# NEWS LETTER

**The new academic year has started at IST Austria, bringing many exciting developments.**

Two new professors have been recruited to IST Austria. Mathematical physicists Robert Seiringer and Laszlo Erdös will open up a new field of research for IST Austria when they move to the IST Austria campus in spring 2013. Lab Building East will be opened this month, significantly increasing space to host the growing number of research groups.

The IST Austria Graduate School is now in its third year. We are happy to welcome 18 new PhD students, who come from 12 different countries and a range of scientific disciplines to work on their PhD degree at IST Austria.

We hope you'll enjoy finding out more about IST Austria, its scientists and their research.

Thomas A. Henzinger | President
Gerald Murauer | Managing Director

## NEW PROFESSORS

**Robert Seiringer** is an Austrian mathematical physicist. He studied Theoretical Physics at the University of Vienna. In 2001, Seiringer moved to Princeton University, where he became Assistant Professor in 2003. Since 2010 he is Associate Professor with tenure at McGill University in Montreal, Canada. In 2009, Seiringer received the Henri Poincaré Prize of the International Association of Mathematical Physics. Robert Seiringer and his research group focus on many-body systems in quantum mechanics.

**Laszlo Erdös** is a Hungarian mathematician. He studied mathematics at the Loránd Eötvös University in Budapest and did his PhD with Elliott H. Lieb at Princeton University in 1994. After holding junior positions at ETH Zurich and the Courant Institute (NYU) he stayed at the Georgia Institute of Technology, Atlanta for five years. Since 2003 he is Professor at the Ludwig Maximilian University Munich. Erdös works in mathematical analysis and probability theory focusing on problems arising from physics.

## SCIENCE AT IST AUSTRIA

### Developmental Biology

### Carl-Philipp Heisenberg

The group of Carl-Philipp Heisenberg works on cell and developmental biology using the zebrafish as model organism. In two recent publications in a *Science* special issue focusing on "Forces in Development", the group gives new insights into the forces governing zebrafish gastrulation.

Gastrulation is an early step in development, during which the three germ layers - ectoderm, endoderm and mesoderm - form, giving rise to the different structures and organs of the embryo. In their first paper, the researchers studied how cells are sorted into the correct germ layers. Sorting is driven, in part, by cells' different abilities to form contacts between each other. The scientists showed that tension at the cell surface is an essential force required for the formation of cell-cell contacts, and is the main factor in driving cell sorting. They challenge previous models, which proposed that cell adhesion is important for cell sorting, by showing that it plays mainly a supportive role in contact formation.



In their second paper, the researchers focused on epiboly, a process in gastrulation during which a protective layer, the enveloping cell layer or EVL, comes to cover the embryo. Previously, it was thought that the force pulling the EVL over the embryo comes from a contractile ring at its rim, which contracts around the circumference of the embryo like a purse-string. The group shows that the rim actually also contracts along its width. When resisted by friction, this contraction translates into the pulling force required for epiboly.

Adhesion Functions in Cell Sorting by Mechanically Coupling the Cortices of Adhering Cells| Maitre et al., 2012 | Science 338, 253-256
Forces Driving Epithelial Spreading in Zebrafish Gastrulation | Behrndt et al., 2012 | Science 338, 257-260

# NEWSLETTER

## NEWS

### New PhD students join IST Austria

IST Austria welcomed the new intake of PhD students of its Graduate School on September 17. The 18 students came to IST Austria from 12 different countries, and have now started in the research groups of IST Austria.

For many of the new students, the interdisciplinarity of the PhD program was one of the main attractions of IST Austria, giving students the chance to work in new and different fields. The open organization and the topics currently represented on campus convinced students to join. Also, the possibility to try out different projects during laboratory rotations and to start work on a PhD degree with a BS drew students to IST Austria.

