Recent Publications
Hearing – Learning after stroke – Hearing in grasshoppers – Writing robot – Grasping movements

Meet the scientist
Henning Sprekeler

News and Events
Archivist in the sound library

People are adept at recognizing sensations such as sounds or smells, even when many stimuli appear simultaneously. But how the association between the current event and memory works is still poorly understood. Scientists at the Bernstein Center and the Ludwig-Maximilians Universität (LMU) Munich have developed a mathematical model that accurately mimics this process with little computational effort and may explain experimental findings that have so far remained unclear.

The so-called ‘cocktail party-problem’ has already kept scientists busy for decades. How is it possible for the brain to filter familiar voices out of background noise? It is a long-standing hypothesis that, over the course of our lives, we create a kind of sound library in the auditory cortex of the brain. Christian Leibold and Gonzalo Otazu, members of the Bernstein Center Munich and engaged at the Ludwig-Maximilians Universität (LMU) Munich now show in a new model how the brain can compare stored and perceived sounds in a particularly efficient manner. Figuratively speaking, current models operate on the following principle: An archivist (possibly the brain region thalamus) compares the incoming sound with the individual entries in the library, and receives the degree of matching for each entry. Usually, however, several entries fit similarly well, so the archivist does not know which result actually is the right one.

The new model is different: as previously, the archivist compares the sound with the library entries, this time getting back only a few really relevant records and information about how much the archived and heard elements differ. Therefore, large amounts of data are only sent back when the input is unknown or when matches are poor. “Perhaps this is also one reason why we can ignore known sounds better than new ones,” speculates Leibold, head of the study. During a test, the model was easily able to concurrently detect the sound of a violin and a grasshopper from 400 sounds with an overlapping frequency spectrum. Furthermore, computational and memory requirements were significantly smaller than in comparable models. For the first time, a library-based model allows a highly efficient real-time implementation, which is a prerequisite for an implementation in brain circuits.

Experiments long ago showed that a lot of information is sent from the cerebrum to the thalamus, so far without a universally accepted explanation. The new model predicts exactly this flow of information. “We quickly knew that our model works. But why and how, we laboriously had to find out,” Leibold says. Abstract mathematical models of neurobiological processes have the advantage that all contributing factors are known. Thus, one can show whether the model works well in a broad, biologically relevant application-spectrum, as in this case. The researchers now want to incorporate their findings into other models that are more biologically detailed and finally test it in psychoacoustic experiments.

Stroke impairs learning also in remote brain regions

Stroke patients often have difficulties with re-learning simple skills such as walking or talking, and the causes are still unknown. In a new study, researchers from the Bernstein Network and the Universities of Göttingen and Jena now show that a stroke even affects the learning ability of remote brain areas. Learning processes in the visual system of mice were impaired, in some cases even for weeks. The scientists conclude that plastic brain changes are modulated by networks far bigger than previously assumed. By administration of anti-inflammatory drugs, some of the networks were able to regain their learning ability.

In Germany alone, every year some 200,000 people suffer from strokes. It is still not understood why the affected subjects often find it so difficult to relearn everyday abilities. There are still debates about the best starting time for therapy and the best approach towards medication. Scientists have long observed that the localized blood flow disturbance can also affect distant brain areas. Now scientists led by Siegrid Löwel and Otto Witte have examined the effects of a local stroke on neuronal plasticity in the visual system of mice as part of the “Visual Learning” project of the Bernstein Focus: Neuronal Basis of Learning.

Closing one eye in healthy animals leads to an increase in the visual acuity of the remaining eye, and both hemispheres process information from the open eye more intensely. “We have shown that the brain loses this ability after a stroke,” says Franziska Greifzu, PhD student in the laboratory of Siegrid Löwel, a neurobiologist at the Bernstein Focus Neurotechnology and the University of Göttingen, and head of the study. For the investigation, a stroke was induced in an area of the cerebral cortex that has no known effect on the visual system. Closing one eye immediately after the stroke resulted in the mouse brain being unable to normally adapt to the new situation; it had lost its ability to learn. Two weeks after the brain damage, the ability to adapt was partly regenerated.

