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Human Brain Project launches European research infrastructure

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The Human Brain Project (HBP) is developing a shared European research infrastructure with the aim of examining the organization of the brain using detailed analyses and simulations and thus combating neurological and psychiatric disorders. For this purpose, the HBP is creating new information technologies like neurosynaptic processors which are based on the principles governing how the human brain works. Following today's launch of the scientific infrastructure set up by researchers from 24 countries over the last two-and-a-half years, the Human Brain Project is now entering its next phase.

The infrastructure can be accessed through various platforms. It is intended to drive progress not only in neuroscience but also in the European development of HPC and robotics as well as to interconnect researchers through four large European supercomputer and data centres. Notably, researchers not involved in the project consortium will also be able to access the infrastructure.

Scientists from the supercomputer centres at Forschungszentrum Jülich and ETH Zurich are coordinating the creation and work of the platform for High Performance Analytics and Computing. The platform deals with the huge volumes of neuroscientific data on the human brain: storing these data, integrating them into models, and analysing them in simulations.

The Jülich Supercomputing Centre (JSC) and twelve collaboration partners provide the European neuroscientists with support in using the

supercomputer resources, storage systems, and user software. Petabyte data sets (1 petabyte = 1015 bytes), generated for example by imaging techniques such as polarized light imaging, can be analysed and visualized on supercomputers like JURECA using state-of-the-art methods like deep learning. "Users and developers work together very closely. With leading manufacturers, we are developing the interactive supercomputer, which is as easy to use as a laptop and is one of the most crucial instruments for in silico experiments on virtual human brains," says Prof. Thomas Lippert, director of JSC and co-leader of the platform alongside Prof. Thomas Schulthess (ETH Zurich).

Prof. Katrin Amunts, director of the Institute of Neuroscience and Medicine - Structural and Functional Organization of the Brain, and her group are using the platform's JURECA supercomputer to develop the three-dimensional brain model BigBrain. BigBrain is the world's most detailed reconstruction of the cell structure of a full human brain. The HBP's future brain atlas will comprise additional information on neural fibre tracts which connect the various brain regions to each other. "Our brain atlas will provide researchers - whether they are involved in the Human Brain Project or not - with access to all globally available data on the brain, a bit like Google Earth," says Katrin Amunts, coordinator of the event marking the launch of the HBP infrastructure and leader of the HBP subproject on human brain organization.

A team headed by Prof. Markus Diesmann, director at Jülich's Institute of Neuroscience and Medicine - Computational and Systems Neuroscience, is investigating neural networks in the brain. Using supercomputers, the researchers hope to draw conclusions on the brain as a whole with its some 100 billion neurons. Yet, the most powerful supercomputer today is capable of simulating no more than one percent of the human brain. In addition, these simulations must comprise a critical number of neurons and synapses as otherwise the deviations from reality are too large. "For this reason, we are using the Jülich

supercomputer JUQUEEN to develop error-correcting mathematical models as well as the necessary simulation and analysis software for big data analyses. This work is part of the Neural Simulation Technology Initiative (NEST)," says Markus Diesmann.

During the launch, Prof. Sonja Grün's team presented very concrete insights into what has been achieved over the past two-and-a-half years in a live demonstration that was also be web-streamed live. Grün is deputy director of Jülich's Institute of Neuroscience and Medicine - Computational and Systems Neuroscience. This live demo illustrated how complex tasks will be processed in future by the HBP research infrastructure and comprehensively documented. "Our live demo involves the creation of a mathematical model using NEST software, its simulation on a supercomputer, the analysis of the resulting data using the Jülich software tool Elephant, and the visualization of the results," says Sonja Grün.

More information: hbp-hpc-platform.fz-juelich.de/

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