Matthew Ricci

The Rachel and Selim Benin School of Computer Science and Engineering
The Hebrew University of Jerusalem
Rothberg Family Buildings
The Edmond J. Safra Campus
9190401 Jerusalem, Israel

Phone: +1 484-792-1245
Email: matthew.ricci@mail.huji.ac.il
URL: matthew-ricci.net

Current position

Zuckerman Postdoctoral Fellow
School of Computer Science and Engineering
The Hebrew University of Jerusalem
Supervisor: Mor Nitzan

Areas of interest

Representation learning for dynamical systems
Cell-cell and gene regulatory networks
Neural dynamics in vision

Education

2020 *Ph.D. in Computational Neuroscience*
Brown University
Specialization: Neural dynamics, computer vision
Advisor: Thomas Serre
Dissertation: "Towards Systematic Vision: Limitations of Convolutional Neural Networks and Future Directions in Oscillatory Coding"

2012 *MA/BA in Mathematics*
University of Pennsylvania
Specialization: Signal processing
Advisor: Philip Gressman

2012 *BA in Musicology*
University of Pennsylvania

Specialization: American modernism, modernist performance practice
Advisors: Arman Schwartz, Emily Dolan

Appointments held

Jul. 2020 - Jul. 2021 — *Postdoctoral Associate*
Data Science Initiative
Brown University
Supervisor: Stuart Geman

Aug. 2018 - Feb. 2018 — *Visiting Doctoral Researcher*
Département d'informatique
École normale supérieure (Ulm)
Principal Investigator: Stéphane Mallat

2013-2014 — *Research Assistant*
Rutgers University Center for Cognitive Science
Principal Investigator: Randy Gallistel

Grants, honors & awards

Jul. 1, 2021- — Zuckerman Postdoctoral Fellowship
Hebrew University of Jerusalem
Principal Investigator: Mor Nitzan

Sep. 1, 2017- July 1, 2019 — NSF Graduate Research Fellowship
Award no. 1644760
Principal Investigator: Thomas Serre

2018 — Brown University Graduate School Travel Grant

2017 — CCN Travel Grant

Jan. 1, 2015- Jan. 1, 2017 — NIH Vision Training Grant
Award no. 5T32EY018080-08
Principal Investigator: Michael Paradiso

2012 — Admitted to Phi Beta Kappa

2011 — Submatriculated into graduate program, Department of Mathematics, University of Pennsylvania

Peer-Reviewed Publications

Submited

Moriel, N. Ricci, M., Nitzan, M. Let's Do the Time-Warp-Attend: Learning Topologically-Invariant Representations of Dynamical systems. (Submitted)

Ricci, M.G., Thackray, J., Tischfield, M., Abraira, V. Animal2Vec: Sequence embedding methods for computational ethology. (Submitted)

Published

Bohic, M., Pattison, L.A., Jhumka, Z.A., Rossi, H., Thackray, J.K., Ricci, M.G., Foster, W., Arnold, J., Mossazghi, N., Yttri, E.A., Tischfield, M.A., Smith, E. S-J, Abdus-Saboor, I., Abraira, V. (2023) Behavioral and nociceptor states of inflammatory pain across timescales in 2D and 3D. Neuron (Accepted)

Ricci, M., Kim, J., Johansson, F. (2023). Passage-of-time Model of the Cerebellar Purkinje Cell. Frontiers in Computational Neuroscience (Accepted)

Ricci, M., Moriel, N., Piran, Z., Nitzan, M, (2023) Phase2vec: Dynamical systems embedding with a physics-informed convolutional network. 10th International Conference on Learning Representations, ICLR 2023 - Conference Track Proceedings (Spotlight)

Gallistel CR, Johansson F, Jirenhed DA, Rasmussen A, Ricci M, Hesslow G (2022). Quantitative properties of the creation and activation of a cell-intrinsic duration-encoding engram. Frontiers in Computational Neuroscience Nov 3;16:1019812. doi: 10.3389/fncom.2022.1019812. PMID: 36405788; PMCID: PMC9669310.

