OIST News

The Okinawa Institute of Science and Technology Promotion Corporation is an independent administrative institution launched in September 2005 to prepare for the establishment a graduate university of science and technology in Okinawa. OIST News is a print publication intended to highlight precursory activities at OIST.

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Members of the Neural Computational Unit

Neural Computational Unit
Principal Investigator: Dr. Kenji Doya (center)

The Okinawa Institute of Science and Technology Promotion Corporation (hereafter OIST) was established on September 1, 2005 to prepare for the establishment of a new graduate university. The Neural Computation Unit, led by Dr. Kenji Doya, is one of the four precursory research programs started in April 2004 in Uruma City. Following his participation in the three-week Okinawa Computational Neuroscience Course (OCNC) 2007 as a co-organizer, Dr. Doya spoke about his passion for research and sports.

An avid athlete finds interest in brain mechanism
I have been enjoying a variety of sports since youth, such as tennis, skiing, windsurfing, and most recently, triathlon. In my undergraduate days, I lived through winter working as a ski instructor, and many of my students asked me why their bodies did not move in certain ways even though they understood what I told them. This piqued my curiosity and led me to the research on motor control and learning. For my undergraduate thesis project, I built a robot that learned

Dr. Doya in front of triathlon medals

locomotion pattern on its own. After receiving a Ph.D. in the study of learning algorithms for artificial neural networks, a major turning point in my career came in 1991, when I moved to the Department of Biology at the University of California, San Diego (UCSD), as a post-doctoral researcher. There, I was exposed to real neurons, and I was re-educated by real neurobiologists. In 1993, I joined the nearby Salk Institute and learned the research style of mathematicians and physicists working with biologists in wet labs.

The first settlers at OIST
After returning to Japan in 1994, I have been fortunate to pursue my study under excellent research environment provided by Advanced Telecommunications Research
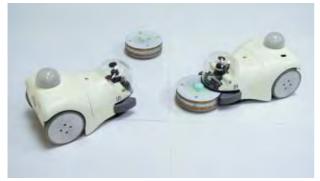
Institute International (ATR), Nara Institute of Science and Technology (NAIST), and Japan Science and Technology Agency (JST). In the spring of 2004, my life took a new turn when I moved to Okinawa to launch an OIST initial research project focusing on systems neurobiology and robotic studies. The unit that began with no desk, no computer, and just six staff members including myself, has now expanded to 15 researchers, with four in the theory group, six in the neurobiology group, and five in the robotics group.

Seeds planted in Okinawa are starting to bud

This is the fourth year of our five-year research project. I am particularly excited that the new research projects that we started in Okinawa have started to yield novel results.

1. Cyber Rodents-How to design rewards for robots?

Our major research focus is "reinforcement learning," a theory for an animal or a robot to learn behaviors from positive or negative rewards. Most studies deal with learning under a given rule of rewards, but we are interested in designing rewards in robots. In order to test our ideas on the origin of rewards, we have built robots called Cyber Rodents, which can "survive" by capturing
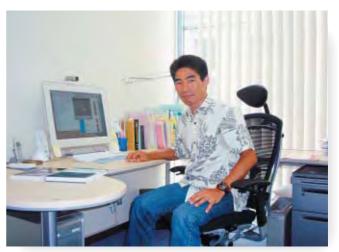

Cyber Rodents and battery packs

battery packs and "reproduce" in software by transmitting their programs or parameters through infrared communication. An obvious way is to define recharging and successful "gene" transfer as the rewards, but learning foraging and mating behaviors simply from these rewards require enormous random exploration, letting most robots "die" by exhaustion. Meanwhile, granting rewards for seeing a battery pack or another robot has enabled much faster learning by promoting more focused behaviors. This may be synonymous with what happens when we see colorful fruits or a reproductive partner. Quite often, when the strength of such supplementary rewards or the

parameters of our learning algorithm is not set right, we find robots learning strange behaviors, such as vacantly looking at a battery pack, or not reaching for a battery unless it can be caught immediately. These "pathetic" learned behaviors could be robotic models of psychiatric disorders. Our current aim is to let Cyber Rodents evolve their own reward functions and learning algorithms to adapt to changing environments. We believe that the ideas developed here will be the basis of future robots that can evolve through the Internet and give better insights to the designs of reward systems in the brain.

