IST AUSTRIA
Institute of Science and Technology

NEWSLETTER

5th edition | May 2013

In the coming months, IST Austria opens its doors for many visitors from inside and outside the scientific community.

At the Science-Industry Talk on June 4, organized jointly with the Federation of Austrian Industrialists (IV), we are looking forward to bringing together experts of industrial and academic research to discuss what the two domains can learn from each other. The international panel includes Horst Domdey, Hermann Hauser, Hermann Kopetz and Sriram Rajamani.

On June 8, IST Austria is open for everyone interested in experiencing the world of science and in learning more about IST Austria, its people and campus, its research and graduate school at the Open Campus.

We hope to welcome you soon at one of our events at IST Austria!

Beate Zöchmeister | Head of Executive Office

ISTFELLOW

Round three of the ISTFELLOW program to start soon!

Launched in July 2012, the ISTFELLOW program partially funded by the European Union will, over a period of five years, support the research of 40 postdocs at IST Austria for two years each.

Two fellows selected in the first round are already on campus: Remy Chait and Krisztián Kovács haven taken up their work in the Guet and the Csicsvari groups, respectively. Third fellow Patrik Noren will arrive this summer and join Caroline Uhler's group. The second call for fellows was completed recently and saw a rise in applications by candidates from all over the world.

The deadline for the third round of applications is September 15, 2013. More information about ISTFELLOW and how to apply can be found at ist.ac.at/research/postdoctoral-research/istfellow.

SCIENCE AT IST AUSTRIA

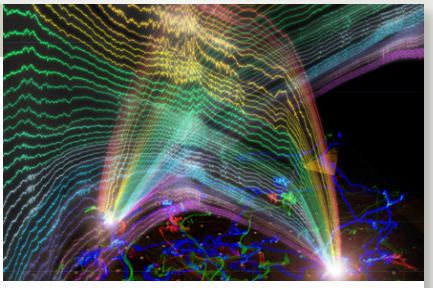
Neuroscience

Jozsef Csicsvari

During learning, information is transformed into memory through processing and encoding in neural circuits. In a publication in *Neuron,* a team including Jozsef Csicsvari uncovered a novel role for interneurons in the rat hippocampus during the formation of spatial memory.

Space is represented in the hippocampus through plastic connection changes between neurons. The group investigates spatial learning using the cheeseboard maze, which contains holes, some of which hide food. Spatial memory is encoded through firing of "place cells", excitatory pyramidal cells which fire when the animal arrives at a particular location. During learning, the place of firing can change to encode new reward locations, forming memory maps.

The researchers investigated the timescale of map formation, showing that pyramidal neuron maps representing previous and new reward locations "flicker", with both firing patterns occuring. The scientists also showed that inhibitory interneurons change their firing rates during map formation and flickering, but only during learning trials. These changes are shown to be due to connection changes between pyramidal cells and interneurons, and are beneficial for learning as they allow the regulation of plasticity between pyramidal cells and controlling the timing in their firing.



The research shows that also inhibitory interneuron circuits modify their behavior during learning, suggesting that they could be involved in map selection - helping one map take over during learning, so that the relevant information is encoded.

Dynamic reconfiguration of hippocampal interneuron circuits during learning | Dupret et al., 2013 | Neuron 2013.01.033

YOUNG SCIENTIST SYMPOSIUM 2013

What is shape?

The Young Scientist Symposium (YSS) 2013 on "Understanding shape: *in silico* and *in vivo*", organized independently by PhD students and postdocs of IST Austria, successfully drew an interdisciplinary audience of around 100, mainly young, scientists to IST Austria on April 26.

The concept of shape touches on many areas of research, from shape description in mathematics, over shape formation during embryonic development to shape perception in computer vision. The multidisciplinary symposium brought together alternative views on how to deal with shape and form. Six experts, all from different field of research, covered description, formation and perception of shape in their talks. Cutting up lettuce, Chaim Goodman-Strauss, a mathematician from the University of Arkansas, encouraged his audience to play with their lunch to discover curvature and growth. "When is a giraffe a giraffe?" asked Vittorio Ferrari, expert in Computer Vision from the University of Edinburgh, who also appreciated the chance to learn from neuroscientists and biologists at the symposium. In a lively panel discussion following the talks, audience and experts exchanged ideas on the topics raised, also revealing the panelists' favorite shapes.