The researchers examined whether inflammation could be responsible for this compromised learning. Therefore, they treated the animals immediately after the stroke with an anti-inflammatory drug. The result was that the treated animals developed, as with healthy animals, an increased visual acuity of the open eye. “The impaired learning ability after a stroke could be rescued to normal levels by use of anti-inflammatory drugs”, explains Witte, a neurologist at the University Hospital of Jena.

How the damaged area of the brain affects the visual system is still unclear. “There are obviously a lot more interactions between brain areas than we know and usually test experimentally,” says Löwel. Now the scientists want to examine more closely what changes a stroke entails on the cellular level and how learning ability can be completely restored.

Less is more in the grasshopper’s ear

Our senses are constantly flooded with stimuli. In order to distinguish important from unimportant information, our senses already provide a valuable preprocessing step for the brain. Even just a few cells suffice in order to process complex stimuli, as scientists from the Bernstein Center Berlin and the Humboldt-Universität zu Berlin (HU) showed. They investigated how the auditory system of grasshoppers recognizes species-specific courtship songs and found that only three cellular interconnections are needed for song identification. Furthermore, it does not matter that the signals transmitted to the brain are far less precise than the input signals.

Millions of stimuli affect us, but only a fraction of these are important to us. The stimuli are filtered by the sensory organs and preprocessed, such that our brain is able to track what is important without becoming overwhelmed. The retina, for instance, does not only send single pixel information to the brain, but also information about movements and edges. For this purpose, a large network of thousands of cells is necessary. However, in many animals the neuronal networks of the sensory organs are much more simply constructed. Researchers led by Bernhard Ronacher, Susanne Schreiber and Sandra Wohlgemuth of the Bernstein Center and the HU in Berlin wondered how efficiently simple networks can perform preprocessing of complex stimuli. To answer this question, they examined the auditory system of grasshoppers, which is important for the recognition of species-specific courtship songs. The studied neurons are found in the thoracic ganglia of the animals.

To their surprise, the researchers discovered that after three cellular processing steps, the information was already heavily modified, and, above all, temporally inaccurate. However, the neuronal signals that were transmitted to the brain did contain the essential information about song features.

The courtship songs of different grasshopper species are characterized by alternating sounds and pauses. The activity of the sensory cells that sit in the ear on the abdomen of the animals was precisely temporally coupled with the incoming stimulus patterns. This allows the animals a very accurate classification of the patterns of courtship songs. But already the following cells showed a specific pattern of activity that forwarded only a fraction of the information. “At the beginning, we were very surprised that the network destroys that important precision,” says first author Jan Clemens. However, their analysis shows the reason for the change in signals. “While at the beginning of processing, most information lies in the precise timing of neuronal signals, the output signals are rather a yes-no answer,” says group leader Susanne Schreiber. Thus, many details are lost on the way to the grasshoppers’ brain, but the essential content about song features is much more readily available to the animal.

Thus, this small network also matches the prediction that information processing should be highly efficient in nervous systems in order to survive in evolution. For the next step, the scientists in Berlin aim to rebuild this neuronal network on the computer in order to understand such important data processing more thoroughly.

Robot demonstrates human-like handwriting

Scientists at the University of Göttingen and the Bernstein Focus Neurotechnology Göttingen have developed a method allowing robots to learn fluid movements such as writing or reaching for objects. This would allow future machines to be able to imitate handwriting, pour water into a glass or load a dishwasher.

Most human movements consist of a multitude of individual actions, which are automatically connected to each other. When a child learns to write, it initially guides the pen hesitantly. Over time, the child gradually learns to smoothly connect the individual letters to each other. To date, however, machines work only through a chain of distinct motion elements. Scientists working with Florentin Wörgötter, coordinator of the Bernstein Focus Neurotechnology at the University of Göttingen, have now altered the mathematical basis of control commands in a few, but crucial, details. As a result, the robot can combine actions, such as writing multiple letters that are dynamically connected to each other. Thus, robotic movements come much closer to the biological model than previously.

“In ten to fifteen years service robots will play a major role, so it is important that machine movement becomes more and more human-like, and thus predictable for us, so that we can work together without accidents,” explains Wörgötter.

