Bernstein Network Computational Neuroscience

Bernstein Newsletter

Recent Publications
How colors enter the world of the fly – A grid in the brain – Computing with silicon neurons – Robots with insect brains – Memories are "geotagged" with spatial information

Meet the Scientist
Wilhelm Stannat

Mitteilungen und Termine
Personalia – Bernstein Conference 2014 – Second Bernstein Sparks Workshop in Tutzing – New layout Bernstein website

03/2014

How colors enter the world of the fly

Tasty bread crumb or just a boring dust grain? Color vision facilitates the recognition of objects. To distinguish colors, the brain compares signals from sensory cells that are activated by light of different wavelengths. But how does color information reach a fly's brain? Insects possess compound eyes, which are composed of many individual eye units, so-called ommatidia. A single ommatidium consists of eight light-sensitive photoreceptor cells. Six of them are arranged in a ring, with the two remaining cells located in its center. In flies, the six outer receptor cells respond to light over a broad range of wavelengths. Since the perception of color depends on the processing of specific wavelength regions, researchers assumed that these receptors are mainly responsible for motion perception. In contrast, the two inner photoreceptors are sensitive to light of single narrow wavelength regions—and may therefore pass on precise information about colors. So far, they have been considered to be the exclusive source of color vision in flies.

Neuroscientists at the Bernstein Center Munich, the Max Planck Institute of Neurobiology in Martinsried, and the LMU Munich now discovered that this assumption needs to be revised. "The outer photoreceptors contribute to color discrimination of the fly as well," explains Thomas Wachtler, one of the researchers involved in the study. Using a computer model, the biologists mimicked the processing of photoreceptor signals in the fly eye—and realized that the wavelength sensitivity of the outer photoreceptors must be taken into account in order to obtain the fly's color discrimination abilities.

To support their theoretical results with experimental data, the researchers selectively controlled photoreceptor function in genetically manipulated flies. In this way, they obtained flies that possessed only one of the two color-specific inner receptor cells besides the outer receptor cells. Yet, the flies were able to distinguish two colors. "This indicates that the brain draws on information from both inner and outer photoreceptors for the color comparison," explains Christopher Schnaitmann, first author of the study. The assumption was confirmed when the scientists inhibited the activity of nerve cells that convey signals from the outer receptor cells to the brain: the flies' ability to perceive color differences was severely impaired.

Both inner and outer receptor cells of the innumerable ommatidia in the flies' compound eyes play an important role for color vision.
© Pavel Masek/BCOS

The outer photoreceptors thus seem to be true multitaskers, contributing to both motion and color vision in the fly. Their dual role makes sense in small animals: it ensures that despite a limited number of neurons, flies still have complex visual skills—and may easily distinguish a bread crumb from a dust grain.

Schnaitmann C, Garbers C, Wachtler T, Tanimoto H (2013): Color discrimination with broadband photoreceptors. Current Biology, 23(23): 2375-82.

A grid in the brain

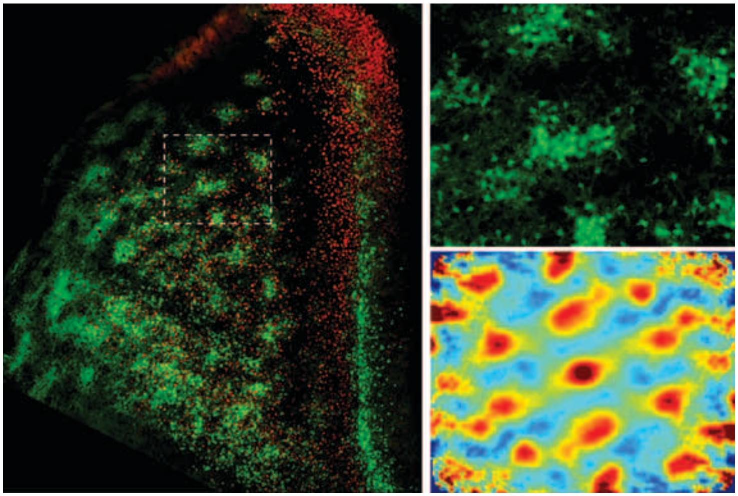
To calculate the distance between two places, animals and humans rely on an internally generated navigation system. In mammals, components of this navigational system are the hippocampus and the entorhinal cortex. These structures memorize and represent our environment in form of a cognitive map, which is a mental representation of space. The representation of space in the entorhinal cortex is particularly fascinating—here, nerve cells discharge in a grid like pattern across space when the animal is moving. It is thought that this so-called grid cell activity works much like the grid lines on a map providing mammals with a metric for space. So far, it has been unclear how such grid patterns of activated nerve cells are anatomically formed in the brain.

