Curriculum Vitae

Szabolcs Horvát

contact: email: szabolcsh@ru.is or szhorvat@gmail.com
tel: +354 825 6366
web: szhorvat.net
mail: Reykjavik University, Menntavegur 1, 102 Reykjavík, Iceland

Research Topics

complex systems; network science; graph algorithms; random graph models;
spatial networks; statistical mechanics of networks; biological networks; connectomics;

Professional Experience

2023-   Assistant professor at the Department of Computer Science at Reykjavik University.

2018-2023   ELBE postdoctoral fellow 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. Working with Dr. Carl Modes.

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 Babeș–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: Babeș–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

Fellow at the Wissenschaftskolleg zu Berlin (Berlin Institute for Advanced Study), College for Life Sciences Fellowship, academic year 2021-22.

Twice supported by the Chan Zuckerberg Initiative in the Essential Open Source Software for Science program to develop the igraph complex network analysis software (EOSS2 and EOSS4 grants).

PRESTIGE Marie Curie Actions fellowship programme, incoming mobility grant (2015-16) www.campusfrance.org/en/prestige

Teaching experience and qualifications

Full courses taught at Reykjavik University: Calculus for Computer Science (T-304-CACS), Graph Theory (T-445-GRTH).

26th Estonian Winter School in Computer Science, "Random graphs and methods for constructing them", Viinistu, Estonia, March 2024.

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.

Center for Systems Biology Dresden: Supervision of undergraduate interns (physics & biology backgrounds) on theoretical and applied network science projects.

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),
"AI", "Biology", "Nonlinear Dynamics", "Journal of Physics: Complexity", "Journal of Open Source Software", "PLOS Computational Biology", "Journal of Physics A".

"IOP trusted reviewer", "IOP Outstanding Reviewer"

Member of topic editor board of the "Entropy" journal.

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

Involvement in the coordination between open source network analysis software projects, and setting up NASCol, a software sustainability alliance for network analysis software [nascol.net](#) (2023).

Organizer of the [Software Tools for Network Science](#) satellite event of NetSci 2024 (June 2024, Québec City, Canada).

Contributor to [Mathematica StackExchange](#). Community management for the open-source igraph project.

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), Icelandic (beginner).

Published software

Core member of the development team of [igraph](#), a leading open source network analysis library ([https://doi.org/10.5281/zenodo.3630268](#)).

IGraph/M, a graph theory and network analysis package for Mathematica, based on igraph ([https://doi.org/10.5281/zenodo.1134932](#)).

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

MaTeX, a Mathematica package to create publication-quality figure labels ([https://doi.org/10.5281/zenodo.883841](#)).

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

See also [github.com/szhorvat](#).

Publications

1. Y. Meng, **Sz. Horvát**, C. D. Modes, P. A. Haas, Impossible ecologies: Stability and interaction networks in ecological communities, *under review*, [https://arxiv.org/abs/2309.16261](#)

2. M. Antonov, G. Csárdi, Sz. Horvát, K. Müller, T. Nepusz, D. Noom, M. Salmon, V. Traag, B. Foucault-Welles, F. Zanini, igraph enables fast and robust network analysis across programming languages, *preprint*, [https://arxiv.org/abs/2311.10260](#)

3. B. Molnár, I.-B. Márton, **Sz. Horvát**, M. Ercsey-Ravasz, Community detection in directed weighted networks using Voronoi partitioning, *Scientific Reports* **14**, 8124 (2024).

4. F. Molnár, **Sz. Horvát**, A. R. Ribeiro Gomes, J. M. Armas, B. Molnár, M. Ercsey-Ravasz, K. Knoblauch, H. Kennedy, Z. Toroczkai, Predictability of cortico-cortical connections in the mammalian brain, *Network Neuroscience* 1–56 (2023).

5. **Sz. Horvát**, J. Podkalicki, G. Csárdi, T. Nepusz, V. Traag, F. Zanini, D. Noom, IGraph/M: Graph theory and network analysis for Mathematica, *Journal of Open Source Software*, **8(81)**, 4899 (2022).

6. **Sz. Horvát** and C. D. Modes, Connectedness matters: Construction and exact random sampling of connected networks, *Journal of Physics: Complexity* **2** 015008 (2021).

7. M. Hecht, K. Gonciarz, **Sz. Horvát**, Tight Localizations of Feedback Sets, *ACM Journal of Experimental Algorithmics* **26**, 1.5 (2021).

8. **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).

9. **Sz. Horvát**, R. Gămănuţ, M. Ercsey-Ravasz, L. Magrou, B. Gămănuţ, 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).

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

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

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

13. 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).

14. **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).

15. **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).

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

17. 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).

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

19. 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

"Characterizing spatial networks through proximity graphs", Physics Networks Satellite of NetSci 2024, Canada.

"Characterizing spatial networks through β-skeletons", invited talk at University of Iceland, November 2023.

"Random sampling of connected graphs with given degrees", ICE-TCS seminar at Reykjavik University, September 2023

"igraph — the network analysis package", NetSci 2023, July 2023.

"Towards principled and rigorous network null models", invited talk at Potsdam Institute for Climate Impact Research, Germany, February 2023.

"The quest for better network null models", invited talk at Centre For Computational Physics, University of Lincoln, UK, March 2022.

"The quest for better network null models", invited talk at Max Planck Institute for Infection Biology, Berlin, January 2022.

"The world through the lens of networks", colloquium at Berlin Institute for Advanced Study (Wissenschaftscolleg zu Berlin), November 2021.

"Spatial networks and proximity graphs", invited talk at CASUS, Görlitz, August 2021.

"Point pattern analysis through proximity graphs", March Meeting of the American Physics Society, March 2021

"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 Babeș-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. Néda, 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-ulys.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