ATANU CHATTERJEE

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Department of Physics, Worcester Polytechnic Institute, 100 Institute Road, Worcester, MA 01605, USA

RESEARCH INTERESTS

Statistical Mechanics and Thermodynamics of Far-from-equilibrium Processes, Soft-Condensed Matter: Theory and Experiment, Complex Systems, Network Theory

PROFESSIONAL EXPERIENCE

Visiting Scientist – Department of Physics of Complex Systems, Weizmann Institute of Science, Israel (Dec 2019 – Jan 2020)

Visiting Scientist – Department of Energy, Politecnico di Torino, Italy (Oct 2017 – Jan 2018)

Course Instructor – Department of Physics, Worcester Polytechnic Institute, USA (Aug 2019 – present)

Graduate Teaching Assistant – Department of Physics, Worcester Polytechnic Institute, USA (Jan 2016 – May 2019)

Graduate Research Assistant – Department of Civil and Electrical Engineering, Indian Institute of Technology Madras, India (Jul 2013 – Dec 2015)

Undergraduate Teaching Assistant – Department of Mechanical Engineering, Bhilai Institute of Technology, India (Jul 2009 – Aug 2010)

EDUCATION

Doctor of Philosophy – Department of Physics, Worcester Polytechnic Institute, USA (Jan 2016 – present)
Advisor: Prof. Germano Iannacchione

Master of Science – Department of Physics, Worcester Polytechnic Institute, USA (Jan 2016 – May 2018)

Master of Science (by research) – Department of Civil and Electrical Engineering, Indian Institute of Technology Madras, India (Jul 2013 – Dec 2015)
Thesis: Studies on the Structure and Dynamics of Urban Bus Networks in Indian Cities (arXiv)
Advisor: Prof. Gitakrishnan Ramadurai

Bachelor of Engineering – Department of Mechanical Engineering, Bhilai Institute of Technology, India (Jul 2009 – Aug 2013)

JOURNAL ARTICLES

Most Relevant Publications

Chatterjee, A. and Iannacchione, G. (2019) Equilibrium Thermodynamics from First Principles (under preparation)

Chatterjee, A. and Iannacchione, G. (2019) Equation of State for a Far-from-equilibrium Thermodynamic System with Emergent Order, **Physical Review E** (submitted)

Chatterjee A., Mears, N., Yadati. Y., and Iannacchione, G. (2019) An Overview of Emergent Order in Driven Systems: From Kuramoto Oscillators to Rayleigh-Bénard Convection, **Entropy** (arXiv) (to appear)

Yadati, Y., Mears, N. and Chatterjee, A. (2019) Spatio-temporal Characterization of Thermal Fluctuations in a Non-turbulent Rayleigh-Bénard Convection at Steady State, **Physica A** (accepted) (arXiv)

Chatterjee A., Yadati, Y., Mears, N. and Iannacchione, G. (2019) Coexisting Ordered States, Local Equilibrium Points, and Broken Ergodicity in a Non-turbulent Rayleigh-Bénard Convection at Steady-state, **Scientific Reports** 9 (1), 10615 (arXiv)

Chatterjee A. and Iannacchione, G. (2019) The Many Faces of Far-from-equilibrium Thermodynamics: Deterministic Chaos, Randomness, or Emergent Order?, **MRS Bulletin** 44 (2), 130–133 (arXiv)

Georgiev, G.Y. and Chatterjee, A. (2016) The Road to a Measurable Quantitative Understanding of Self-organization and Evolution in **Evolution and Transitions in Complexity: The Science of Hierarchical Organization in Nature**, ed. Dr. Gerard Jagers op Akkerhuis, pp. 223–230 *Springer*

Chatterjee, A. (2015) Thermodynamics of Action and Organization in a System, **Complexity** 21 (S1), 307–317

Other Publications

Chatterjee, A., Mears, N., Algarni, S., Charest, A. and Iannacchione, G.S., (2019) High-resolution Experimental Study and Numerical Modeling of Population Dynamics in a Bacteria Culture, **Physical Review E** (arXiv) (submitted)

Chatterjee, A., Georgiev, G.Y. and Iannacchione, G.S. (2016) Aging and Efficiency in Living Systems: Complexity, Adaptation and Self-organization, **Mechanisms of Ageing and Development** 163, 2–7

Georgiev, G.Y., Chatterjee, A. and Iannacchione, G.S., (2016) Exponential Self-Organization and Moore's Law: Measures and Mechanisms, **Complexity**, Article ID 8170632

