

Nicolas Loizou

Contact Details

Address: Johns Hopkins University, 3400 North Charles Street, Baltimore, MD 21218
Email: nicolasloizou1@gmail.com
Website: <https://nicolasloizou.github.io>

Fields of Interests

Large-Scale Optimization, Machine Learning, Convex and Non-Convex Analysis,
Randomized Algorithms, Randomized Numerical Linear Algebra, Data Science,
Distributed and Decentralized Algorithms, Deep Learning.

Professional Appointments

Assistant Professor,
Johns Hopkins University, Dep. of Applied Mathematics and Statistics, (starting Jan. 2022)
Mathematical Institute for Data Science (Primary appointment)
Dep. of Computer Science (Secondary appointment)

IVADO Postdoctoral Research Fellow,
Mila - Quebec Artificial Intelligence Institute, Université de Montréal, Sept. 2019 - Dec. 2021
Hosts: Dr. Simon Lacoste-Julien and Dr. Ioannis Mitliagkas

Research Intern (AI),
Facebook Research, FAIR Montreal, Aug.-Dec. 2018
Project: Distributed Non-convex Optimization Algorithms and Deep Learning
Mentor: Dr. Michael Rabbat

Education

University of Edinburgh, School of Mathematics
PhD in Operational Research and Optimization, 2015 - 2019
PhD Thesis: "Randomized Iterative Methods for Linear Systems: Momentum, Inexactness and Gossip"
Supervisor: Dr. Peter Richtárik

Imperial College London
MSc in Computing (Computational Management Science), 2014-2015
MSc Thesis: "Distributionally Robust Game Theory" with Distinction 83%
Supervisors: Dr. Wolfram Wiesemann and Dr. Panos Parpas

National and Kapodistrian University of Athens
BSc Mathematics, 2010- 2014
Specialization: Applied Mathematics (Statistics and Operational Research).
First-Class Honours (Άριστα): Upper 1% of 350 graduating students

Publications

I have published 14 papers in international journals and major peer-reviewed conferences. The machine learning conferences (ICML, NeurIPS, AISTATS) have a low acceptance rate (typically below 25%) and are the primary conferences of high impact in machine learning and artificial intelligence research. ICASSP and GlobalSIP are the two flagship conferences of the IEEE Signal Processing Society, while Allerton Conference is one of the major conferences of the IEEE Control Systems Society / IEEE Information Theory Society. I also have 6 papers (ArXiv preprints) currently under submission in international journals and major peer-reviewed conferences.

Thesis

N. Loizou.

Randomized Iterative Methods for Linear Systems: Momentum, Inexactness and Gossip.

Ph.D. Dissertation, The University of Edinburgh, 2019

OR Society's Doctoral Award (Runner-up) for the "Most Distinguished Body of Research leading to the Award of a Doctorate in the field of Operational Research" in the United Kingdom.

Preprints

Ryan D'Orazio, Nicolas Loizou, Issam Laradji, Ioannis Mitliagkas

Stochastic Mirror Descent: Convergence Analysis and Adaptive Variants via the Mirror Stochastic Polyak Stepsize, arXiv preprint arXiv:2110.15412, October 2021, (Under submission)

Eduard Gorbunov, Nicolas Loizou, Gauthier Gidel

Extragradient Method: $O(1/K)$ Last-Iterate Convergence for Monotone Variational Inequalities and Connections With Cocoercivity,
arXiv preprint arXiv:2110.04261, October 2021, (Under submission)

Chris Junchi Li, Yaodong Yu, Nicolas Loizou, Gauthier Gidel, Yi Ma, Nicolas Le Roux, Michael I Jordan

On the Convergence of Stochastic Extragradient for Bilinear Games with Restarted Iteration Averaging,
arXiv preprint arXiv:2107.00464, June 2021, (Under submission)

Z. Shi, N. Loizou, P. Richtárik, M. Takac

AI-SARAH: Adaptive and Implicit Stochastic Recursive Gradient Methods
arXiv preprint arXiv:2102.09700, February 2021, (Under submission)