2. Decisions in rats and humans

Our daily life is full of decisions. For example, when you go out for lunch, you may choose a place of good reputation or a newly opened one, and opt for rich, tasty ribs or a healthy salad. Or, you may even decide not to eat at all. What is the basic principle and neural mechanisms of our daily choices? To study this, we are asking rats to perform simple choice tasks and determining what mathematical model best describes the choice sequences under a variety of reward settings. By employing the framework of Bayesian inference, we have built a computer model that can estimate the states and parameters of each individual rat and thereby predicting its future choice behavior. Through electric recording and chemical monitoring, we are searching in a rat's brain for any activities correlated with such states and parameters. When the unit successfully models how humans learn to make choices, and how such learning can go wrong, we believe that our research will be able to explain the mechanisms of affective and cognitive disorders, such as schizophrenia, depression, and addiction.

Dr. Doya at his office in Uruma City

3. OCNC 2007

The Okinawa Computational Neuroscience Course (OCNC), which brings together computational modelers and neurobiological experimenters, saw another success this year. Although such courses have been popular in the United States and Europe, there was nothing comparable in Japan. I started a short domestic course through grass-root efforts in 1999 and I am happy to see it fledge as a comprehensive, international course here in Okinawa. As a co-organizer, I am sure that students return to their labs with new knowledge and practical modeling skills useful for their research. I hope that the human network started in Okinawa will be their lifetime asset. To me, OCNC helps me stay young and updated through interactions with young, promising researchers. I have also been fortunate to publish two books together with some of the lecturers in the previous courses.

Books co-edited by Dr. Doya

Bayesian Brain. Edited by Kenji Doya, Shin Ishii, Alexandre Pouget and Rajesh P.N. Rao. MIT Press. January 2007. ISBN-10: 0-262-04238-X. ISBN-13: 978-0-262-04238-3

Reward and Decision Making in Corticobasal Ganglia Networks. Edited by Barnard Balleine, Kenji Doya, John O'Doherty, and Masamichi Sakagami. Annals of the New York Academy of Sciences. Volume 1104, July 2007. ISBN-1-57331-674-1

Dr. Doya won the 21st Tsukahara Nakaakira Prize, given by the Brain Science Foundation every year to a researcher up to 45 years old in recognition of his/her outstanding and unique research in the field of life science. The award ceremony is scheduled for September 10 in Yokohama. Last year, Dr. Doya also won the 3rd JSPS Prize, given annually by the Japan Society for the Promotion of Science (JSPS) in recognition and support of excellent, young researchers with rich creativity and superlative research ability.

A Promising Star

Dr. Junichiro Yoshimoto
Dynamical Systems Group leader, Neural Computational Unit

Dr. Yoshimoto is one of the five researchers who joined the Neural Computation Unit when it was launched in 2004. He has known Dr. Doya since 1999, when he joined a CREST program under JST, supervised by Dr. Doya. Dr. Yoshimoto earned a Ph.D. in information science from Nara Institute of Science and Technology (NAIST), where he concurrently serves as a visiting associate professor. At OIST, Dr. Yoshimoto is developing a novel computational framework for system identification of biological networks, while also supervising younger researchers from NAIST.

My expertise is in mathematical engineering, and I am familiar with computational modeling. I joined OIST three years ago in hopes of broadening my knowledge of life science, particularly neuroscience. I also wanted to overcome my difficulty in English, and that was another impetus for joining an international organization such as OIST.

Our brain works by communication between billions of neurons as well as chemical signaling within each neuron. The aim of the Dynamical Systems Group is to develop novel computational methods for understanding how such complex networks work. We analyze data collected by the Systems Neurobiology Group and those available in the public domain. The most exciting moment of my research is when the prediction by my computer model matches the result of a real biological experiment.

