

Curriculum Vitae

Szabolcs Horvát

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Current Position

Postdoctoral researcher at the [Stem-cell and Brain Research Institute](#) (Inserm U1208) in Lyon, France. I am working in the Cortical Architecture, Coding and Plasticity group lead by Henry Kennedy.

I am interested in quantitative modelling of complex systems and interdisciplinary applications of the methods of statistical mechanics, such as the maximum entropy principle. My present focus is the network structure of cortical connectomes and its relationship to hierarchical coding in the brain.

Professional Experience

2012-2015 Postdoctoral researcher, University of Notre Dame, Indiana, United States working in [iCeNSA](#) with Prof. Zoltán Toroczkai

Education

2008-2012 PhD degree in physics of complex systems, at Babeş-Bolyai University (Cluj-Napoca, Romania) thesis title: “Statistical physics studies of complex systems”. Supervisor: Prof. Zoltán Néda.

2007-2010 PhD degree in physics of relativistic heavy-ion collisions, University of Bergen (Bergen, Norway) thesis title: “Phase Transitions in Non-Equilibrium Dynamical Systems” Supervisor: Prof. László Csernai

2006-2007 Master’s degree: University of Bergen (Bergen, Norway) thesis title: “Frequency fluctuations in power systems” Supervisor: Prof. László Csernai

2002-2006 Bachelor’s degree: Babeş-Bolyai University (Cluj-Napoca, Romania) thesis title: “Statisztikus fizikai módszerek a makro-ökológiában” (English: “Statistical physics methods in macro-ecology”) Supervisor: Prof. Zoltán Néda

Grants and fellowships

PRESTIGE Marie Curie Actions fellowship programme, incoming mobility grant
<http://www.campusfrance.org/en/prestige>

Teaching experience and qualifications

University of Notre Dame: Substitute instructor on several occasions for graduate level courses on the following subjects: “Statistical Mechanics”, “Electrodynamics”, “Networks, Information & Physics”, “Quantum Mechanics”, “Classical Mechanics”, as well as “Mathematical Methods for Physics Majors” (undergraduate level).

Babeş-Bolyai University: Taught introductory lectures on scientific programming in C++ for master’s students in physics (duration: 2 months)

University of Bergen: Led interactive problem solving sessions for the master’s level PHYS205 Electrodynamics course (3 semesters). Developed homework and midterm problems for the same course, <http://szhorvat.net/teaching/phys205/ed/>

During undergraduate studies at the Babeş-Bolyai University, completed all pedagogy courses and teaching practice required to teach in secondary schools.

Internships and Summer Schools

2011 February-July, Internship at the University of Padova, analysing the network structure of food webs, under the supervision of Prof. Amos Maritan.

2006 February-March, Center for Nonlinear Studies, Los Alamos National Laboratory, Modelling of the spatial distribution of plant species based on the neutral theory of biodiversity.

2003 July-August, Otto von Guericke University (Magdeburg, Germany), Study of pH patterns on the surface of Chara corallina cells in the group of Prof. Stefan C. Müller.

Attended the European Summer University: Challenge of Quantum Mechanics in July, 2005 (<http://www-physique.u-strasbg.fr/side/uee2005/>).

Achievements at competitions

Rudolf Ortway competition (<http://ortway.elte.hu/>): 2003, honourable mention

NYIFFF Competition (<http://nyiff.elte.hu/>): member of team which won 2nd prize in 2003 and 3rd prize in 2004

Romanian National Physics Olympiad (1st prize in 1997, 1st in 1998, 2nd in 1999, honourable mention in 2000, 3rd in 2001, and honourable mention in 2002)

Languages

Hungarian (mother tongue), Romanian (fluent), English (fluent), Norwegian (upper intermediate, passed “level 3 advanced” exam), Modern Greek (lower intermediate), Mandarin Chinese (lower intermediate)

Computer simulations & programming experience

Extensive experience in numerical modelling, computing with graphs/networks, Monte Carlo simulations, data processing and visualization, using HPC clusters

Programming experience on OS X, Linux and Windows systems

Low level languages: Experience in numerical computing and modelling with C and C++.

Mathematical environments: Excellent knowledge of Mathematica (versions 4.0-11); good knowledge of MATLAB; experience with R and Python for numerical computing and data analysis.