The committee organizing YSS 2013 was as international and multidisciplinary as the speakers - the eight students and postdocs came from six different countries to work at IST Austria. Abraham Martin del Campo from Mexico headed the

committee: "It is a valuable experience to interact with leading scientists in the field as well as fellow postdocs and students, and organize such an inspiring event." The YSS 2013 was the second such event organized at IST Austria. The first YSS took place in 2012 on human evolution, its success encouraged the establishment of an annual event series.

SCIENCE AT IST AUSTRIA

Biophysics

Gašper Tkačik

Not only beauty but also reality lies in the eye of the beholder – according to two recent papers by IST Austria professor Gašper Tkačik and his collaborators. Together, the researchers developed a theoretical tool that allows them to define the difference between seemingly very similar visual scenes, opening up exciting possibilities for researching sensory systems.

When we view a scene, the light signals entering our eyes are transformed into sequences of nerve impulses, which are sent to the brain via the optic nerve. Previously, it had been shown that each spot in the visual field is jointly encoded by the activity of a double-digit number of neurons. A population of neurons encoding a single spot in the visual scene does not do so independently, but uses a combinatorial set of activity patterns, a 'code'. In their first paper, the researchers developed a new mathematical model to analyze the code sent by neurons in the retina while being exposed to controlled visual stimulation.

This laid the groundwork for the second paper, in which Tkačik and his co-researchers aimed to see which visual inputs can be distinguished by the brain, and how well. There are many possible mathematical definitions of how two images differ from each other. However, these definitions may not correspond to how differently the brain experiences the two images. The scientists introduced a new, biologically relevant definition of stimulus difference, defining it as the difference in the response the stimuli can reliably induce. The study demonstrates that some stimuli which are mathematically very different cannot be discriminated by the retina very well, while other pairs of mathematically different stimuli reliably cause different and distinguishable neural responses. The research opens up a framework for investigating and understanding sensory stimuli. The developed mathematical tools can be applied to other sensory systems, especially those where there is a lack of a clear concept of stimulus similarity, such as in the olfactory system.

Stimulus-dependent maximum entropy models of neural population codes | Granot-Atedgi E et al., 2013 | PLoS Comput Biol 9(3):e1002922

Retinal metric: a stimulus distance measure derived from population neural responses| Tkačik G et al., 2013 | Phys Rev Lett 110 (2013): 0581049

UPCOMING EVENTS

June 4 | Science Industry Talk 5.00pm

"Partners in Innovation: Synergies between Industry and Basic Research"

Academic and industrial research have developed tools for generating innovation. What can each domain learn from the other in terms of organization, knowledge transfer, and the enabling of serendipity? The Science Industry Talk 2013, organized jointly by the Federation of Austrian Industries (IV) and IST Austria, offers a forum to look at these issues. For further information, please see: ist.ac.at/science-industry-talk.

June 8 | Open Campus 2013 1.00pm-6.00pm

IST Austria opens its doors! Experience the world of science at the interactive research islands prepared by IST Austria research groups. Hands-on experiments let visitors discover the fun of research. Go on a guided tour of the campus, and take a look at the labs or the Miba Machine Shop. More information can be found at: ist.ac.at/open_campus.

June 20 | Opening of the Miba Machine Shop 11.00am

The Miba Machine Shop, IST Austria's in-house electronic and mechanical workshop named in honor of Miba AG's generous donation to IST Austria, is inaugurated.

ANNUAL REPORT 2012

What happened at IST Austria in 2012? Who are the new professors, and how is the Institute developing? IST Austria's annual report for the year 2012 is out now, and reviews the past year at the Institute.

"Our way to excellence" is a new brochure that charts the principles on which IST Austria is based, and how they are implemented in the Institute's development and operation.

Both the Annual Report and the brochure are available for download at ist.ac.at/news-media/downloads.

ERC EVENT

As part of the European Research Council's continued efforts to stimulate extended applications, a "**Widening Participation**" event was organized by the Executive Agency ERC, in cooperation with IST Austria, the Austrian Ministry of Science and Research and the Representation of the European Commission. The event on February 28 and March 1 brought early-career scientists from Central and Eastern Europe together with ERC grantees, allowing young scientists to further explore the possibilities for funding offered by the ERC.

ISTERNSHIP

IST Austria has launched "ISTernship", a new program for **summer internships**.

The program aims to attract outstanding undergraduate students to work on research projects under close supervision of faculty members and lab members during the summer months.