The students for the third intake of the IST Austria Graduate School were selected from 421 applicants, 53 of whom were invited for personal interviews on campus. In their first year of the multidisciplinary IST Austria Graduate School, the students will work on research projects in three different groups and attend advanced courses, covering the entire spectrum of research represented at IST Austria. Upon successfully passing a qualifying exam, students will join research groups at IST Austria to pursue their doctoral research for a further three to four years. Successful students are awarded the PhD degree by IST Austria.
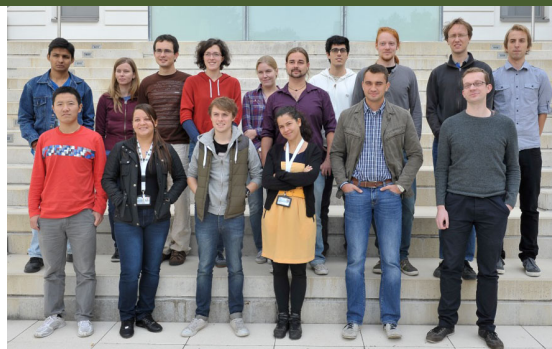
Online application for joining the IST Austria Graduate School in fall 2013 opens on November 15, the deadline for applications is January 15, 2013. Students can visit the campus and meet faculty members on November 24. Further information is available on the IST Austria website at www.ist.ac.at.

## SCIENCE AT IST AUSTRIA

### Computer Science
### Chris Wojtan

Chris Wojtan's group presented their paper "Tracking Surfaces with Evolving Topology" at the leading computer graphics conference SIGGRAPH. The researchers developed an algorithm enabling computers to analyze data scans in which data evolves over time or shows changes in topology. Such data is commonly produced in the sciences in the form of 3D images, point clouds or triangle meshes. One practical example of such data arising is in the analysis of MRI scans. It is clear to us humans that the scans taken are related to each other through time and the movement seen represents movement and deformation of organs. However, computers do not have an idea of the relation and correspondence between these data samples. Therefore, computer scientists need to teach the computer how to match scans and figure out surface deformation over time. In the explanatory video produced by the scientists, which you can see at www.youtube.com/watch?v=JaBBQDx2BBk, a bunny rabbit is turned into a donut.

As an added complication, changes in topology often occur, such that surfaces split or merge throughout time. For example, when analyzing data from fluid simula-

tions, splashes will cause the liquid to separate into droplets and later merge back together. The computer, however, will not "know" where these additional surfaces come from. These changes in topology make it difficult for computers to figure out how one data sample corresponds to another one in a sequence.

The algorithm presented at SIGGRAPH is the first algorithm of its kind able to efficiently find correspondences in such data, even when topology changes occur. The researchers show that the algorithm is successful in analyzing scanned human data, fluid simulation data and morphs between different shapes. The researchers are able to measure surface deformation, track information on a surface or create a single time-evolving surface. These may be useful tools for analyzing data from biology and physics.

Tracking surfaces with evolving topology | Bojsen-Hansen M, Li H & Wojtan C, 2012 | ACM Transactions on Graphics 31, 1-10

## HONORS

**Vladimir Kolmogorov** received the **Koenderink Prize** at this year's European Conference on Computer Vision. The Prize is awarded to papers published at ECCV which have withstood the test of time. Vladimir Kolmogorov received the prize for his paper "What Energy Functions can be Minimized via Graph Cuts?". Graph cuts is an optimization technique that has played a major role in computer vision in the last decade. Vladimir's work on graph cuts is well-known in the community and extensively cited. This particular paper brought the concept of submodularity to computer vision.

## UPCOMING EVENTS

**November 28** | Opening of Lab Building East

IST Austria's Lab Building East opens its doors. In the ceremony, the foundation stones for the next construction phase will be laid.

**December 17** | IST Lecture 5.00pm

Christos H. Papadimitriou, Professor of Computer Science at UC Berkeley, speaks on "Computational Insights and the Theory of Evolution". IST Lectures are open to the public and free of charge. Please register on our website.

# NEWSLETTER

**IST** AUSTRIA
*Institute of Science and Technology*

## HONORS

**Sylvia Cremer** is one of the recipients of the **Science Award of the state of Lower Austria 2012**. Cremer was presented with the award in a ceremony at Grafenegg Palace. Sylvia Cremer is an Evolutionary Biologist interested in behavioral ecology and evolutionary immunology in ant societies.

A further element of the ceremony was the presentation of the book »Land scha[f]ft Wissen – Leben und Forschen in Niederösterreich«. It portrays 72 researchers of Lower Austria, including Thomas Henzinger and Sylvia Cremer.

## CONFERENCES

IST Austria hosts international scientific conferences and workshops. Organized by IST Austria professors together with faculty of other institutes, they bring scientists from a range of fields to the campus. Recent examples include the European **NEURON** course '12, the first such course in Europe. The **Sensory Coding & Natural Environment 2012** conference was attended by more than 90 researchers. Future collaborations were discussed at the "**Algebraic Statistics Workshop**". The "**Cell and Tissue Biomechanics**" symposium takes place on Nov 15 & 16.