Now, a research team headed by Leibniz prize winner Michael Brecht from the Humboldt-Universität in Berlin, the Cluster of Excellence Neurocure, and the Bernstein Center Berlin has discovered a grid-like network of nerve cells in the entorhinal cortex. By using a protein that binds to calcium in selected nerve cells, the scientists visualized a small circuit of nerve cells. The dendrites of these neurons formed a hexagonal pattern in space that had a striking resemblance to the known grid pat-terns. Moreover, the neurons in this network showed the same characteristic activity rhythm as the grid cells, when the researchers measured the nerve cell activity in moving animals.

"People have known that the brain divides places into grids, much like we draw lines on a map. However, what was not known is what causes the brain to do it. What we have shown here, is the existence of a circuit in the brain, which physically looks like the spatial activity pattern of the so-called grid cells. This makes us think that this circuit structure might be the underlying cause of this representation", Brecht comments on the study that has been published in the renowned scientific journal *Science*.

Hence, the discovery of the neural network might help us to understand how the brain generates grid lines on our mental maps and how we mentally measure distances. The scientists also hope to gain insight into how the brain forms spatial memories—a brain function which is disturbed or lost in many neurodegenerative diseases such as dementia. On a more fundamental level, how the brain forms spatial memories may be related to how we form memories in general: as in the memory palaces of the ancient Greeks, objects could be linked with places to serve as a mnemonic device.

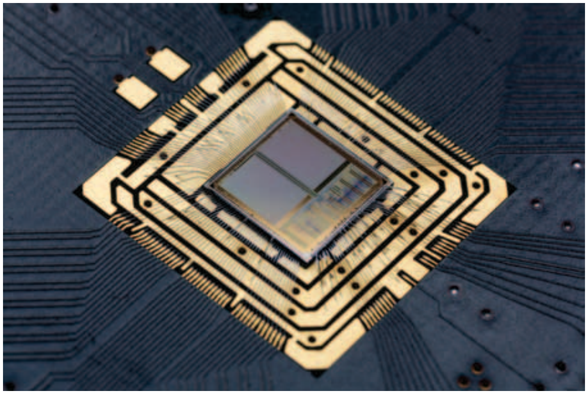
Ray S, Naumann R, Burgalossi A, Tang Q, Schmidt H, Brecht M (2014): Grid-layout and Theta-modulation of Layer 2 Pyramidal Neurons in Medial Entorhinal Cortex. Science. Advanced Online Publication.



A grid-like network of nerve cells in the brain (left, and top right) shows a similar hexagonal organization (right, bottom) to the mental map formed by the nerve cells in the brain.

Computing with silicon neurons

A bakery assistant who takes the bread from the shelf just to give it to his boss who then hands it over to the customer? Rather unlikely. Instead, both work at the same time to sell the baked goods. Similarly, computer programs are more efficient if they process data in parallel rather than to calculate them one after the other. However, most programs that are applied still work in a serial manner.



The neuromorphic chip containing silicon neurons which the researchers used for their data-classifying network.

Scientists from the Freie Universität Berlin, the Bernstein Center Berlin and Heidelberg University have now refined a new technology that is based on parallel data processing. In the so-called neuromorphic computing, neurons made of silicon take over the computational work on special computer chips. The neurons are linked together in a similar fashion to the nerve cells in our brain. If the assembly is fed with data, all silicon neurons work in parallel to solve the problem. The precise nature of their connections determines how the network processes the data. Once properly linked, the neuromorphic network operates almost by itself. The researchers have now designed a network–a neuromorphic "program"—for this chip that solves a fundamental computing problem: It can classify data with different features. It is able to recognize handwritten numbers, or may distinguish certain plant species based on flowering characteristics.