Chalvidal, M., Ricci, M.G., Serre, T., VanRullen, R. (2021) Go With the Flow: Adaptive Control for Neural ODEs. 8th International Conference on Learning Representations, ICLR 2021 - Conference Track Proceedings

Alamia, A., Luo, C., Ricci, M.G., Kim, J., Serre, T. and VanRullen, R. (2020) Differential involvement of EEG oscillatory components in identy vs. spatial-relation reasoning tasks. eNeuro, 8 (1) ENEURO.0267-20.2020

Ricci, M., Cadène, R., & Serre, T. (2020). Same-different conceptualization : A machine vision perspective. Current Opinion in Behavioral Sciences, 37, 47–55. https://doi.org/10.1016/j.cobeha.2020.08.008

Ricci, M., and Serre, T. (2020). Hierarchical Models of the Visual System. Encyclopedia of Computational Neuroscience, 1–14. https://doi.org/10.1007/978-

1-4614-7320-6_345-2

Kim, J., Ricci, M.G., and Serre, T. (2018) Not-so-CLEVR: Learning same-different relations strains feedforward neural networks, Journal of the Royal Society Interface, 8(4), https://doi.org/10.1038/35073582

Ricci, M.G, Kim, J. and Serre, T. (2018) Same-Different Problems Strain Convolutional Neural Networks, Proceedings of the 40th Annual Conference of the Cognitive Science Society.

Ricci, M.G., and Gallistel, R. (2017). Accurate Step-Hold Tracking of Smoothly Varying Periodic and Aperiodic Probability. Atten. Percept. Psychophys., 1–32. https://doi.org/10.3758/s13414-017-1310-0

Technical Reports and Preprints

Ricci, M., Moriel, N., Piran, Z., Nitzan, M., Phase2vec: Dynamical systems embedding with a physics-informed convolutional network. arXiv:2212.03857v1 [cs.LG]

Ricci, M.G., Jung, M., Zhang, Y., Chalvidal, M., Soni, A., Serre, T. KuraNet: Systems of Coupled Oscillators that Learn to Synchronize. arXiv:2105.02838 [nlin.AO]

Bohic, M., Pattison, L.A., Jhumka, Z.A., Rossi, H., Thackray, J.K., Ricci, M.G., Foster, W., Arnold, J., Mossazghi, N., Yttri, E.A., Tischfield, M.A., Smith, E. S-J, Abdus-Saboor, I., Abraira, V. Behavioral and nociceptor states of inflammatory pain across timescales in 2D and 3D. bioRxiv 2019.12.16.877829

Ricci, M.G., Jung, M., Zhang, Y., Chalvidal, M., Soni, A., Serre, T. KuraNet: Systems of Coupled Oscillators that Learn to Synchronize. arXiv:2105.02838 [nlin.AO]

Chalvidal, M., Ricci, M.G., Serre, T., VanRullen, R. Go With the Flow: Adaptive Control for Neural ODEs. arXiv:2006.09545 [cs.LG]

Alamia, A., Luo, C., Ricci, M.G., Kim, J., Serre, T., VanRullen, R. Differential involvement of EEG oscillatory components in sameness vs. spatial-relation visual reasoning tasks bioRxiv 2019.12.16.877829

Gallistel, C. R., Johansson, F., Jirenhed, D.-A., Rasmussen, A., Ricci, M., and Hesslow, G. (2020). Quantitative Properties of the Creation and Activation of a Cell-Intrinsic Engram. BioRxiv, 2020.03.17.995258.

Ricci, M.G., Kim, J and Johansson, F. A Passage-of-time Model of the Cerebellar Purkinje Cell, 2016, arXiv:1605.03060v2 [q-bio.NC]

Works in Progress

Ricci, M., Moriel, M. Piran, Z., Nitzan, M. Spatial-Phase2vec: representation learning for reaction-diffusion models.