The Minister for Science and Culture in the state of Lower Saxony, Prof. Dr. Johanna Wanka, was delighted by the capabilities of the robot, demonstrated on a visit to the Bernstein Focus Neurotechnology and the Bernstein Center for Computational Neuroscience in Göttingen. After the Minister provided a handwritten sample, the robot mimicked it perfectly. “Now, our robot is the first to officially master a ministerial handwriting,” said Wörgötter with a smile. “I am excited about the scientific results obtained at this location in Göttingen and I look forward to the many new possible applications for these technologies in the field of service robotics, though I will continue to write my signature myself,” states the Minister.

The mathematical method that was further developed by the Göttingen scientists is particularly characterized by the fact that it can be easily transferred to different courses of action and produces extremely smooth movements. Thus, it could make a significant contribution to the development of robots that support humans in their daily lives in the future.

Getting a grip on grasping

Quickly grabbing a cup of coffee is an everyday action for most of us. However, for people with severe paralysis this task is unfeasible – but not “unthinkable”. Because of this, interfaces between the brain and a computer can in principle detect these “thoughts” and transform them into steering commands. Scientists from Freiburg have now found a way to distinguish between different types of grasping, on the basis of the accompanying brain activity.

Tobias Pistohl and colleagues from the Bernstein Center Freiburg and the University Medical Center describe how they succeeded in differentiating between the brain activities associated with precision grips and grips using the whole hand. Ultimately, the scientists aim at developing a neuroprosthesis: A device that receives direct commands from the brain, and that can be used by paralysed people to control the arm of a robot – or even their own limbs.

One big problem with arm movements had been unresolved up to now. In our daily lives, it is important to be able to handle different kinds of objects in different ways, for example a feather and a brick. The researchers from Freiburg found aspects in the brain’s activity that can differentiate between precision grips and whole-hand grips.

To this end, Pistohl and his collaborators made use of signals that are measured on the surface of the brain. The big advantage of this approach is that no electrodes have to be implanted directly into this delicate organ. At the same time, the obtained signals are much more precise than those that can be measured on the scalp’s surface.

The scientists conducted a simple experiment with patients that were not paralysed, but had electrodes implanted into their skull for other medical reasons. The task was to grab a cup, either with a precision grip formed by the thumb and the index finger, or with their whole hand. At the same time, a computer recorded the electrical changes at the electrodes. The scientists were able to find signals in the brain’s activity that differed depending on the type of grasp, and a computer was able to attribute these signals to the different hand positions with great reliability. Now, the next challenge will be to identify these kinds of signals in paralysed patients as well – with the aim of eventually putting a more independent life back within their reach.

Text: Gunnar Grah, Bernstein Center Freiburg


Corrigendum

Martin Nawrot and Clemens Boucsein contributed equally to the publication about which the article „Thinking outside the column“ (Newsletter 09/2011) reported.
Henning Sprekeler

There appears to be a paradox in brain research. On the one hand, our brain can store memories for decades. On the other hand, it is highly adaptive. How can the brain satisfy these seemingly contradictory requirements? Henning Sprekeler intends to examine these and many other questions in detail. He received the Bernstein Award 2011 from the German Federal Ministry for Education and Research (BMBF) for this project, and with this grant he will over the next five years establish an independent research group at the Humboldt-Universität zu Berlin (HU) and the Bernstein Center Berlin.

Memories can only be stored long-term in the neuronal networks of our brain if the structure and activity of these networks remain stable, regardless of time and external influences. But how does the brain ensure this stability? “We have known for many years that the activity of neuronal networks must be very well balanced in order to function properly,” explains Sprekeler. For the network to be balanced, it is essential that the activity of excitatory and inhibitory neurons is in balance: “If inhibitory neurons have too little influence, the excitatory cells synchronize sooner or later. However, if inhibitory cells have too much influence, the neurons of the network fall almost silent. Both can critically disturb brain activity,” describes the brain researcher. Disruptions of this balance seem to play an important role in neurological disorders such as epilepsy and schizophrenia. Also because of this, research into the “activity of balanced neuronal networks” has come more into the focus of neuroscience lasting recent years.