International Workshops and Seminars

OIST has been hosting international workshops and seminars to enhance cooperation with research institutions at home and abroad. These workshops and seminars also help introduce the vision of establishing a graduate university in Okinawa to the worldwide scientific community. Below are workshops and seminars that took place between April and July this year.

April 20-22 International Workshop at the Seaside House

"Inverse Problems and Biology"
Organizers: Dr. Robert Sinclair, OIST and Dr. Klaus Stiefel, OIST

April 24-26 International Seminars at the Initial Research Project Laboratory

"Towards a Theory of Learning and Levels for Biology"
Speaker: Dr. Anthony Bell, University of California at Berkeley

"Quantitative Assessment of Phylogenetic Indels and the Roots of Placental Mammals"
Speaker: Dr. Peter Waddell, University of South Carolina, South Carolina Cancer Center

"A New Approach toward Detecting Community Structures in Networks"
Speaker: Professor Andreas Dress, CAS—MPG Partner Institute for Computational Biology

"Pianos, Plants and Pasta: Their Impact on Mathematics"
Speaker: Dr. Robert S. Anderssen, The Commonwealth Scientific and Industrial Research Organisation

"Olfaction Targeted"
Speaker: Dr. Peter Mombaerts, The Rockefeller University

May 10 Open Seminar at the Okinawa Industrial Technology Center

"The Impact of the Major Acidic Phospholipid Deficiency on Regulation of Gene Expression in Escherichia coli"
Speaker: Dr. Hideki Nagahama, Saitama University

May 14 Special Seminar at the Okinawa Industrial Technology Center

"Neural and Molecular Mechanisms of Operant Reward Learning"
Speaker: Dr. John H. Byrne, The University of Texas Medical School at Houston

May 30 Seminar at the Initial Research Project Laboratory

"microRNAs: from Scale Invariance to Stem Cells"
Speaker: Dr. Jonathan Miller, Baylor College of Medicine

June 26-July 12 at the Seaside House

Okinawa Computational Neuroscience Course (OCNC) 2007

The Okinawa Computational Neuroscience Course (OCNC) 2007 took place from June 26 to July 12 at the OIST Seaside House. The fourth course in an annual series that began in 2004 offered lectures on single neurons, neural networks and behaviors with ample time for student projects. The course brought together 18 lecturers, 8 tutors and 31 students from 16 countries. The participants, mostly first-time visitors to Okinawa, shared their course experience and their impressions of Okinawa.
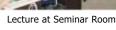
Lecturers

"Japan should be proud of OIST"

Professor Eve Marder

Brandeis University, USA
Chief Editor, Journal of Neurophysiology
President-elect, Society for Neuroscience

OCNC 2007 reminded me of a summer school at the Marine Biology Laboratory (MBL) in Woods Hole, Massachusetts. The traditional course offers students with an opportunity to meet distinguished scientists and establish a life-long peer network. Japan should be proud of OIST. Having participated in OCNC 2007, I feel sure that OIST will become one of the most beneficial, well-managed institutions in the country. Its ability to recruit world-class scientists will help Japan put on a more international face, since it has not been easy up to now for foreign scientists to come and work in this country.

Lecture at Seminar Room

Students engage in panel discussion

"I was a girl who dreamed of becoming a zoologist"

Dr. Sophie Deneve

Group Leader, Group for Neural Theory, ENS Paris, France

As a child, I dreamed of becoming a zoologist since I was interested in animal behavior. Computational neuroscience is a booming field. I have found in OCNC a general course, but the discussions were in-depth, covering many subjects from the cable theory of neural arbors to behavior. My lecture focused on computational models, and it was successful - or at least I can say I did not lose my audience. If I am invited to join OIST as a principal investigator in the future, I will definitely consider the offer, as long as there is enough funding for my research and administrative support, and as long as there is an international community big enough to make foreigners feel welcome.