"The design of the network architecture has been inspired by the odor-processing nervous system of insects," explains Michael Schmuker, lead author of the study. "This system is optimized by nature for a highly parallel processing of the complex chemical world." Together with research group leaders Martin Paul Nawrot and Thomas Pfeil, Schmuker provided the proof of principle that a neuromorphic chip can solve such a complex task. For their study, the researchers used a chip with silicon neurons, which was developed at the Kirchhoff Institute for Physics of Heidelberg University.

Computer programs that can classify data are employed in various technical devices, such as smart phones. The neuromorphic network chip could also be applied in super-computers that are built on the model of the human brain to solve very com-plex tasks. Using their prototype, the Berlin scientists are now able to explore how networks must be designed to meet the specific requirements of these brain-like computer. A major challenge will be that not even two neurons are identical—neither in silicon nor in the brain.

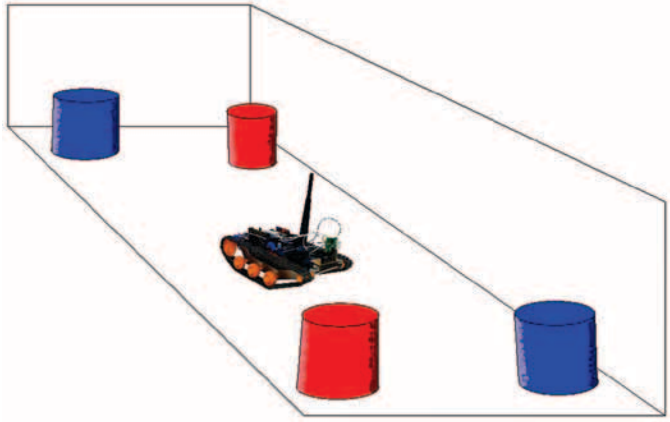
Schmuker M, Pfeil T, Nawrot M P (2014): A neuromorphic network for generic multivariate data classification. PNAS, published ahead of print January 27

Robots with insect brains

Autonomous robots that find their way through unfamiliar terrain? Not so distant future. Researchers at the Bernstein Fokus Neuronal Basis of Learning, the Bernstein Center Berlin and the Freie Universität Berlin have developed a robot that perceives environmental stimuli and learns to react to them. The scientists used the relatively simple nervous system of the honeybee as a model for its working principles. To this end, they installed a camera on a small robotic vehicle and connected it to a computer. The computer program replicated in a simplified way the sensorimotor network of the insect brain. The input data came from the camera that—akin to an eye—received and projected visual information. The neural network, in turn, operated the motors of the robot wheels—and could thus control its motion direction.

The outstanding feature of this artifical mini brain is its ability to learn by simple principles. “The network-controlled robot is able to link certain external stimuli with behavioral rules,” says Martin Paul Nawrot, head of the research team and member of the sub-project „Insect inspired robots: towards an understanding of memory in decision making” of the Bernstein Focus. “Much like honeybees learn to associate certain flower colors with tasty nectar, the robot learns to approach certain colored objects and to avoid others.”

In the learning experiment, the scientists located the network-controlled robot in the center of a small arena. Red and blue objects were installed on the walls. Once the robot’s camera focused on an object with the desired color—red, for instance—, the scientists triggered a light flash. This signal activated a so-called reward sensor nerve cell in the artificial network. The simultaneous processing of red color and the reward now led to specific changes in those parts of the network, which exercised control over the robot wheels. As a consequence, when the robot “saw” another red object, it started to move toward it. Blue items, in contrast, made it to move backwards. “Just within seconds, the robot accomplishes the task to find an object in the desired color and to approach it,” explains Nawrot. “Only a single learning trial is needed, similar to experimental observations in honeybees.”