In addition to its stability, the flexibility of the brain is extremely important for its function to learn new content. It has long been known that the process of learning causes changes in the strength of connections between neurons, as well as forming new connections or removing old ones. This connectivity plasticity has been extensively studied from the molecular level up to large-scale network models. Therefore, nowadays we have a much better understanding of the changes which are set in motion. But still, many basic questions remain unanswered.

The plasticity of neuronal connections, for example, which is essential for the learning process, automatically changes the influence of the excitatory or inhibitory neurons in the network. What mechanism prevents the network activity getting out of hand or becoming silent at such moments? How does the brain avoid these instabilities, which are almost inevitable when neuronal plasticity is introduced into strongly recurrent - and therefore biologically realistic – model networks? So far, not many have investigated these questions. “Once certain neurons obtained more influence, the entire balance ran out of control and the network 'exploded', so to speak,” describes Sprekeler on the situation up to now.

Past research focused primarily on the plasticity of excitatory neurons and paid less attention to changes in inhibitory neurons. Together with colleagues, Sprekeler has now developed a model that could explain how a continuous balance between activation and inhibition persists in complex networks when the balance of power changes by learning. To this end, the scientists paid more attention to the plasticity of inhibitory neurons than previous models. “In this way we can now systematically investigate the
influence of learning processes in balanced networks.” In initial studies, the researchers already found that the readjustment of the balance in turn affects the learning process - how this happens exactly, is as yet unexplored. Therefore, over the next few years, Sprekeler would like to develop models that simulate the plasticity and self-organization of networks, in particular, taking the inhibitory elements into account.

Sprekeler belongs to the theoreticians among neuroscientists. He studied physics in Freiburg and Berlin. “Originally I was interested in mathematical signal analysis in neuroscience, a field whose mathematical methods were familiar to me from quantum mechanics,” he explains. “Over the years, my interest has steadily moved towards biology.” His PhD thesis on “Slowness Learning: Mathematical Approaches and Biological Mechanisms” in the lab of Laurenz Wiskott at the HU Berlin finally marked his arrival in Computational Neuroscience. A stay of over two years in the laboratory of Wulfram Gerstner at the Brain Mind Institute of the Ecole Polytechnique Federale de Lausanne in Switzerland, from 2008 onwards, brought him closer to experimental research. “I wanted to work with more experimentally oriented scientists. As a theoretician, one must get close to the experiment to understand which models make sense and which don’t.” He now wants to contribute this experience to the Bernstein Network.

But his theory-oriented background is still important to him. With his projects within the Bernstein Award, he also wants to get back to his academic roots. He seeks, among other things, for answers to fundamental questions in neuroscience. For example, on which principles do neuronal networks develop and organize themselves? He is also interested in how stimuli are encoded in the brain. By receiving external stimuli, we learn about our environment and develop an internal representation of the world. What are the effects of these stimuli and the associated learning processes on the development, structure and activity patterns of the brain? He is interested in whether simple principles are veiled behind these developmental and organizational processes and what they might look like.

When Sprekeler returned to the HU Berlin in early 2011, he was able to quickly develop and expand connections to other members of the Bernstein Network: besides Laurenz Wiskott, Richard Kempter and Susanne Schreiber, with whom he had been in contact since the times of his PhD thesis, collaborations are planned with Michael Brecht and Dietmar Schmitz, among others. There, Sprekeler will examine the data transfer from the hippocampus into the cortex and the development of episodic memory. “I want to contribute to a future understanding of how complex networks like the brain learn,” describes the Munster-born researcher his motivation in brain science. What does the Bernstein Prize mean to him? “It gives me the security to calmly pursue my research in the next few years. For that, I am very glad and grateful.” This calm will be needed while devoting the next few years to the paradoxes of brain research.