Tutors

"Student projects were of much higher quality than I anticipated"

Dr. Justin Kinney
Salk Institute, USA

Dr. Klaus Stiefel, a principal investigator at OIST and my former colleague at the Salk Institute, invited me to participate in OCNC 2007 as a tutor. The course exceeded my expectations. The subtropical climate of Okinawa and the meals were outstanding. The course covered a wide range of topics including both theoretical and experimental approaches. The student projects were of much higher quality than I anticipated, partly because this year's OCNC set aside the entire afternoon for students to work on them. I saw many students working well into the evening and even past midnight.

Student Project

"I am convinced that OIST will excel within 10 years"

Dr. Carson Roberts,
University of Texas at San Antonio, USA

I learned about OCNC 2007 through a mailing list. As a tutor with a background in materials science and the experimental physics of semiconductor devices, I helped the students with their projects on detailed neuron models. We worked so hard that I left the Seaside House only a few times during the first week! I strongly support OIST and have even started considering joining the institution as a researcher in 2012, when it plans to open as a graduate school. As long as the Japanese government keeps up its funding, I am convinced that OIST will excel within 10 years.
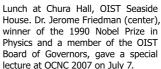
Students

"OCNC 2007 far exceeded my expectations"

Ms. Eeva Makiraatikka
Tampere University of Technology, Finland

I applied for this course on the strong recommendation of my supervisor, who knows OIST Principal Investigator Dr. Erik De Schutter. The course far exceeded my expectations. I was satisfied with the administrative support and the speakers, including two lecturers who were truly superb. I

also appreciated the safety of the Seaside House. Lunch time served as a forum to go over morning lectures with other participants, including the parts that I did not understand very well.

Lunch at Chura Hall, OIST Seaside House. Dr. Jerome Friedman (center), winner of the 1990 Nobel Prize in Physics and a member of the OIST Board of Governors, gave a special lecture at OCNC 2007 on July 7.

Participants visited Initial Research Projects in Uruma City. Shown here is the Developmental Neurobiology Unit, where zebrafish are used to elucidate the mechanism that regulates neuronal development.

"Best accommodations I have ever experienced"

Mr. Kazuhisa Shibata
Ph.D. Candidate, NAIST/ATR, Japan

I decided to take part in this course because it met my needs. I am an experimenter familiar with psychophysics and neuroimaging. I wanted to expand the scope of my research by studying more about computational modeling. The Seaside House offered the best accommodations I have ever experienced. I was particularly impressed by the wireless LAN available throughout the building. No wonder this course is so popular every year, attracting five times as many applicants as places available.

"Some of the best lectures I have heard in years"

Mr. Johannes Hjorth
Ph.D. Student, Royal Institute of Technology, Sweden

I enjoyed good lectures related to my field, including some of the best I heard in years. I believe the duration of the course was just right. There was nice food, friendly staff, and a great climate. I would seriously consider coming back to OIST in the future.

Dr. Torsten Wiesel, winner of the 1981 Nobel Prize in Physiology or Medicine and a co-chair of the OIST Board of Governors, gave a special lecture at OCNC 2007 on July 10.

Participants visited the main campus construction site in Onna Village and received a brief orientation from an OIST staff member about the construction plan.

New Research Units at OIST

Computational Neuroscience Unit (established in April 2007)

Principal Investigator
Dr. Erik De Schutter

Dr. Erik De Schutter, who leads the Computational Neuroscience Unit, has focused his research on the use of computational methods to study how neurons and microcircuits in the brain operate. Trained as a medical doctor and neurologist, Dr. De Schutter initially worked on simulating invertebrate central pattern generators. During a post-doctoral study at the California Institute of Technology in the early 1990s, he switched to studying the function of the cerebellum and developed a model of the cerebellar Purkinje cell, the most detailed single neuron model at that time. In 1996, Dr. De Schutter co-founded the EU advanced course in computational neuroscience. He joined OIST from the University of Antwerp, Belgium, where he was the principal investigator of the Theoretical Neurobiology Unit.