Chatterjee, A., Manohar, M. and Ramadurai, G. (2016) Statistical Analysis of Bus Networks in India, **PLoS One** 11 (12), e0168478

Chatterjee, A., Ramadurai, G. and Jagannathan, K. (2016) Contagion Processes on Urban Bus Networks in Indian Cities, **Complexity** 21 (S2), 451–458

Chatterjee, A. (2015) Energy, Entropy and Complexity – *Thermodynamic and information-theoretic perspectives on ageing* in **Challenging Ageing – The anti-senescence effects of Hormesis, Environmental Enrichment and Information Exposure**, ed. Dr. Marios Kyriazis, *Bentham Science*

Chatterjee, A. (2015) Is the Statement of Murphy's Law Valid?, **Complexity** 21 (6), 374–380

INVITED TALKS

Non-equilibrium Thermodynamics from First Principles: Experiments, Theory, and Simulations (Dec 2019) Department of Physics of Complex Systems, Weizmann Institute of Science, Israel

The Many Faces of Far-from-equilibrium Thermodynamics (Feb 2019) MRS Webinar: Bio-inspired "Far From Equilibrium" Materials

Non-equilibrium Thermodynamics from First Principles (Dec 2017) ECCO-GBI Seminar Series, Vrije Universiteit Brussel, Belgium (YouTube)

Complexity, Organization and Self-organization (May 2014) Second International Cyprus Symposium, University of Nicosia, Cyprus (Slides)

Physical Foundations of Self-organizing Systems (Dec 2013) ECCO-GBI Seminar Series, Vrije Universiteit Brussel, Belgium (YouTube)

CONFERENCE PRESENTATIONS

Chatterjee A. and Iannacchione, G. (2020) Equation of State for a Far-from-equilibrium Thermodynamic System with Emergent Scales at Steady-state, **American Physical Society (March meeting)**, USA

Chatterjee A. (2019) Pattern Formation in Out-of-equilibrium Driven Systems, **New England Complex Fluids Workshop**, USA

Yadati, Y., Chatterjee, A. and Iannacchione, G. (2018) Spatio-temporal Characterization of Thermal Fluctuations in a Non-turbulent Rayleigh-Bénard Convection at Steady State, **Discrete Simulations in Fluid Dynamics**, USA

Yadati, Y., McGrath, S., Chatterjee, A., Georgiev, G. and Iannacchione, G. (2018) A Detailed Thermodynamic Study of Rayleigh-Bénard Cells, **American Physical Society (March meeting)**, USA

Chatterjee A. and Iannacchione, G. (2018) Non-equilibrium Thermodynamics from First Principles, **American Physical Society (March meeting)**, USA

Chatterjee, A., Georgiev, G.Y., Vu, Thanh and Iannacchione, G.S. (2017) A Model for Entropy Production, Entropy Decrease, and Action Minimization in Self-organization, **American Physical Society (March meeting)**, USA

Chatterjee, A., Georgiev, G.Y. and Iannacchione, G.S. (2017) Variational Approaches to Quantify Self-organization in Complex Systems, **American Physical Society (March meeting)**, USA

Georgiev, G.Y., Chatterjee, A., Vu, T. and Iannacchione, G.S. (2016) Variational Approaches to Self-Organization, **Conference on Complex Systems**, Netherlands

Georgiev, G.Y., Chatterjee, A., Vu, T. and Iannacchione, G.S. (2016) Benard cells as a Model for Entropy Production, Entropy Decrease and Action Minimization in Self-Organization, **Conference on Complex Systems**, Netherlands

Chatterjee, A., Georgiev, G.Y., Vu, T. and Iannacchione, G.S. (2016) On the Physical Foundations of Self-organization: Energy, Entropy and Interaction, **Conference on Complex Systems**, Netherlands

Chatterjee, A., Ramadurai, G. and Jagannathan, K. (2015) Structure and Dynamics of Urban Bus Networks, **ITRA Workshop**, India

Chatterjee, A.and Ramadurai, G. (2015) On the Dynamic Stability of Complex Networks, **Dynamical Systems: Theory and Applications**, Poland

Chatterjee, A., Ramadurai, G. and Jagannathan, K. (2015) Contagion Processes on Urban Bus Networks in Indian Cities, **Dynamical Systems: Theory and Applications**, Poland

Chatterjee, A. and Ramadurai, G. (2014) Statistical Analysis of the Chennai Bus Network and its Sub-networks, **European Conference on Complex Systems**, Italy