*Synaptic plasticity often shows a characteristic, asymmetric dependence on the relative timing of pre- and postsynaptic activity (characteristic graph sketched as balance). The central goal of Sprekeler’s research agenda is to understand how such forms of synaptic plasticity interact with the observed balance between excitatory and inhibitory currents in cortical networks.*
News and Events

Personalia

**Ernst Bamberg** (BFNT Göttingen, MPI of Biophysics, Frankfurt) cooperates with the Sanofi subsidiary Fovea Pharmaceuticals. The objective is to develop new optogenetic applications for the treatment of retinal diseases.

http://idw-online.de/de/news440770 (in German)

**Wolf Singer** (BFNT Frankfurt, MPI for Brain Research, Frankfurt) received the Order of Merit, First Class, of the Federal Republic of Germany, conferred by the Hessian Minister for Federal Affairs, Minister of State, Michael Boddenberg.

www.nncn.de/nachrichten-en/bundesverdienstordensinger/

**Jürgen Hennig** (BFNT Freiburg-Tübingen, University Hospital Freiburg) was elected new member of the German Academy of Sciences Leopoldina, received, together with the research team of Jan Korvink (IMTEK, Freiburg), the “red dot award” for the development of a novel helmet for high-resolution magnetic resonance imaging and was awarded with an Einstein Professorship of the Chinese Academy of Sciences.

www.nncn.de/nachrichten-en/hennigleopoldina/
www.nncn.de/nachrichten-en/einsteinprofessor/

**Steffen Katzner** (Centre for Integrative Neuroscience of the Tübingen University, BCCN Tübingen) receives an ERC Starting Grant for his project “Cortical circuits of visual perception” in which the neuronal basis of visual perception will be investigated.

http://idw-online.de/de/news445270 (in German)

**Gary Lewin** (BCCN Berlin and MDC for Molecular Medicine, Berlin-Buch) receives an ERC Advanced Grant for the investigation of the genes that allow the African naked mole rat (Heterocephalus glaber) to survive under extreme conditions and to feel no pain.

http://idw-online.de/de/news449594 (in German)

**Wilhelm Stannat** has been appointed to the W3-Professorship for “Mathematical Stochastics – Stochastic Processes in the Neurosciences” that was newly established within the framework of the BCCN Berlin. Since October 2011, he conducts research and teaching at the TU and the BCCN Berlin.

www.nncn.de/nachrichten-en/stannat/

**Stephanie Westendorff**, Postdoc with Alexander Gail (BCCN and BFNT Göttingen, German Primate Center (Deutsches Primatenzentrum, DPZ), Göttingen), receives the DPZ Sponsorship Prize 2011 for her outstanding research on the planning and control of targeted arm movements in the primate brain.

http://idw-online.de/de/news448025 (in German)

Images: Axel Griesch; Jürgen Hennig; Friedhelm Albrecht, Uni Tübingen; Uwe Eising, MDC; Wolf Singer; Wilhelm Stannat; M. Hampe, Deutsches Primatenzentrum
Bernstein Conference 2011

This year’s Bernstein Conference was organized by the BFNT Freiburg-Tübingen under the direction of Ulrich Egert and was held in conjunction with the annual meeting of the trinational neuroscience network Neurex. Approximately 400 international participants registered for the conference. As in past years, all conference abstracts were published in Frontiers in Computational Neuroscience.

www.frontiersin.org/events/bernstein_conference_2011/1484/computational_neuroscience

Bernstein Award 2011

As in previous years, the first highlight of the conference was the prize giving ceremony of the Bernstein Award. The award was presented by Dr. Christiane Buchholz (Federal Ministry of Education and Research) to Henning Sprekeler (Humboldt-Universität zu Berlin). With up to 1.25 Mio. Euros, the Bernstein Award is one of the most highly remunerated research awards for young scientists.

Bernstein Bazar

Following the presentation of the Bernstein Award, the Bernstein Bazar offered journalists – in a format similar to speed dating – the opportunity to get an overview over current topics of the neurosciences by talking to the Bernstein Awardee and 14 further researchers from the Bernstein Network.

Poster awards

The Bernstein Center Freiburg (BCF), together with the Freiburg NeurAG, presented poster awards, each endowed with 500 Euros, to Jan Clemens (Humboldt-Universität zu Berlin), Tomislav Milekovic (Imperial College London, UK & University of Freiburg), Cengiz Pehlevan (Harvard University, USA), and Michael Schmuker (Freie Universität Berlin, BCCN Berlin).

