Jorio Cocola

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EDUCATION

Northeastern University — Boston, MA
Ph.D. Candidate in Mathematics — *2018-05/2022 (Expected)*
Advisor: Prof. Paul Hand

Rice University — Houston, TX
M.A. in Computational and Applied Mathematics — *2019*

Rice University — Houston, TX
Ph.D. student in Computational and Applied Mathematics — *2016-2018*
(Transferred to Northeastern University)

Polytechnic University of Milan — Milan, Italy
M.Eng. in Mathematical Engineering — *2016*

Polytechnic University of Milan — Milan, Italy
B.Eng. in Mathematical Engineering — *2012*

MASTER'S THESES

M.A. *"Microlocal Analysis of Hyperbolic Equations with Memory and Applications"*,
Supervisor: Prof. Maarten de Hoop (Rice University).

M.Eng.: *"Parametrix for an Hyperbolic Initial Value Problem with Weak Dissipation in Viscoelasticity"*,
Supervisors: Elena Beretta (Polytechnic University of Milan) & Prof. Maarten de Hoop (Rice University).

RESEARCH

RESEARCH INTERESTS

- Machine Learning
- High-Dimensional Statistics
- Computational Science
- Optimization
- Inverse Problems
- Partial Differential Equations

RESEARCH EXPERIENCE

- **Research Assistant, Northeastern University**, Sep. 2018 - Present.
  Mathematics and Applications of Machine Learning:
  Developed mathematical theory for the training of neural networks, investigated statistical-computational tradeoffs in inference problems with generative network priors and developed principled training algorithms for generative networks to be used in inverse problems.

- **Research Intern, Sandia National Laboratories**, Jun. 2021 - Aug. 2021.
  Machine Learning Methods for Nonlinear Model Reduction:
  Developed compressing techniques for deep networks to be used for model reduction methods in transport and advection dominated advection-diffusion problems. Contributed to the open source PRESSIO library (python/C++ library for model reduction).

- **Research Assistant, Rice University**, Aug. 2016 - Aug. 2018.
  Microlocal Analysis and Deep Learning for Inverse Problems in Seismic Imaging:
  Worked on hyperbolic wave equations with memory terms with applications in viscoelastic wave propagation and seismic inverse problems. Proved a propagation of singularities result for first order equations with memory, and proposed a novel microlocal reverse time-continuation method. Developed a deep learning methods for seismic inverse scattering based on network-unrolling.

- **Visiting Research Student, Purdue University** Oct. 2014 - Apr. 2015.
  Harmonic Analysis and Partial Differential Equations:
  Research for my master's thesis at Polytechnic University of Milan. Constructed and analyzed solution operators (parametrices) for first order hyperbolic initial value problems with weak memory terms.

PUBLICATIONS

1. Jorio Cocola, Paul Hand, and Vladislav Voroninski, *Global Guarantees for Recovery of Two-Layers Vector-valued ReLU Networks*, (in preparation)
2. Jorio Cocola, John Tencer, Eric J. Parish, Francesco Rizzi and Patrick J. Blonigan, *Scalable Model Reduction on Nonlinear Manifolds*, (in preparation).
3. Gunn Sean, Jorio Cocola and Paul Hand, *Regularized Training of Intermediate Layers for Generative Models for Inverse Problems*, (submitted, available upon request).
4. Jorio Cocola, Paul Hand and Vladislav Voroninski. *No Statistical-Computational Gap in Spiked Matrix Models With Generative Network Priors*, in Entropy, 23(1), p.115., 2021.
5. Jorio Cocola, Paul Hand and Vladislav Voroninski. *Nonasymptotic Guarantees for Spiked Matrix Recovery with Generative Priors*, in Advances in Neural Information Processing Systems 33 (2020).
6. Jorio Cocola and Paul Hand, *Global Convergence of Sobolev Training for Overparameterized Neural Networks*, in International Conference on Machine Learning, Optimization, and Data Science (LOD 2020), pp.574–586. Springer, 2020.
7. Richard H. Byrd, Jorio Cocola and Richard A. Tapia, *Extending the Pennisi–McCormick Second-Order Sufficiency Theory for Nonlinear Programming to Infinite Dimensions*, in SIAM Journal on Optmization, 29(3), pp.1870-1878, 2019.
8. Jorio Cocola and Maarten de Hoop, *Microlocal Analysis Of Hyperbolic Initial Value Problems With Weak Memory Terms*, in GMIG Technical Report, 2017.