Trans-Membrane Trafficking Unit (established in April 2007)

Principal Investigator
Dr. Fadel A. Samatey

Born in Senegal and educated in France, Dr. Fadel Alexis Samatey arrived in Japan in 1994 on a two-year EU Science and Technology fellowship. In 1996, he began working on X-ray protein crystallography, and this work continues, now with a focus on the structure of membrane proteins. Although Dr. Samatey is new to Okinawa, he is fluent in Japanese, partly due to his past research positions at various institutions in Japan. He heads the Trans-Membrane Trafficking Unit focusing on research into the functional analysis of membrane proteins through high-resolution structure determination.

Cellular and Molecular Synaptic Function Unit (established in April 2007)

Principal Investigator
Dr. Tomoyuki Takahashi

The aim of the Cellular and Molecular Synaptic Function Unit, led by Dr. Tomoyuki Takahashi, is to understand the regulatory mechanisms of synaptic transmission by using the calyx of Held, a fast glutamatergic relay synapse in the brainstem auditory pathway involved in sound localization. After graduating from the Tokyo Medical and Dental University in 1975, Dr. Takahashi held several research positions at various academic institutions at home and abroad before becoming a professor at the University of Tokyo in 1993 and at its graduate school of medicine in 1996. During this time, he organized annual retreats to provide participating researchers with a forum for interaction and exchange of information outside laboratories. Two of his researchers at the University of Tokyo have joined Dr. Takahashi's unit at OIST.

Developmental Signaling Unit (established in May 2007)

Principal Investigator
Dr. Mary Ann Price

The major interest of the Developmental Signaling Unit, headed by Dr. Mary Ann Price, is the mechanisms cells use to decode extracellular signals during development. The current focus of the unit is Hedgehog signal transduction, an important developmental signaling pathway increasingly recognized for its role in human disease, and in particular the regulation of Ci, the key transcription factor on the pathway. Dr. Price's laboratory uses a variety of approaches to address questions in this field, including Drosophila genetics. Originally from the United States, Dr. Price lived in Okinawa for about four years with her family during her youth. Formerly a researcher at the University of Sheffield, she moved to Okinawa from the United Kingdom to lead what is soon going to be a group of five researchers and one staff from China, India, Russia and Okinawa, Japan.

Events

The 4th Meeting of the Board of Governors

The 4th meeting of the OIST Board of Governors took place on July 9 at Bankoku Shinryokan in Nago City. In the meeting, which took place for the first time in Okinawa, board members discussed progress on construction of the OIST main campus, as well as research activities. Some board members visited Yamada Junior High School and Onna Junior High School in Onna Village, and gave a lecture at the University of the Ryukyus in Nishihara Town on July 10.

Dr. Yuan T. Lee, winner of the 1986 Nobel Prize in Chemistry, is surrounded by students after giving a lecture at the University of the Ryukyus. President Teruo Iwamasa (second from the right) and Vice President Keisuke Taira of the university also welcome Dr. Lee.

Participants of the 4th BOG meeting

Board members, Dr. Yuan T. Lee (left), Dr. Jerome Friedman (center), and Dr. Hiroko Sho, observe a craft-making class during their visit to Yamada Junior High School in Onna Village on July 10.

Visit by Then Minister Sanae Takaichi

Then Minister Sanae Takaichi, for Okinawa and Northern Territories Affairs, Science and Technology Policy, Innovation, Gender Equality, Social Affairs and Food Safety, visited the Seaside House and the main campus construction site on July 4. She pledged that the Japanese government would continue assisting OIST along with local municipal governments and other concerned parties. She also emphasized the need to develop support infrastructure for OIST and its researchers, such as housing and childcare facilities.

Then Minister Takaichi is greeted by Dr. Gail Tripp of the Human Developmental Neurobiology Unit at the Seaside House.

Visit by Women from the Tancha Day Service Center

Women from the Tancha Day Service Center visited OIST on July 11. Some of them were surprised at the appearance of the former Hakuun-so, which has been renovated and reopened as the OIST Seaside House.

Women from the Tancha Day Service Center

Main Campus Update

Construction of the main campus is under way, with completion of some of the facilities at the laboratory zone expected in spring 2009. The extent of progress can be viewed on our Website, along with the latest activities at OIST. http://www.oist.jp

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