Brains for Brains Awards

The Bernstein Association for Computational Neuroscience presented this year’s young researchers’ awards to Elizabeth Forbes (University of Queensland, Australia) and Daniel Rasmussen (University of Waterloo, Canada). Ines Derya Steenbuck (Universities of Freiburg and Amsterdam) received a special award. The awards were made possible by generous donations by the companies Brain Products GmbH and Multi Channel Systems MCS GmbH.

Fellows of Sloan-Swartz Centers

Within the framework of the German-US-American exchange program between the Bernstein Network and the Sloan-Swartz Centers for Theoretical Neurobiology, the BCF and the Bernstein Center Munich sponsored the participation of the American PhD students / postdocs Cengiz Pehlevan (Harvard University, Cambridge), Joseph Makin (University of California San Francisco), Gabrielle Gutierrez (Brandeis University, Waltham) and David Markovitz (New York University, New York) at the Bernstein Conference.

NeuroVision Film Contest

For the first time, a short film competition was held within the framework of the Bernstein Conference. Candidate films covered themes from the neurosciences in a generally understandable form. The audience prize went to Florian Rau and the jury prize was shared between Florian Rau and Denys Matthies. Each price was endowed with 500 Euros by the BCF.

Interactive art installation „sensory neuronal network“

Furthermore, the conference featured the first public exhibition of an interactive installation by artist Rainer Dunkel and Benjamin Staude (formerly BCF), controlled by a neural network.

www.nncn.de/nachrichten-en/bernsteinconference2011/
In memory of Valentino Braitenberg

Valentino Braitenberg, brain scientist and former director at the MPI for Biological Cybernetics, passed away in Tübingen on September 9, 2011, at the age of 85.

His life’s work and his extraordinary personality were inextricably interwoven and left a strong impression on everyone who had the good fortune to know him personally. The focus of his research was the functional interpretation of brain structures. When electronic computers emerged in the 1950s, it was clear to Braitenberg that they presented conceptual models for brain function. Thus, his neuroanatomical studies aimed at identifying the typical network structure of individual brain areas. He then used this knowledge to translate their structural features into possible schemes of their function. In doing so, Braitenberg made neuroanatomy an indispensable pillar of brain research. His influence on modern brain research, including Computational Neuroscience, is comparable to that of the founders of neurocybernetics, who introduced the logical analysis of neural networks (McCulloch and Pitts 1943), the concept of feedback in homeostatic systems (Norbert Wiener 1948), the concept of information and redundancy in perception (Shannon 1948), and the neural theory of association and “cell assemblies” (Hebb 1949). We miss you, Valentino.

A book with the title “Tentacles of the mind. Encounters with Valentino Braitenberg” (Edition Raetia) will appear soon.

Bernstein scientists at Public Dialogue about neuronal implants

Within the framework of a public dialogue (“Bürgerdialog”), the German Federal Ministry of Education and Research (BMBF) offers the general public the opportunity to learn about and discuss new medical technologies and to provide politics with their feedback on the questions, concerns and hopes that these technologies raise. This public dialogue is part of an extensive exchange about several future technologies between citizens, science, economy and politics that the BMBF is organizing over the coming four years. Members of the Bernstein Network contributed to this exchange by offering their expertise on the focus topic “Neuronal Implants”.

At a corresponding public conference on September 24, 2011, in Munich, Alfred Stett (BFNT Freiburg-Tübingen and NMI, Reutlingen) and Werner Hemmert (BCCN and TU Munich) presented current developments in the fields of retinal and cochlear implants to 100 selected citizens. Michele Nicoletti (PhD student in Werner Hemmert’s group) participated as a junior expert in a special youth dialogue event on the same topic, held within the Day of Talents (“Tag der Talente”) on September 18 in Berlin.

www.buergerdialog-bmbf.de (in German)
New call for proposals: Bernstein Award 2012

In 2012, the German Ministry of Education and Research (Bundesministerium für Bildung und Forschung, BMBF) intends to confer the seventh annual Bernstein Award to an excellent young scientist with outstanding research ideas in the field of Computational Neuroscience. The “Bernstein Award for Computational Neuroscience” is endowed with up to 1.25 Mio € for a period of five years, and allows young scientists from all nations to establish an independent research group at a German university or research institution. Application deadline for the year 2012 is May 2nd, 2012.