## MATH SYMPOSIUM

The **IST Austria Math Extravaganza** symposium takes place in the Mondi Seminar Center of IST Austria on December 14. It aims to present an overview of emerging developments in the field in order to establish where particularly far-reaching and interesting results can be expected within the next decade. László Lovász, Jeffrey Lagarias, Lisbeth Fajstrup and Alexander Bobenko will present their work at the symposium. Please register by December 7 if you would like to attend.

## COLLOQUIUM SPEAKERS

PAST SPEAKERS (SEPTEMBER-OCTOBER): **Daniel E. Gottschling,** Fred Hutchinson Cancer Center (Sept 3) **| Karsten Kruse,** Saarland University (Sept 17) **| Idan Segev,** The Hebrew University of Jerusalem (Sept 24) **| David Bannerman,** University of Oxford (Oct 1) **| Jerry Coyne,** The University of Chicago (Oct 15) **| Vijay Balasubramanian,** University of Pennsylvania (Oct 22) **| Nicholas Eriksson,** 23andMe (Oct 29)

UPCOMING SPEAKERS (NOVEMBER-FEBRUARY): **Jan Peters,** Technical University Darmstadt (Nov 12) **| Brian Charlesworth,** The University of Edinburgh (Nov 19) **| Gábor Tamás,** University of Szeged (Nov 26) **| Virgil Widrich,** University of Applied Arts Vienna (Dec 3) **| Ilya Nemenman,** Emory University (Dec 10) **| Martina Havenith,** Ruhr University Bochum (Jan 14) **| Jiri Matas,** Czech Technical University Prague (Jan 21) **| Ruth Lehmann,** The Skirball Institute NYU (Feb 11)

## SELECTED RECENT PUBLICATIONS

**Dynamic pruning of factor graphs for maximum marginal prediction**
Lampert C H, 2012 | *Neural Information Processing Systems 2012*

**Tracking surfaces with evolving topology |** Bojsen-Hansen M, Li H & Wojtan C, 2012 | *ACM Transactions on Graphics* 31, 1-10

**A survey of partial observation stochastic parity games |** Chatterjee K, Doyen L & Henzinger T A, 2012 | *Formal Methods in System Design* 1, 1-17

**Alexander duality for functions: The persistent behavior of land and water and shore |** Edelsbrunner H & Kerber M, 2012 | *SCG: Symposium on Computational Geometry* 249-258

**Delayed continuous time Markov chains for genetic regulatory circuits**
Guet CC, Gupta A, Henzinger T A, Mateescu M & Sezgin A, 2012 | *LNCS CAV: Computer Aided Verification* 7358, 294-309

**Minimizing a sum of submodular functions |** Kolmogorov V, 2012 | *Discrete Applied Mathematics* 160, 2246-2258

**Controlling liquids using meshes**
Raveendran K, Thuerey N, Wojtan C & Turk G, 2012 | *SCA: Eurographics/ACM SIGGRAPH Symposium on Computer Animation 2012*

**Augmented attribute representations**
Sharmanska V, Quadrianto N & Lampert C H, 2012 | *ECCV: European Conference on Computer Vision 2012*

**Limits to the rate of adaptive substitution in sexual populations |** Weissman D B & Barton N H, 2012 | *PLoS Genetics* 8, e1002740

**Explicit mesh surfaces for particle based fluids |** Yu J, Wojtan C, Turk G & Yap C, 2012 | *Computer Graphics Forum* 31, 815-824

**Efficient controller synthesis for consumption games with multiple resource types |** Brazdil B, Chatterjee K,

Kucera A & Novotny P, 2012 | *LNCS CAV: Computer Aided Verification* 7358, 23-28

**Information theoretic clustering using minimal spanning trees**
Müller A, Nowozin S & Lampert C H, 2012 | *DAGM: Symposium of the German Association for Pattern Recognition* 746, 205-215

**A deconvolution-based method with high sensitivity and temporal resolution for detection of spontaneous synptic currents** *in vitro* **and** *in vivo* **|** Pernia-Andrade A J, Goswami S P, Stickler Y, Fröbe U, Schlögl A & Jonas P, 2012 | *Biophysics Journal* 103, 1-11

**The most persistent soft clique in a set of sampled graphs |** Quadrianto N, Lampert C H & Chen C, 2012 | *ICML International Conference on Machine Learning 2012*

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