TALKS

1. "Applications and Perspective of Machine Learning Methods for Signal Recovery", *Invited Talk at the CRISP Group Research Meeting*, Harvard University, December 2021.
2. "Nonasymptotic Guarantees for Spiked Matrix Recovery with Generative Priors", *Poster at NeurIPS 2020*, December 2020.
3. "Generative Priors and Computational-Statistical Gap", *Talk at Asilomar 2020*, November 2020.
4. "Closing the Computational-to-Statistical Gap in Spiked Matrix Models with Generative Neural Networks", *Poster at the workshop "Statistics and Computation"*, The Alan Turing Institute, London, January 2020.
5. "High Dimensional Hypothesis Testing and Le Cam's Contiguity", *Reading Group in Machine Learning*, Northeastern University, November 2019.
6. "Optimal Transport: from Kantorovich to Wasserstein-GAN", *Reading Group in Machine Learning*, Northeastern University, October 2019.
7. "Microlocal Analysis: an Introduction to the Theory and Its Applications", *CAAM Graduate Student Seminar*, Rice University, April 2018.
8. "Microlocal Compensation Relaxation in RTM", *GMIG Annual Project Review*, Houston, April 2018.
9. "Attenuation, High Frequency Wave Propagation and Anisotropy", *GMIG Annual Project Review*, Houston, April 2017.
10. "Attenuation, Equivalence Principle, High-Frequency Wave Propagation and Downward Continuation", *GMIG Annual Project Review*, Chicago, April 2015.

TEACHING EXPERIENCE

- **Teaching Assistant.** CS 6140: Machine Learning, Instructor Prof. Paul Hand, Fall 2021, Northeastern University.
- **Teaching Assistant.** CS 7150: Deep Learning, Instructor Prof. Paul Hand, Spring 2021, Northeastern University.
- **Mentor.** MATH 4025: Applied Math Capstone Project, Instructor Prof. Lee-Peng Lee, Spring 2021, Northeastern University.
- **Instructor.** DS 2001: Science Practicum for Programming for Data Science, Fall 2020, Northeastern University.
- **Teaching Assistant.** MATH 7243: Machine Learning 1: Statistical Learning Theory and Algorithms, Instructor Prof. Nathaniel Bade, Spring 2019 & 2020, Northeastern University.
- **Instructor.** MATH 1215: Mathemathical Thinking, Fall 2019, Northeastern University.
- **Teaching Assistant.** MATH 3081: Probability and Statistics, Instructor Prof. Paul Hand, Fall 2018, Northeastern University.
- **Grader.** CAAM 336: Differential Equations in Science and Engineering, Fall 2017, Rice University.
- **Grader.** CAAM 453: Numerical Analysis I, Instructor Luis Nunes Vicente, Fall 2016, Rice University.

SERVICE

- Reviewer - *SAMPTA 2019, Deep Inverse 2021 (Workshop at NEURIPS 2021).*
- Organizer - *Rice University CAAM Graduate Student Seminar*

LANGUAGES

Italian (native), English (fluent)

REFERENCES

Prof. Paul Hand (Advisor)
Assistant Professor
Dept. of Mathematics and Dept. Computer Science
567 Lake Hall
Northeastern University, Boston, MA 02215
p.hand@northeastern.edu

Dr. John Tencer (Industry)
Research Scientist
Sandia National Laboratories
Albuquerque, NM
jtencer@sandia.gov

Prof. Richard Tapia
University Professor
Maxfield-Oshman Professor in Engineering
CAAM - MS 134
Rice University
Houston, Texas 77005 - 1892
rat@rice.edu

Dr. Nathaniel Bade (Teaching)
Associate Data Engineer
Mobius Logic Inc.
nate.d.bade@gmail.com