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Review: Bernstein Conference 2011 – stories from the neurosciences

The German National Bernstein Network for Computational Neuroscience (NNCN), a unique network of researchers working in the still young field of computational neuroscience, held this year's annual meeting in Freiburg, a city in the south of Germany that is home to six German Bernstein Centers. Now in its 7th year, this year's Bernstein Conference on Computational Neuroscience also addressed applied aspects of neurotechnology.

How are female grasshoppers, with brains consisting of around sixty nerve cells, able to select the "right" male from the large number of chirring males? How do doctors manage to get patients to move an artificial arm purely by thought? And how can a group of nerve cells, which store information for many years, create activity patterns that are both stabile and flexible? These are only a handful of questions currently being worked on by researchers from the National Bernstein Network for Computational Neuroscience, established in 2004 and funded by the German Ministry of Education and Research (BMBF). All the questions relate to the function of neuronal networks. "The Bernstein Network has just undergone evaluation by independent experts who have all attested the excellence and innovation of the research work that is carried out by the network," said the BMBF's Dr. Christiane Buchholz, speaking at the conference. "We would like to support the combination of basic research and the NNCN's application-oriented activities to an even greater extent than before."

The only scientific network of its kind

Prof. Dr. Ulrich Egert, one of the founding directors of the Bernstein Center for Computational Neuroscience in Freiburg,

The combination of basic research and more application-oriented aspects was in fact one of the major topics of the three-day conference held in Freiburg from 4th to 6th October. The organizers set aside a whole day for researchers working in the field of neurotechnology. In a series of 10 lectures, experts spoke about the progress they have made in the application of brain-machine interfaces or deep brain stimulation. It is expected that brain-machine interfaces will enable paralyzed patients to control prostheses at some stage in the future. Deep brain stimulation has the potential to treat symptoms such as tremor, rigour and bradykinesis. NNCN researchers are investigating the potential of implantable electrodes for use in brain-machine interfaces and deep brain stimulators, their side effects and technical implementation. "With around 200 research groups, the Bernstein Network is one of the largest scientific networks in Germany and the only network for computational neuroscience in the world," said the rector of the University of Freiburg, Prof. Dr. Hans-Jochen Schiewer. "The NNCN researchers, who also work with colleagues around the world, establish links between basic research and industrially relevant applications, and the University of Freiburg's role is to support the

welcoming those who attended the 2011 Bernstein Conference. (© Bernstein Network for Computational Neuroscience (NNCN))

network in this type of work."

This year's conference in Freiburg is the seventh conference since the NNCN was established in 2004. With more than 400 researchers from all over the world and 200 posters, the recent conference was the largest ever meeting organized by the NNCN. The fact that the conference was held in Freiburg opened up the unique opportunity to exchange ideas with researchers from the Neuroscience Upper Rhine Network (NEUREX), which brings together researchers from German, French and Swiss universities along the Upper Rhine. Many researchers from the Bernstein Center for Computational Neuroscience in Freiburg are also members of NEUREX, so the Freiburg venue gave the organizers the opportunity to bring the annual meetings of the two networks together as a single meeting. "NEUREX's objective is to expand," said NEUREX President Prof. Dr. Paul Pévet from the University of Strasbourg, explaining that "working in cooperation with the Bernstein Center in Freiburg, with its excellent national and international contacts, is very important for us in this respect."

Balance between flexibility and stability

The large number of scientific posters, presenting around 200 projects carried out mostly by young scientists working in the computational neurosciences, also highlighted how important the funding of young scientific talent is for the two neuroscience networks. The Bernstein Prize for Computational Neuroscience, which was awarded for the sixth time this year and comes with a purse of 1.25 million euros, is also an expression of the BMBF's efforts to give young researchers the opportunity to do outstanding and independent research. This year's prizewinner, Dr. Henning Sprekeler, who studied physics in Freiburg and Berlin and now works at Humboldt-Universität in Berlin, is working on the process of learning using balanced neuronal networks. The prize was awarded by Dr. Buchholz, who highlighted that Sprekeler's approach combines two major research areas of the Bernstein Network, namely learning and theoretical neuroscience.