The robot in the arena. The small camera films the objects and passes the information to the neural network by wifi. The network processes the data and controls the movement direction of the robot.
© Martin Paul Nawrot

The current study has been carried out within an interdisciplinary collaboration between Martin Paul Nawot’s research group “Neuroinformatics” (Institut of Biology), and the group “Intelligent Systems and Robotics” (Institute of Computer Science) headed by Raúl Rojas at Freie Universität Berlin. The scientists are now planning to expand their neural network by supplementing more learning principles. Thus, the mini brain will become even more powerful—and the robot more autonomous.

Helgadóttir L I, Haenicke J, Landgraf T, Rojas R., Nawrot M P (2013): Conditioned behavior in a robot controlled by a spiking neural network. 6th International IEEE/EMBS Conference on Neural Engineering (NER), 891 - 894

Video: www.youtube.com/watch?v=Qb_R_E4DPYs

Memories are „geotagged“ with spatial information

For the first time, scientists at the Epilepsy Center at the University Hospital and the Bernstein Center Freiburg as well as neuroscientists from Philadelphia have demonstrated on the neuronal level, how close memories are associated with places. The researchers showed that in humans, memories are “geotagged” with spatial markers that are activated during the retrieval of these memory contents.

“This essential advancement in knowledge about the mechanisms of human memory is based on a unique opportunity to record single nerve cell activity in epilepsy patients while examining their mental activity,” says Andreas Schulze-Bonhage, one of the head scientists of the international team. The Freiburg epilepsy researcher conducted the study within a multi-year collaboration with a research group led by Michael Kahana at the University of Pennsylvania. In Freiburg, the technical possibility to record the activity of single nerve cells in humans was established in Europe for the first time.

Epilepsy patients—who underwent recordings with intracranial electrodes for the detailed analysis of their seizures—participated as subjects in the memory experiment. While relaxing in their hospital beds, they navigated through a virtual reality that was displayed on a screen—similar to a computer game. The virtual reality, which was programmed in Philadelphia, showed a city with buildings, such as supermarket, post office and pharmacy. The subjects were asked to deliver diverse items to specific locations and then recall as many items as possible. Meanwhile, the researchers recorded their neuronal activity and later compared the activation pattern that arose at specific delivery locations with those patterns that emerged during the retrieval phase when the participants remembered the objects associated with the places.

The scientists discovered that, immediately before the subjects recalled an object, the spatial information of the delivery location associated with it was reactivated in the brain. “It has been known for some time that so called place cells encode the location of a person. We have now found that these neurons also play an important role in memory processes,” says Schulze-Bonhage. The scientists were even able to predict the next object which would be recalled on basis of the place cell’s activity.

The inclusion of spatial information in memory contents explains why memories that are linked to the same place can be conjointly reactivated. This demonstrates once more the close interaction of different cognitive functions—in this case, the spatial orientation and memory—in the human brain. The study was supported by the German Research Foundaton (Deutsche Forschungsgemeinschaft), the German Federal Ministry of Education and Research and the U.S. National Institutes of Health and was published in the prestigious journal *Science*.

Text: University Hospital Freiburg (translated and modified by BCOS)

Miller J F, Neufang M, Solway A, Brandt A, Trippel M, Mader I, Hefft S, Merkow M, Polyn S M, Jacobs J, Kahana M J, Schulze-Bonhage A (2014): Neural Activity in Human Hippocampal Formation Reveals the Spatial Context of Retrieved Memories. Science 342, 1111-1114.

Wilhelm Stannat

© Wilhelm Stannat

How can a single nerve cell simultaneously process thousands of signals? What effects do internal cellular fluctuations, or random external influences—such as thermal noise—have on this process? These are the kinds of questions that Wilhelm Stannats deals with at the Bernstein Center Berlin, where he was appointed to the newly created professorship "Mathematical stochastics—stochastic processes in the neurosciences" in 2011. Stannat, who was born in Westphalia in 1968, focuses his research on stochastic partial differential equations. These are particularly well suited for the description of complex dynamic systems such as neuronal networks. Additionally, stochastic methods also allow the analysis of large and complex medical data sets of the type that emerge from modern diagnostic procedures. Stochastics is a subfield of mathematics that deals with probability theory and statistics.

