

Curriculum Vitae

Szabolcs Horvát

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Current Position

I am currently an [ELBE](#) postdoctoral fellow in the group of Dr. Carl Modes at the [Center for Systems Biology Dresden](#), a joint initiative of the Max Planck Institute for Cell Biology and Genetics and the Max Planck Institute for the Physics of Complex Systems.

I have a general interest in the quantitative modelling of complex systems and networks and the interdisciplinary applications of the methods of statistical mechanics. My present focus is on the study of constrained random graph models, as well as on the analysis of biologically relevant networks, in particular the connectome and other spatially embedded networks.

Professional Experience

- 2015-2017** Postdoctoral researcher at the [Stem-cell and Brain Research Institute](#) (Inserm U1208) in Lyon, France, working in the Cortical Architecture, Coding and Plasticity group lead by Dr. Henry Kennedy.
- 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: "Statistikus 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>

Supported by the Chan Zuckerberg Initiative in the [Essential Open Source Software for Science](#) program to contribute to the [igraph](#) project.

Wissenschaftskolleg zu Berlin, College for Life Sciences Fellowship, academic year 2021-22.

Teaching experience and qualifications

Center for Systems Biology Dresden: Mentoring of summer interns during the 2019 IMPRS intern programme. Tutor at the 2019 Dresden Summer School in Systems Biology.

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” (sample notes: szhorvat.net/teaching/cm-notes.pdf), 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, 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 in Romania.

Community involvement

Reviewer for journals: New Journal of Physics, Proceedings of the Royal Society A, Physical Biology, Physica A, Scientific Reports, Entropy (member of reviewer board and topic editor board), Nonlinear Dynamics, Journal of Physics: Complexity, Journal of Open Source Software, PLOS Computational Biology.

“IOP trusted reviewer”, “IOP Outstanding Reviewer”

[Peer Community in Network Science](#) recommender.

Contributor to Mathematica StackExchange.

Languages

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

Software

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

Co-maintainer and active contributor to the popular [igraph](#) open source network analysis library.

Open source projects:

[IGraph/M](#), a graph theory and network analysis package for Mathematica, based on igraph

[LTemplate](#), a framework for easily extending Mathematica through C++

[MATLink](#), an advanced Mathematica-MATLAB interface (matlink.org)

See also <https://github.com/szhorvat>

Publications

- M. Hecht, K. Gonciarz, **Sz. Horvát**, Tight Localizations of Feedback Sets, *ACM Journal of Experimental Algorithmics* **26**, 1.5 (2021).
- Sz. Horvát** and C. D. Modes, Connectedness matters: Construction and exact random sampling of connected networks, *Journal of Physics: Complexity* **2** 015008 (2021).
- Sz. Horvát**, A. Fathima, S. Görlich, M. Schlierf, C. D. Modes, N. Kröger, Computational Analysis of the Effects of Nitrogen Source and Sin1 Knockout on Biosilica Morphology in the Model Diatom *Thalassiosira pseudonana*, *Discover Materials* **1**, 8 (2021).
- F. Molnár, **Sz. Horvát**, A. R. Ribeiro-Gomes, M. Ercsey-Ravasz, K. Knoblauch, H. Kennedy, Z. Toroczkai, Predictability of cortico-cortical connections in the mammalian brain, *preprint* (2020) — *bioRxiv preprint*: <https://doi.org/10.1101/2020.12.03.410803>
- 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. Nédá, 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).
- L. P. Csernai, Y. Cheng, **Sz. Horvát**, I. N. Mishustin, and S. Zschocke, Quark Number Scaling in Fluid Dynamics and Hadronization via Quarkyonic Matter, *EPJ Web Conf.* **13**, 07003 (2011).
- Sz. Horvát**, A. Derzsi, Z. Nédá, 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. Nédá, 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. Ujvári, Ion-Selective Membranes Involved in Pattern-Forming Processes, *Journal of Physical Chemistry B* **108**, 18135 (2004).

Presentations

“igraph — the network analysis packages”, Essential Open Source Software for Science meeting organized by the Chan Zuckerberg Initiative, December 2020.

“Exact random sampling of connected graphs with a given degree sequence”, 9th Slovenian International Conference on Graph Theory, Bled, Slovenia, June 2019.

“Maximum entropy models of networks and their applications”, invited talk at Babeş-Bolyai University, Dept. of Physics, Cluj-Napoca, Romania, August 2017.

“Maximum entropy models of networks and their applications”, invited talk at Huazhong University of Science and Technology, School of Automation, Wuhan, China, July 2017.

“Maximum entropy models of networks and applications to connectome imputation”, invited talk at EPIcx lab, Paris, France, February 2017.

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

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

“Reducing degeneracy in Exponential Random Graph models”, invited talk at Northwestern Institute on Complex Systems, 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”, invited talk given at Frankfurt Institute for Advanced Studies, Frankfurt, Germany, June 2013.

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

“Non-equilibrium Hadronization and Quark-number Scaling”, invited 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, Cluj-Napoca, Romania, May 2008.

Other talks

“The Science of Complex Systems”, popular science talk at Espace Ulys event (www.espace-ulyss.fr), Lyon, France, 2016

“igraph and *Mathematica*”, Wolfram Technology Seminar, Lyon, France, October, 2016

“*Mathematica* as a Glue Language: Connecting Tools Together”, Wolfram Technology Seminar, (Grenoble, March, 2016 and Marseille, May, 2016)

“The Science of Complex Systems and Networks”, popular science presentation given at Architecture Project (architecture-project.com), Valletta, Malta, 2011