Dr. Christiane Buchholz of the German Federal Ministry of Education and Research (BMBF) awarded the 2011 Bernstein Award for Computational Neuroscience to Dr. Henning Sprekeler. (© Bernstein Network for Computational Neuroscience (NNCN))

"What happens in our brain as we learn new things?" was the question posed by Dr. Sprekeler at the beginning of his lecture, the first in a series of scientific talks. Sprekeler mainly focuses on a paradoxical property of neuronal networks in the human brain and elsewhere. Each nerve cell is connected with many other nerve cells, both excitatory and inhibitory. The connections between nerve cells are bound to get stronger as we learn new things; this is the neural correlate of learning and memory. In addition, the same neuronal networks must also be able to prevent the incessant excitation of nerve cells, or to put it another way, the activity of inhibitory and excitatory nerve cells must always be balanced. But what changes must occur in the brain in order to balance the activity of excitatory and inhibitory nerve cells? How does the brain maintain stable activity, such as memory, and how, on the other hand, can it change through learning processes? The Bernstein Award means that Sprekeler will now be able to set up his own research group at the Bernstein Center for Computational Neuroscience in Berlin to focus on precisely these questions.

At the core of the interactive

The Bernstein Network researchers had ample time at the three-day conference to exchange information and practical knowledge with international colleagues. Around thirty scientific lectures provided insights into theoretical and computer-based neuroscience. The conference also featured a cultural programme, including films and art exhibitions, which also gave insights into the potential of this discipline, and included the interactive installation "sensory neuronal network" by the Berlin artist Rainer Dunkel, which was created in close cooperation with scientists from the Bernstein Center

"sensory neuronal network" installation of Berlin-based Rainer Dunkel lies a neuronal network that reacts to contact with acoustic and visual cues. (© Bernstein Network for Computational Neuroscience (NNCN))

in Freiburg. The installation reacts to its viewers with acoustic and optical cues. A short film competition, the NeuroVision Film Contest, was also held at the conference. Each film took a particular neuroscience issue and attempted to answer the question “Can you show us the invisible?”

Speed dating and exciting stories

The Bernstein Bazar gave journalists the opportunity to hear exiting stories from the world of computational neuroscience, in a set-up similar to speed dating. (© Bernstein Network for Computational Neuroscience (NNCN))

A new feature at this conference was the Bernstein Bazar, which gave journalists the opportunity to talk to fifteen experts from all fields of computational neuroscience and listen to their thrilling tales, in a set-up similar to speed dating. Dr. Tonio Ball, head of “Intracranial Electroencephalopathy and Functional Imaging” at the Bernstein Center Freiburg, and the founding director of the Bernstein Center Freiburg, Prof. Dr. Ulrich Egert, talked about the potential of electrode systems which can be used to investigate as well as manipulate brain function. Ball is a member of the Brain-Machine-Interfacing Initiative (BMII) at the University of Freiburg and he described how paralyzed patients are able to move a cursor on a computer screen solely with the power of thought that is recorded with electrodes in the form of brain waves.

Dr. Jan Benda from the Bernstein Center Munich took his audience into the mysterious world of underwater organisms. He talked about how weakly electrical fish can communicate with each other and perceive the presence of obstacles through electrical fields. Prof. Dr. Susanne Schreiber, Junior Professor of Computational Neurophysiology at the Bernstein Center Berlin, related the fascinating performance of a group of around 60 neurons in the brain of female grasshoppers that are able to distinguish the chirring of different males.

The Bernstein Bazar also focused on topics such as vision, brain disorders and treatment options, and the processes of learning, remembering and forgetting. Each journalist had 10 minutes per “topic table”, with three researchers from the Bernstein Network. Time was far too limited to discuss any issue in detail, but journalists had the opportunity to return to issues of interest later in face-to-face talks. Who knows? Maybe the next Bernstein Bazar will be open to other interested people. Whatever happens, the computational neurosciences have a lot of interesting tales to tell.

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More Information

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