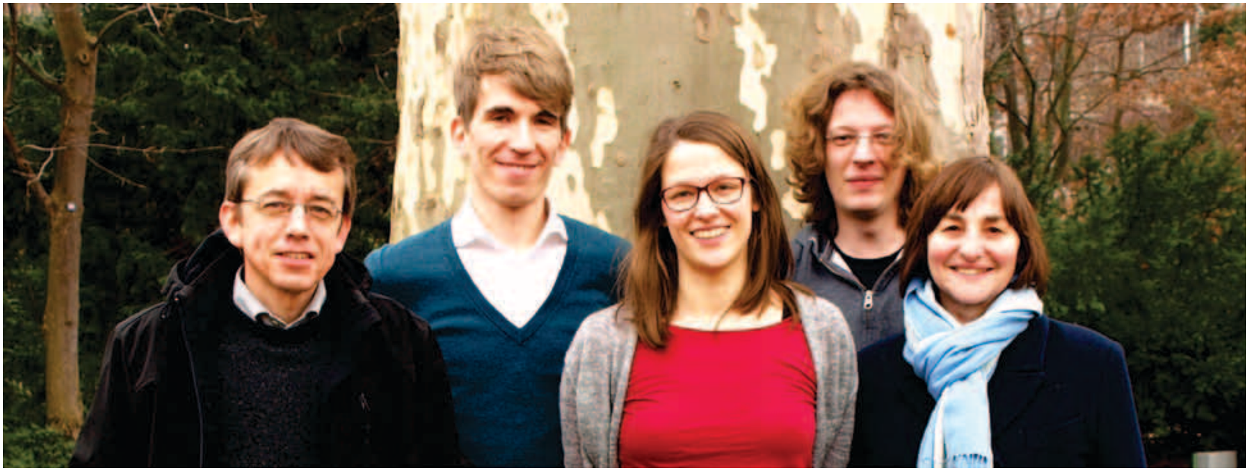
"When I was introduced to stochastics during my graduate studies in Bonn, it was a kind of awakening experience for me," explains Wilhelm Stannat, who has already shown a strong interest in mathematics since his young days. "It seemed like a completely new mathematical language." Quite soon he realized that stochastics was the direction that he wanted to pursue. In his diploma—and later his doctoral thesis—he engaged himself mainly with the stochastic analysis in infinite dimensions, that can be applied for example to the analysis of prices processes on financial markets. He was awarded with the Dissertation Award of the Westphalia-Lippe University Society at the University of Bielefeld in 1996, where he had followed his supervisor Michael Röckner two years earlier. Since that time, three main application areas are at the focus of Stannat's research: models of population genetics, fluid dynamics, and signal processing under the influence of uncertainties. "Based on these applications, I try to develop the relevant theory," says the mathematician.

Stannat initially devoted himself to models of population genetics and studied how different influences—such as mutation and selection—may act on gene sequences. Around the turn of the millenium, he spent a year on a scholarship with Professor SR Srinivasa Varadhan at the Courant Institute of Mathematical Sciences at New York University. "He is a true big shot in the field," says Stannat, "but also impressed me as a human being: the way he was detached from the typical small scientific feuds, apparently not constantly concerned about his own advantage, was very impressive." It was Varadhan who encouraged Stannat to pursue an academic career in the long run.

Back in Germany, Stannat completed his *Habilitation* at the Faculty of Mathematics, University of Bielefeld, in 2002. Four years later, he accepted a position as Professor of Stochastics at the Department of Mathematics, Technical University of Darmstadt. Here, he began to deal with fluid dynamics and signal processing under the influence of uncertainties—the latter initially applied in technical applications, and later in neural models. Neuroscience is one of the most prominent applications of stochastics. "However, I got into my current research focus rather accidentally through a collaboration with Ralf Galuske and Gordon Pipa at the Bernstein Fokus Neurotechnology in Frankfurt," Wilhelm Stannat explains. "I had been familiar with stochastic integrate and fire models as classical stochastic problems for a long time—yet, it was not until five years ago that I have worked with them for the first time." Which later turned out to constitute quite a change in his CV: Since his appointment at the Bernstein Center and the Technical University Berlin in October 2011, Stannat deals exclusively with neural models.