The first call for interns met with large interest, 250 applications were received. Due to the great success, the program will be repeated in summer 2014, with online applications opening in early 2014.

COLLOQUIUM SPEAKERS

PAST SPEAKERS (FEBRUARY-APRIL): **Ruth Lehmann,** The Skirball Institute, NYU (Feb 11) **| Immanuel Bloch,** Max Planck Institute of Quantum Optics (Feb 25) **| Anne Ridley,** King's College London (Mar 4) **| Enrico Coen,** John Innes Centre (Mar 11) **| John P. Adelman,** Oregon Health and Science University (Apr 8) **| Niels Bierbaumer,** University of Tübingen (Apr 15) **| Steve Smale,** City University of Hong Kong (Apr 22) **| Stephan Sigrist,** Freie Universität Berlin (Apr 29)

UPCOMING SPEAKERS (MAY-JULY): **Martin Feinberg,** The Ohio State University (May 6) **| Didier Stainier,** University of California, San Francisco (May 13) **| Jack Taunton,** University of California, San Francisco (May 27) **| Andrew Murray,** Harvard University (June 10) **| Thierry Emonet,** Yale University (June 17) **| José Manuel Sanchez Ruíz,** Universidad de Granada (June 24)

SELECTED RECENT PUBLICATIONS

Cell adhesion mechanics of zebrafish gastrulation | Maitre J, Berthoumieux H, Krens SFG, Salbreux G, Julicher F, Paluch E & Heisenberg C, 2013 | *Medecine Sciences* 29(2)

Genotypic recognition and spatial responses by rice roots | Fang S, Clark RT, Zheng Y, Iyer-Pascuzzi AS, Weitz JS, Kochian LV, Edelsbrunner H, Liao H & Benfey PN, 2013 | *PNAS* 110(7)

Modelling evolution in a spatial continuum | Barton NH, Etheridge AM & Veber A, 2013 | *Journal of Statistical Physics* 2013(1): P01002

Quantitative relaxation of concurrent data structures | Henzinger TA, Kirsch CM, Payer H, Sezgin A & Sokolova A, 2013 | *POPL 2013*, 317-328

Homology and robustness of level and interlevel sets | Bendich P, Edelsbrunner H, Morozov D & Patel A, 2013 | *Homology, Homotopy, and Applications* 15(1), 51-72

Optical control of metabotropic glutamate receptors | Levitz J, Pantoja C, Gaub B, Janovjak H, Reiner A, Hoagland A, Schoppik D, Kane B, Stawski P, Schier AF, Traunder D & Isacoff Y, 2013 | *Nature Neuroscience* 16(4), 507-516

A counterexample to the chain rule for conditional HILL entropy and what deniable encryption has to do with it | Krenn S, Pietrzak K & Wadia A, 2013 | *LNCS TCC: Theory of Cryptography Conference* 7785, 23-39

Mosaic analysis with double markers reveals cell type specific paternal growth dominance | Hippenmeyer S, Johnson RL & Luo L, 2013 | *Cell Reports* 3(3), 960-967

3D phenotyping and quantitative trait locus mapping identify core regions of the rice genome controlling root architecture | Topp CN, Iyer-Pascuzzi AS, Anderson JT, Lee CR, Zurec PR, Symonova O, Zheng Y, Buksch A, Mileyko Y, Galkovskyi T, Moore BT, Harer J, Edelsbrunner H, Mitchell-Olds T, Weitz JS & Benfey PN, 2013 | *PNAS, in press*

Statistical thermodynamics of natural images | Stephens GJ, Mora T, Tkacik G & Bialek W, 2013 | *Physical Review Letters* 110 018701

Does hybridisation influence speciation? | Barton NH, 2013 | *Journal of Evolutionary Biology* 26(2), 267-269

SCFTIR1/AFB-auxin signalling regulates PIN vacuolar trafficking and auxin fluxes during root gravitropism | Baster P, Robert S, Kleine-Vehn J, Vanneste S, Kania U, Grunewald W, Rybel B, Beeckman & Friml J, 2013 | *The EMBO Journal* 32, 260-274

3D kinetic alpha complexes and their implementation | Kerber M & Edelsbrunner H, 2013 | *ALENEX: Algorithm Engineering and Experiments 2013*

A full list of publications from IST Austria can be found at publist.ist.ac.at

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