Public lecture series: Goals and methods of neurotechnology

To present the scientific content of the excellence cluster application BrainLinks-BrainTools - in which many scientists of the Bernstein Center Freiburg are involved - to the broad public, the University of Freiburg will, in the winter term 11/12, host a lecture series on Neurotechnology. The public lectures (which are held in German) will span the whole breadth of topics of this field, including contributions from biology, engineering, and medical applications.

www.bcf.uni-freiburg.de/news/20111017-blbt-lecture

The Bernstein Coordination Site whishes you a Merry Christmas and a successful New Year 2012!
## News and Events

### Upcoming Events

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<td>Mar. 5-9, 2012 Munich</td>
<td>4th G-Node Winter Course on Neural Data Analysis</td>
<td>S. Grün (BCCN Berlin), T. Wachtler-Kulla, M. Volk (G-Node, BCCN Munich)</td>
<td><a href="http://www.g-node.org/dataanalysis-course-2012">www.g-node.org/dataanalysis-course-2012</a></td>
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<tr>
<td>Oct. 7-12, 2012 Freiburg</td>
<td>BCF/NWG Course: Analysis and Models in Neurophysiology</td>
<td>S. Rotter, U. Egert, A. Aertsen, J. Kirsch (Bernstein Center Freiburg), S. Grün (BCCN Berlin)</td>
<td><a href="http://www.bcf.uni-freiburg.de/events/conferences-workshops/20121007-nwgcourse">www.bcf.uni-freiburg.de/events/conferences-workshops/20121007-nwgcourse</a></td>
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The Bernstein Network

Chairman of the Bernstein Project Committee: Andreas Herz (Munich)
Deputy Chairman of the Project Committee: Theo Geisel (Göttingen)

Bernstein Centers for Computational Neuroscience (Coordinator)
Berlin (Michael Brecht)
Freiburg (Ad Aertsen, Director: Stefan Rotter)
Göttingen (Theo Geisel)
Heidelberg / Mannheim (Daniel Durstewitz)
Munich (Andreas Herz)
Tübingen (Matthias Bethge)

Bernstein Focus: Neurotechnology (Coordinator)
Berlin (Klaus-Robert Müller)
Frankfurt (Christoph von der Malsburg, Jochen Triesch, Rudolf Mester)
Freiburg – Tübingen (Ulrich Egert)
Göttingen (Florentin Wörgötter)

Bernstein Focus: Neuronal Basis of Learning (Coordinator)
Visual Learning (Siegfried Löwel)
Plasticity of Neural Dynamics (Christian Leibold)
Memory in Decision Making (Dorothea Eisenhardt)
Sequence Learning (Onur Güntürkün)
Ephemeral Memory (Hiromu Tanimoto)
Complex Human Learning (Christian Büchel)
State Dependencies of Learning (Petra Ritter, Richard Kempter)
Learning Behavioral Models (Ioannis Iossifidis)

Bernstein Groups for Computational Neuroscience (Coordinator)
Bochum (Gregor Schöner)
Bremen (Klaus Pawelzik)
Heidelberg (Gabriel Wittum)
Jena (Herbert Witte)
Magdeburg (Jochen Braun)

Bernstein Collaborations for Computational Neuroscience

Bernstein Award for Computational Neuroscience
Matthias Bethge (Tübingen), Jan Benda (Munich), Susanne Schreiber (Berlin), Jan Gläscher (Hamburg), Udo Ernst (Bremen), Henning Sprekeler (Berlin)

German INCF-Node (Coordinator)
G-Node (Andreas Herz, Director: Thomas Wachtler-Kulla)

German–US-American Collaborations (German Coordinator)
Berlin–Cambridge (Klaus Obermayer)
Freiburg–Cambridge (Andreas Schulze-Bonhage)
Lübeck–New York (Lisa Marshall)
Mannheim–Los Angeles (Thomas Hahn)
Munich–San Diego (Christian Leibold)

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