Now, Wilhelm Stannat focuses on stochastic processes in neural models at all neural levels: single nerve cell, networks, and the entire brain. On the one hand, he wants to simplify equations used by neuroscientists for their analyses, without losing the essential information content. Stannat describes: "Literally, I examine how we can improve the simulation of ion channels on the computer. How can we optimize the underlying algorithms so that the equations work faster?" On the other hand, the neuroscientist is particularly interested in the transition between the different levels. How can you draw conclusions from the activity of individual ion channels on the overall neuronal membrane potential—taking random influences into account? Until today, no precise mathematics have been developed that may describe this process. "Most of the times, data is been fed into a model and an output is obtained," explains Stannat. "However, besides the pure simulation result, you also want to have a justification for it. In the end, the result is more than the mere sum of its input data." Using his stochastic tools, Stannat is able to analyze the characteristics of the models' dynamics and to develop equations that describe them. This way, the mathematician may connect the various neural dimensions. In the long term, Wilhelm Stannat plans to provide exactly elaborated models for data processing. "I want to build a bridge between mathematics and neuroscience," Stannat explains. For the future, he wants to collaborate with theoretically and experimentally oriented neuroscientists to examine signal processing within and between nerve cells.

Stannat enjoys living in the capital: "Berlin is a top location for mathematical research in Germany. My position is therefore the perfect opportunity to combine neuroscience with mathematics." Also privately, the scientist has adapted to his new home base. Together with his wife and their two 7 and 9 year old sons, he particularly likes to explore the museums of the city at the weekends.



Together with his research group, Wilhelm Stannat investigates stochastic processes in neural models at all levels.
© Martin Sauer

Personalia


Marlene Bartos and **Arvind Kumar** (both Bernstein Center and University of Freiburg) are members of the renowned Network of European Neuroscience Institutes (ENI-NET). Marlene Bartos led the application of the Freiburg group and has been named its team leader. Arvind Kumar belongs—together with other Freiburg scientists—to the group's current young investigators.
www.nncn.de/en/news/nachrichten-en/freiburg-researchers-accepted-in-eni-net

Michael Frotscher (Bernstein Center Freiburg, University Medical Center Hamburg-Eppendorf) received the Jacob Henle Medal of the Medical Faculty at the University of Göttingen that is annually awarded for outstanding, medically relevant scientific achievements.
www.nncn.de/en/news/nachrichten-en/michael-frotscher-receives-jacob-henle-medal

Jürgen Hennig (BFNT Freiburg-Tübingen, University Hospital Freiburg) received the honorary doctorate from the Maastricht University for his research on magnetic resonance imaging.
www.nncn.de/en/news/nachrichten-en/jurgen-hennig-receives-honorary-doctorate



Knut Holthoff (left), **Christian Hübner** (center, both BFNL visual learning, University Hospital Jena), and **Stefan Kiebel** (D-USA Collaboration, BCCN Berlin, University Hospital Jena) participate in a new Priority Programme of the German Research Foundation that investigates connection forming processes in the brain.
www.nncn.de/en/news/nachrichten-en/bernstein-members-participate-in-new-dfg-priority-program

Ivana Kajic, Master student in the Computational Neuroscience program at the BCCN Berlin and student assistant in the laboratory of Klaus Obermayer (BCCN Berlin, BFNT Berlin, BNFL complex human learning, BCOL memory network, D-USA Collaboration), received the DAAD award for excellent perfomances of non-German students at the TU Berlin for the year 2013.
www.nncn.de/en/news/nachrichten-en/ivana-krajic-receives-daad-award

Katja Reinhard, PhD student with Thomas Münch (BCCN and CIN Tübingen, University of Tübingen), was awarded the Lush Prize 2013 endowed with £12.500 for her scientific studies on the human retina.
www.nncn.de/en/news/nachrichten-en/katja-reinhard-receives-lush-prize-2013

Wolf Singer (BFNT and MPI for Brain Research Frankfurt) received the Cothenius Medal of the National Academy of Sciences Leopoldina for his outstanding scientific lifetime achievements.
www.nncn.de/en/news/nachrichten-en/wolf-singer-receives-cothenius-medal

10th Bernstein Conference takes place in Göttingen

The Bernstein Conference (www.bernstein-conference.de) is the Bernstein Network's central forum that has developed over time into the largest annual Computational Neuroscience conference in Europe and attracts an international audience from across the world.