Chatterjee, A. and Ramadurai, G. (2014) Bus-networks in India: random or scale-free?, **Dynamics Days Asia-Pacific**, India

Chatterjee, A. and Ramadurai, G. (2014) Scaling Laws in Chennai Bus Network, **International Conference on Complex Systems and Applications**, France

Chatterjee, A. and Georgiev, G. (2014) Physical Foundations of Self-organizing Systems, **American Physical Society (March meeting)**, USA

Chatterjee, A., Yadav, A. and Agrawal, A. (2012) Role of Modeling and Simulation in Engineering Sciences, **International Conference on Innovation and Research in Technology for Sustainable Development**, India

Chatterjee, A. (2012) Game-theoretic formulation of complex systems, **International Conference on Game Theory and Management**, Russia

AWARDS AND HONORS

Travel Award, Center of Mathematical Sciences and Applications, Harvard University, 2019 ($ 500)

Sigma Pi Sigma Honor Society for Physics Students (induction), WPI chapter, 2019

Sigma Xi Scientific Research Society (induction), WPI chapter, 2017

Inaugural PhD Global Research Experience Award, 2017 ($ 10,000)

Graduate Student Travel Award, 2016, 2017, 2018 ($ 500 each)

Outstanding Graduate Research Assistant, Department of Physics, 2016

Department of Physics funding to attend NECSI-MIT Summer School, Cambridge, USA, 2016 ($ 3,000)

Graduate Teaching Assistantship, WPI, 2016 – present

IIT Madras International Travel Grant, 2015 (INR 150,000 $\sim$ $ 2,500)

ITRA-Media Labs Asia Graduate Research Fellowship, IIT Madras, 2013 – 2016

Department of Science and Technology, Government of India: International Travel Grant, 2012 (INR 300,000 $\sim$ $ 4,000)

PROFESSIONAL ACTIVITIES

Referee/Reviewer: Complexity, AIP Advances, Meccanica, Transportation, Physica A

Member: American Physical Society (2013 – present)

STUDENT ADVISING AND MENTORING

Bachelor Thesis Co-advising

Yash Yadati, WPI (May 2017 – present): Physics of Complex Systems — Network Theory in Rayleigh-Bénard and Stock Markets (in progress)

Nicholas Mears, WPI (May 2018 – May 2019): Stochastic Simulations in Far-From-Equilibrium Thermal Systems (Thesis) — **Current**: Multi-disciplinary Systems Engineer, The MITRE Corporation

Mentoring/Summer Research

Emily Whittles, WPI (Oct 2017 – May 2018): Complexity at the Interface of Technology and Biology

Hope Clairmont, WPI (Oct 2017 – Dec 2018): Far-from-equilibrium Fluctuations in Soft-matter

Noor Kawmi, Assumption College (May 2017 – Jun 2017): Complexity at the Interface of Technology and Biology

Jocelyne Tamayo Vargas, Assumption College (May 2017 – Jun 2017): Stochastic Modelling and Agent-based Simulations

Sean McGrath, Assumption College (May 2017 – Jun 2017): Pattern Formation in Non-turbulent Rayleigh-Bénard Conection

Thanh Vu, Assumption College (May 2016 – Jun 2017): Stochastic Modelling and Agent-based Simulations

Yaofeng Wang, WPI (Sep 2016 – Dec 2016): Stochastic Modelling and Agent-based Simulations

COMPUTATIONAL SKILLS

Programming Languages	Python, MATLAB, R, C/C++, HTML
Software & Tools	Gephi, Cytoscape, LaTeX, Inkscape, Photoshop, ImageJ, OriginPro

REFERENCES

Prof. Germano Iannacchione: Department of Physics, Worcester Polytechnic Institute and National Science Foundation, USA — **Email**: gsiannac@wpi.edu

Prof. Gitakrishnan Ramadurai: Transportation Engineering Division, Department of Civil Engineering, Indian Institute of Technology Madras, India — **Email**: gitakrishnan@iitm.ac.in

Prof. Padmanabhan Aravind: Department of Physics, Worcester Polytechnic Institute, USA — **Email**: paravind@wpi.edu

Prof. Francis Heylighen: Director of the Evolution, Complexity and Cognition research group and of the Global Brain Institute, Vrije Universiteit Brussel, Belgium — **Email**: fheyligh@vub.ac.be

Prof. Umberto Lucia: Department of Energy, Politecnico di Torino, Italy — **Email**: umberto.lucia@polito.it