Theis, T., Thackray, J. Ricci, M.G., Tshang, M., Oputal, O. Mahmood, M., Vivinetto, A., Bernstein, A., Ruven, C., Tucker, A., Birch, D., Eisdorfer, J.T., Shrier, T., Kumar, S., Tysseling, V., Dulin, J., Sahni, V., Hollis, E.R.,Schachner, M., Abraira, V. A machine-vision approach for automated locomotor recovery evaluation at millisecond timescales.

Conferences, Talks and Workshops

As conference presenter

May 2023 — Ricci, M., Moriel, N., Piran, Z., Nitzan, M "Phase2vec: Dynamical systems embedding with a physics-informed convolutional network". 10th International Conference on Learning Representations, ICLR 2023 (Spotlight), Kigali, Rwanda. May 1-5 2023

March 2023 — Ricci, M., Moriel, N., Piran, Z., Nitzan, M "Phase2vec: Dynamical systems embedding with a physics-informed convolutional network". Physics of Life 2023. IOP. Harrowgate, UK. March 27-30, 2023

Sep. 2022 — Ricci, M. "Learning Generalizable Representations of Dynamical Systems". NETDATA22: Inverse Network Dynamics - Network structure and function from nonlinear dynamics and time series data. Dresden, Germany. Sep. 12-21 , 2022

Nov. 2021 — Mahmood, M., Theis, T., Ricci, M.G., Abraira, V. "A Machine-Vision Approach for Automated Locomotor Recovery Evaluation at Millisecond Timescales". Annual Biomedical Research Conference for Minority Students (ABRCMS), Virtual. Nov. 10-13, 2021.

July 2021 — Theis, T., Thackray, J.K., Ricci, M.G., Abraira, V. "A machine vision approach for automated locomotor recovery at millisecond timescales". 38th Annual National Neurotrauma Symposium, Virtual. July 11-14, 2021.

June 2020 — Ricci, M.G, "N'Sync: Learning to Synchronize in Complex Networks" Brown University Uncoference, Virtual. June 29-30, 2020.

Feb. 2020

Ricci, M.G., Zhang, Y., Soni, A., Jung, M., Serre, T. "Kura-Net: Exploring systems of coupled oscillators using deep learning" Poster, COSYNE 2020. Denver, USA. February 27-March 2, 2020.

Feb. 2019 Ricci, M.G., Windolf, C., Serre, T. "A Formal Model of Neural Synchrony for Unsupervised Image Grouping". Poster, COSYNE 2019. Lisbon, Portugal. February 28-March 3, 2019.

July 2018 "Not-So-CLEVR: Same-different problems strain feedforward neural networks". 40th Annual Meeting of the Cognitive Science Society", July 25, 2018. Monona Terrace Community and Convention Center, Madison, WI.

Sep. 2017 "A Dichotomy of Visual Relations, Or the Limits of Convolutional Neural Networks", Conference on Cognitive Computational Neuroscience (CCN), September 6-8, 2017. Columbia University, NYC.

Aug. 2017 "Deep RL Bootcamp", August 26-27, 2017, University of California, Berkeley. (Accepted)

June 2015 "Cell autonomous metabotropic signaling", Kavli Futures Symposium – The Synapse Hypothesis: To be or not to be. June 25-26, 2015. University of California, Santa Barbara

As guest speaker

March 2022 "Go with the flow: Representation Learning for Dynamical Systems". Hebrew University of Jerusalem. School of Computer Science and Engineering. March 10, 2022

June 2020 "The Kuramoto Model Meets Machine Learning: Some Early Results in the Statistical Modeling of Oscillatory Systems". University of Ghent. PI: Tom Verguts. June 19, 2020

Nov. 2019 "The Serre Lab: From machine learning to biology and back again", Information Theory (APMA 1710). Instructor: Govind Menon. November 11, 2019.

Oct. 2019 "Coupled Oscillators for Data Science: A Research Program", Serre Lab-ANITI Joint Meeting, PIs: Thomas Serre, Rufin VanRullen. October 24, 2019.

Sep. 2019 "Review: Coupled Oscillators for Perceptual Grouping", Carney Institute for Brain Science. September 5, 2019.

April 2019 "Systems of coupled neural oscillators: Results and applications based on Slotine, Izhikevich, Kuramoto", Carney Institute for Brain Science. April

30, 2019.