This year's Bernstein Conference will be organized by BFNT Göttingen under the direction of Florentin Wörgötter and will take place in Göttingen from September 2–5. For the second time, the Bernstein Conference will host a series of pre-conference workshops taking place on September 2–3. The workshops provide an informal forum for the discussion of timely research questions and challenges. Controversial issues, open problems, and comparisons of competing approaches are encouraged. The main conference will be held from September 3–5.

As in past years, the Bernstein Award will be officially announced and presented at the beginning of the main conference. In 2014, the Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung, BMBF) will confer the ninth annual Bernstein Award to an excellent junior scientist with outstanding research ideas in the field of Computational Neuroscience. The Award is endowed with up to € 1.25 million for a period of five years, and allows young scientists to establish an independent research group at a German university or research institution. A press conference will provide journalists the opportunity to get information about the awardee and his/her research.

The Valentino Braitenberg Award will be presented for the second time during the Bernstein Conference for outstanding research that contributes to elucidating the functional implications of neural dynamics and brain architecture. Also the fifth prize giving ceremony of the Brains for Brains Young Researchers' Computational Neuroscience Award conferred by the Bernstein Association for Computational Neuroscience will take place within the framework of the Bernstein Conference 2014. Deadline for application will be April 25 (www.nncn.de/en/bernstein-association/brains-for-brains-2014).

In an evening lecture with Tamim Asfour from the Karlsruhe Institute of Technology, the general public is invited to learn more about new research findings. The lecture takes place on September 4.
www.bernstein-conference.de

Opening Lecture
Larry Abbott
Nathaniel Sawtell

Sensory Coding/ Decoding
Fritjof Helmchen
Christian Machens
Maneesh Sahani
Jan Schnupp

Optogenetic Analysis of Cortical Computations
Mriganka Sur
Adam Kepecs
Timothy H. Murphy

Bernstein Conference 2014

Neuroprosthetics
Dario Farina
Daniel Palanker
Bernd Meyer

Neural Control of Action Selection
Bijan Pesaran
Michael N. Shadlen
Paul Cisek

Public Lecture
Tamim Asfour

Public PhD Student Event
Giulio Tononi
Joseph Levine

2nd Bernstein Sparks Workshop held in Tutzing

The second Bernstein Sparks Workshop, entitled “Neuroengineering the Brain: from Neuroscience to Robotics... and back”, took place in Tutzing from December 2–4, 2013.

More than 60 leading researchers, postdocs, graduate students and company representatives working in the border areas between computational neuroscience and systems engineering with a focus on robotics discussed currently available neuromorphic computing approaches applicable in future technical systems. The workshop increased the visibility of realistic large scale neural simulations in conjunction with closed-loop robotic systems, which provide adequate realworld stimuli. Additionally, it promoted the transfer of computational neurotechnology (algorithms and hardware) into the robotics research community.

The local organizers were Jörg Conradt and Gordon Cheng (both BCCN and TU München) as well as Susanne Schneider and Stefan Ehrlich (both TU München). They were supported by the Bernstein Coordination Site (BCOS) and the Center of Competence Neural Engineering (www.neuro-engineering.de) at TU München.

Bernstein Sparks Workshops are a forum for intensive dialogue between worldwide renowned experts on current research topics in which major developments are currently taking place. They are meant to contribute to “kindling” key scientific processes that could trigger breakthroughs in research or in assessing new application fields.
www.nncn.de/en/news/nachrichten-en/2nd-bernstein-sparks-workshop-held-in-tutzing

Bernstein Network website relaunched in new design

Since December 2013, the website of the Bernstein Network presents itself in a new design. Please find the redesigned website still under the usual URL

www.nncn.de

The new website is courteously hosted on the servers of G-Node, INCF‘s German node and one of the core infrastructures of the Bernstein Network.
www.nncn.de/en/news/nachrichten-en/bernstein-network-website-has-new-layout