Graphics programming: GUI programming with Qt; OpenGL

Other: version control systems (SVN, git, mercurial); awk; TeX/LaTeX; HTML

Projects: *MATLink*, an advanced Mathematica-MATLAB interface, <http://matlink.org>

IGraph/M, a Mathematica interface for calling the igraph network analysis library

LTemplate, a framework for easily extending Mathematica through C++

See also <https://github.com/szhorvat> and <https://bitbucket.org/szhorvat/>

Publications

Sz. Horvát, R. Gămănuț, M. Ercsey-Ravasz, L. Magrou, B. Gămănuț, D. C. Van Essen, A. Burkhalter, K. Knoblauch, Z. Toroczkai, H. Kennedy, Spatial Embedding and Wiring Cost Constrain the Functional Layout of the Cortical Network of Rodents and Primates, *PLoS Biology* **14**, e1002512 (2016).

Sz. Horvát, É. Czabarka, Z. Toroczkai, Reducing Degeneracy in Maximum Entropy Models of Networks, *Physical Review Letters* **114** (2015).

Sz. Horvát, Z. Néda, Complex phase space of a simple synchronization model, *Physica D* **256-257**, 43 (2013).

S. Zschocke, **Sz. Horvát**, I. N. Mishustin, and L. P. Csernai, Nonequilibrium hadronization and constituent quark number scaling, *Physical Review C* **83**, 044903 (2011).

Sz. Horvát, A. Derzsi, Z. Néda, and A. Balog, A spatially explicit model for tropical tree diversity patterns, *Journal of Theoretical Biology* **265**, 517-523 (2010).

Sz. Horvát, V. K. Magas, D. D. Strottman, and L. P. Csernai, Entropy development in ideal relativistic fluid dynamics with the Bag Model equation of state, *Physics Letters B* **692**, 277-280 (2010).

Sz. Horvát, E. Á. Horváth, G. Máté, E. Káptalan, Z. Néda, Unexpected synchronization, *Journal of Physics: Conference Series* **182**, 012026 (2009).

L. P. Csernai, Y. Cheng, **Sz. Horvát**, V. Magas, D. Strottman, and M. Zétényi, Flow analysis with 3-dim ultra-relativistic hydro, *Journal of Physics G* **36**, 064032 (2009).

Sz. Horvát and P. Hantz, Pattern formation induced by ion-selective surfaces: Models and simulations, *Journal of Chemical Physics* **123**, 085707 (2005).

P. Hantz, J. Partridge, Gy. Láng, **Sz. Horvát**, M. Újvári, Ion-Selective Membranes Involved in Pattern-Forming Processes, *Journal of Physical Chemistry B* **108**, 18135 (2004).

Presentations

“The brain as a spatially embedded network”, Santé@Labex conference, Lyon, France, December 2016

“Reducing degeneracy in Exponential Random Graph models”, IXXI, École normale supérieure Lyon, France, January 2016

“Reducing degeneracy in Exponential Random Graph models”, Northwestern Institute on Complex Systems, Evanston, Illinois, January 2015

“Reducing degeneracy in Exponential Random Graph models”, Amaral Lab at Northwestern University, Evanston, Illinois, January 2015

“Avoiding Degeneracy Through Convexification in Exponential Random Graph Models”, DARPA GRAPHS meeting, November 2013 (poster).

“A Gentle Introduction To The Statistical Mechanics of Networks and Exponential Random Graph Models”, talk given at Frankfurt Institute for Advanced Studies, Frankfurt, Germany, June 2013.

“Reducing Degeneracy in Exponential Random Graph models”, talk given at Max Planck Institute for the Physics of Complex Systems, Dresden, Germany, June 2013.

“Non-equilibrium Hadronization and Quark-number Scaling”, talk given at Central China Normal University, Wuhan, China, 2010.

“Entropy change during the final stages of expansion in relativistic fluid dynamics calculations” and “Constituent quark number scaling of the elliptic flow and the final hadronization of QGP”, presented at TORIC workshop, Sardinia, Italy, 2010.

Sz. Horvát, Z. Nédá, H. M. Tóháti, A. Derzsi, A. Balogh, “A Spatially Explicit Macroecological Model”, presented at the International Workshop on Stochastic Phenomena, May 2008, Cluj–Napoca, Romania.