Aug. 2019 "Kosterlitz Machines", Carney Institute for Brain Science. August 7, 2019.

Oct. 2018 "Get Rhythm: Object Multiplexing in Phase Neural Networks". Centre de Recherche Cerveau et Cognition, Toulouse, France. October 2., 2018

March 2018 "Reinforcement Learning 101", Computational Cognitive Science (CLPS 1291). Instructor: Thomas Serre. March 22, 2018.

Dec. 2017 "Visual Relations and Convolutional Networks", Perception & Action Seminar, Brown University, Department of Cognitive, Linguistic and Psychological Sciences. December 7, 2017

Oct. 2015 "Contemporary Problems in Vision", Brown University, Department of Cognitive, Linguistic and Psychological Sciences. October 9, 2015.

June 2015 "Contemporary Problems in Vision", UCL Gatsby Computational Neuroscience Unit. June 26, 2015.

June 2015 "Challenges to Hebbianism: A Case from Cerebellar Learning", UCL Gatsby Computational Neuroscience Unit, June 25, 2015.

June 2015 "Challenges to Hebbianism: A Case from Cerebellar Learning", University of Geneva. June 3, 2015.

June 2015 "Challenges to Hebbianism: A Case from Cerebellar Learning", Neurospin. June 5, 2015.

March 2014 "Non-stationary Bernoulli Processes: Ideal Observers' Predictions and Surprisals", Rutgers University Center for Cognitive Science. March 28, 2014.

As organizer

April 2018 "Beyond Deep Learning Workshop: Session 2", Brown University, April 6, 2018
Speakers: David Heeger (NYU), Dima Amso (Brown University), Tom Griffiths (UC Berkeley)

Jan. 2018 "Beyond Deep Learning Workshop: Session 1", Brown University, January 18-19, 2018
Speakers: Matthias Bethge (Universität Tübingen), Randy Gallistel (Rutgers University), Gary Marcus (NYU), Samuel Gershman (Harvard)

Teaching

Brown University

2019-present *Mentor*
Visiting undergraduate researcher, Yuwei Zhang
Nankai University
Project: An end-to-end differentiable clustering algorithm using the Kuramoto Model

2019 *Teaching Assistant*
Human Cognition (CLPS 0200)
Instructor: Katheryn Spoehr

2018 *Teaching Assistant*
Deep Learning in Brains, Minds and Machines (CLPS 1950)
Instructor: Thomas Serre

2017 *Teaching Assistant*
Introduction to Programming for Mind, Brain and Behavior (CLPS 1292)
Instructor: Thomas Serre

2016-2018 *Mentor*
Masters student, Charles Windolf
Department of Applied Mathematics, Brown University
Project: Angular Gibbs random fields for image processing

University of Pennsylvania

2012-2013 *Tutor*
Multivariable calculus, linear algebra (MATH 103, MATH 104)
Department of Mathematics

Princeton Review

2013 *SAT Instructor*
2013 *MCAT Instructor*

References

Mor Nitzan
Senior Lecturer
School of Computer Science and Engineering
The Hebrew University of Jerusalem
Rothberg Family Buildings
The Edmond J. Safra Campus
9190401 Jerusalem, Israel
mor.nitzan@mail.huji.ac.il

Thomas Serre
Professor of Cognitive, Linguistic and Psychological Sciences
Brown University
190 Thayer Street
Providence, RI 02906
401-863-2727
thomas_serre@brown.edu

Charles Randy Gallistel
Distinguished Professor Emeritus of Behavioral and Systems Neuroscience
Rutgers University
152 Frelinghuysen Road
Piscataway, NJ 08854
732-445-2973
galliste@ruccs.rutgers.edu

Elie Bienenstock
Professor of Applied Mathematics
Brown University
182 George Street
Providence, RI 02906
401-863-2115
lucien_bienenstock@brown.edu

Matthew Harrison
Professor of Applied Mathematics
Brown University
182 George Street
Providence, RI 02906
401-863-2115
matthew_harrison@brown.edu