Upcoming Events

Date	Title	Organizers	URL
Mar. 10–16, 2014, throughout Germany	Bernstein Events during the Brain Awareness Week 2014	Members of the Bernstein Network are (Co-) Organizers	www.nncn.de/en/news/events/baw2014
Mar. 19–23, 2014, Berlin	30th International Congress of Clinical Neurophysiology (ICCN 2014) organized in conjunction with the Annual Meeting of the German Society for Clinical Neurophysiology and Functional Imaging (DGKN)	O. W. Witte (BFNL Visual Learning), R. Dengler	www.iccn2014.de
April 25, 2014	Deadline for apllications of Brains for Brains Young Researchers' Computational Neuroscience Award 2014	Bernstein Association for Computational Neuroscience	www.nncn.de/en/bernstein-association/brains-for-brains-2014
June 20, 2014, München	3rd Bernstein Sparks Workshop “Modeling and Signal Processing for Auditory Implants”	B. Seeber, W. Hemmert (both BCCN München), Competence Center for Neuroengineering and Competence Center Bio-X at TU München, Bernstein Coordination Site (BCOS)	www.ci2014muc.info/Bernstein-Workshop.708.0.html
July 1–4, 2014, Reutlingen	9th International Meeting on Substrate-Integrated Microelectrode Arrays	A. Stett (BFNT Freiburg-Tübingen), G. Zeck, I. Digel, N. Gugeler, K. Bellack, NMI Reutlingen, Bernstein Center Freiburg, Multi Channel Systems MCS GmbH (industry partner of Bernstein Center Freiburg)	www.nmi.de/de/meameeting
July 11–24, 2014, Cold Spring Harbor Laboratory Banbury Conference Center, USA	Course “Computational Neuroscience: Vision”	G. Boynton, G. Horwitz, J. Pillow, S. Treue (BCCN and BFNT Göttingen)	http://meetings.cshl.edu/courses/2014/c-visi14.shtml
Aug 3–30, 2014, Frankfurt am Main	19th Advanced Course in Computational Neuroscience	E. Ahissar, D. Jaeger, M. Lengyel, C. Machens, Local Organizers: J. Triesch (BFNT Frankfurt), H. Cuntz (BPCN 2013)	http://fias.uni-frankfurt.de/accn
Aug 25–27, 2014, Leiden, The Netherlands	7th INCF Congress of Neuroinformatics	International Neuroinformatics Coordinating Facility (INCF)	www.neuroinformatics2014.org
Sept 2–5, 2014, Göttingen	Bernstein Conference 2014 Workshops: Sept 2–3, 2014 Main Conference: Sept 3–5, 2014	F. Wörgötter (BFNT and BCCN Göttingen, D-J Collaboration), K. Mosch and Y. Reimann (BCCN and BFNT Göttingen), Bernstein Coordination Site (BCOS)	www.bernstein-conference.de
Sept 8–13, 2014, Split, Croatia	G-Node Summer School Advanced Scientific Programming in Python	T. Zito (BCCN Berlin, G-Node), Z. Jedrzejewsky-Szmek (G-Node), L. Periša, I. Kajic (BCCN Berlin), I. Balaževic, F. Petkovski	http://python.g-node.org
Sept 15–19, 2014, Hamburg	International Conference on Artificial Neural Networks (ICANN)	S. Wermter, A. E. P. Villa, W. Duch, P. Koprinkova-Hristova, G. Palm, C. Weber (BFNT Frankfurt), T. Honkela, S. Magg, J. Bauer, J. Chacon, S. Heinrich, D. Jirak, K. Koesters, E.Strahl	http://icann2014.org

The Bernstein Network

Chairman of the Bernstein Project Committee: Andreas Herz

The National Bernstein Network Computational Neuroscience (NNCN) is a funding initiative of the Federal Ministry of Education and Research (BMBF). Established in 2004, it has the aim of structurally interconnecting and developing German capacities in the new scientific discipline of computational neuroscience and, to date, consists of more than 200 research groups. The network is named after the German physiologist Julius Bernstein (1835–1917).

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