”
- “Clear goal-driven HBP roadmap with timeline and with clear and verifiable targets”
- “Gender balance at all levels to reflect the respective research communities”
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Actions In Response To SGA1 Review

- Update of the vision and mission statements for HBP
- Update of the HBP Roadmap for the second half of HBP
  - Introduction of results chain to clarify outputs, outcomes and impacts
  - Detailed planning for the HBP Joint Platform
- Planned change of project structure for SGA3 to focus on vertically-integrated interdisciplinary scientific projects and use cases
- Platform user engagement and user support activities launched
- Implementation of a Gender Action Plan
The HBP Joint Platform
The HBP Joint Platform

**Neuroinformatics Platform:** delivers data curation and management of all data and models, makes data and models discoverable and usable, provides analysis tools

**Brain Simulation Platform:** develops and provides brain models and necessary simulation engines

**HPAC Platform:** provides high-performance computing, analytics services, and data services

**Medical Informatics Platform:** collects, curates, and federates clinical data

**Neuromorphic Computing Platform:** develops and operates neuromorphic computing systems

**Neurorobotics Platform:** develops and operates virtual and physical neurorobotics laboratories
Growth and impact of HBP platforms

**Neuroinformatics Platform**
Number of files uploaded: 181387
Reference atlas: 11.3 Mio server hits, 40548 visitors (Since December 2017)

**Brain Simulation Platform**
- 502 unique active users (+29% since May 2018)
- 75073 page views (+80% since May 2018)
- 11081 use cases executed (+89% since May 2018)

**Medical Informatics Platform**
- MIP installed in 9 hospitals (+29% since May 2018)
- 3 hospitals contributed data from 6619 patients (+5% since May 2018)

**High Performance Analytics and Computing Platform**
400 accounts on HPC and Cloud infrastructure of the HPAC Platform

**Neuromorphic Computing Platform**
5000 SpiNNaker jobs executed (+100% since May 2018)
619500 external user jobs (+30% since May 2018)

**Neurorobotics Platform**
503 registered users (+26% since May 2018)
72220 views of the NRP forums (+93% since May 2018)
875 Twitter followers (+12% since May 2018)
Updated Organisation of Joint Platform

- **Horizontal service layers (the underlying infrastructure)**
  - HBP platform tools and services
  - Infrastructure services

- **Vertical Solutions (tools which are used by customers/users)**
  - Provide specific solutions for end-users that leverage the horizontal services - e.g. running a simulation on the Neurorobotics Platform.
Community Services Under Implementation

**Starting set of Solutions:**

- HBP Brain Atlasimg - multi-level and multi-species
- HBP Multi-scale Brain Simulation
- HBP Complex workflows for linking multi-level neuroscience data
- HBP Neurorobotics Simulation
- HBP Medical Data Analytics
- HBP Neuromorphic solutions for Neuroscience
HBP Brain Atlasing


- **Features and capabilities**
  - Providing multi-level brain data in topographically organized framework to the community accessed through atlas search and navigation
  - Modeling creates links across scales and species including ontologies, semantics and statistics

- **Horizontal services**
  - Curation services and Knowledge Graph (KG)
  - Visualisation services
  - Ontologies, provenance, and versioning
  - Software deployment services
  - Data storage and transfer services
  - Scalable and interactive compute services
Additional Services

ICEI infrastructure services

• Scalable compute, interactive compute, virtual machine (VM) services
• Archival and active data repositories
• Data location and transfer/mover services
• Authentication and Authorization Infrastructure (AAAI), Fenix User and Resource Management Services

Neuromorphic computing systems

Patient data infrastructure

• Data stores in hospitals, patient data management services, patient data query and analysis services
HBP Summit Maastricht 2018

670 attendees
incl. 359 from the public

494 registrations for the Summit
incl. 88 PhD students
Keynotes

Dick Swaab

Rector Magnificus Maastricht University Rianne Letschert

Jeff Hawkins

Science Market record visitor number

Local host Rainer Goebel
Summit Highlights

Commissioner
Mariya Gabriel

28 Plenary Sessions
39 parallel Sessions

Focus On Clinical IMPACT

Town Hall meeting

Linda Richards Keynote

Welcome Reception and Summit Dinner

Poster Sessions

Young Researchers Event
1. Enabling the paralysed to walk  
   (EPFL and CHUV/Unil Courtine SP10)

2. A clinical trial for computer modelled epilepsy treatment  
   (Victor Jirsa - SP4)

3. Writing directly from a camera to the visual cortex  
   (Pieter Roelfsema SP2)

4. SpiNNaker - a super-computer capable of simulating 1 billion point neurons  
   (University Of Manchester - Furber/Lester SP9)
**Personalized computational models HBP**

1. **HIGH RESOLUTION MRI SEQUENCE**
   FOR IMAGING THE ENTIRE EXTENT
   OF DORSAL AND VENTRAL ROOTS

2. **PERSONALIZED COMPUTATIONAL**
   MODEL TO PREDICT THE SURGICAL
   PLACEMENT OF THE LEAD

https://youtu.be/yNAqu-h9Kuw
How The Technique Enables Walking

- A **personalised computer model** is used to optimize the placement of electrodes for each patient.
- Computing fiber activation using a **model developed in the framework of the HBP**.
- Stimulation is delivered as a sequence of **pulse trains** that cycle through phases of locomotion for both legs.
- The time sequence was defined through **optimization with a spinal network model developed during the HBP** that predicts efficacy of the stimulation during movement.
- After **6 months training** the patient shows improvement in the control of her/his legs with and without stimulation.
- The **brain learns to use the stimulation to move the legs** voluntarily to the point that the patients are able to walk using the stimulation and minimal body weight support systems outside the laboratory environment!

*Nature volume 563, pages 65-71 Oct. 2018*
Improving Epilepsy Treatment (SP4)

Patient-specific large-scale brain networks

Proix, Jirsa, Bartolomei, Guye, Truccolo. *Nature Communications*, 9, Date 2018-03-14
Improving Epilepsy Treatment (SP4)

Patient-specific large-scale brain networks

Personalized brain modelling is providing the basis for a large-scale clinical trial in epilepsy (Project EPINOV)


Proix, Jirsa, Bartolomei, Guye, Truccolo. Nature Communications, 9, Date 2018-03-14
Visual Prosthesis For Blindness (SP2)

SpiNNaker project (SP9)

- A million **arm** (neuromorphic) processors (used in mobile phones) united in one computer
- able to model about 1% of the human brain capacity...
- ...or 10 mice brains
**SpiNNaker project (SP9)**

Start-ups and industry interest

Manchester-based MindTrace secures initial €1.5 million to create self-learning machines
High-level scientific publications
Examples of 2018 Publications*

* Among 261 Registered For 2018 In HBP
A week after this year’s HBP Summit, HBP Infrastructure Operations Director and Karlheinz Meier, a co-founder and driving force within the HBP passed away suddenly.

Karlheinz Meier embodied the spirit of encouragement and collaboration that is a hallmark of the HBP.
Thank You