A. Khaled, O. Sebbouh, N. Loizou, R. M. Gower, P. Richtárik

Unified Analysis of Stochastic Gradient Methods for Composite Convex and Smooth Optimization
arXiv preprint arXiv:2006.11573, June 2020, (Under submission)

F. Hanzely, J. Konečný, N. Loizou, P. Richtárik, D. Grishchenko

Privacy Preserving Randomized Gossip Algorithms
arXiv preprint arXiv:1706.07636, June 2017 (Under submission)

Journal Papers

N. Loizou, P. Richtárik.

Revisiting Randomized Gossip Algorithms: General Framework, Convergence Rates and Novel Block and Accelerated Protocols.

IEEE Transactions on Information Theory, 2021.

N. Loizou, P. Richtárik.

Convergence Analysis of Inexact Randomized Iterative Methods,
SIAM Journal on Scientific Computing 42 (6), A3979-A4016, 2020

N. Loizou, P. Richtárik.

Momentum and Stochastic Momentum for Stochastic Gradient, Newton, Proximal Point and Subspace Descent Methods
Computational Optimization and Applications, 77 (3), 653-710, 2020

Peer-reviewed Conference Papers

Nicolas Loizou, Hugo Berard, Gauthier Gidel, Ioannis Mitliagkas, Simon Lacoste-Julien

Stochastic Gradient Descent-Ascent and Consensus Optimization for Smooth Games: Convergence Analysis under Expected Co-coercivity
Advances in Neural Information Processing Systems 35 (NeurIPS 2021)

R. M. Gower, O. Sebbouh, N. Loizou

SGD for Structured Nonconvex Functions: Learning rates, Minibatching and Interpolation
The 24th International Conference on Artificial Intelligence and Statistics (AISTATS 2021),
short version: Optimization for Machine Learning Workshop, NeurIPS 2020

N. Loizou, S. Vaswani, I. Laradji, S. Lacoste-Julien

Stochastic Polyak Step-size for SGD: An Adaptive Learning Rate for Fast Convergence
The 24th International Conference on Artificial Intelligence and Statistics (AISTATS 2021)
short version: Optimization for Machine Learning Workshop, NeurIPS 2020 (**Spotlight Talk**)

N. Loizou, H. Berard, A. Jolicoeur-Martineau, P. Vincent, S. Lacoste-Julien, I. Mitliagkas

Stochastic Hamiltonian Gradient Methods for Smooth Games
Proceedings of the 37th International Conference on Machine Learning (ICML), pages 6370–6381, 2020.

A Koloskova, N Loizou, S Boreiri, M Jaggi, S. U. Stich

A Unified Theory of Decentralized SGD with Changing Topology and Local Updates
Proceedings of the 36th International Conference on Machine Learning (ICML), pages 5381–5393, 2020.

R. M. Gower, N. Loizou, X. Qian, A. Sailanbayev, E. Shulgin, P. Richtárik.

SGD: General Analysis and Improved Rates,
Proceedings of the 36th International Conference on Machine Learning (ICML), pages 5200–5209, 2019.

M. Assran, N. Loizou, N. Ballas, M. Rabbat.

Stochastic Gradient Push for Distributed Deep Learning,
Proceedings of the 36th International Conference on Machine Learning (ICML), pages 344–353, 2019.
short version: Systems for ML workshop, NeurIPS 2018

N. Loizou, M. Rabbat, and P. Richtárik.

Provably accelerated randomized gossip algorithms.
International Conference on Acoustics, Speech and Signal Processing (ICASSP), pages 7505–7509, 2019.

N. Loizou, P. Richtárik.

Accelerated gossip via stochastic heavy ball method.
Annual Allerton Conference on Communication, Control, and Computing (Allerton), pages 927–934, 2018.

N. Loizou, P. Richtárik.

A New Perspective on Randomized Gossip Algorithms,

IEEE Global Conference on Signal and Information Processing (GlobalSIP), pages 440-444, 2016.

N. Loizou.

Distributionally Robust Games with Risk-Averse Players,

Proceedings of 5th International Conference on Operations Research and Enterprise Systems (ICORES), pages 186-196, 2016.

Peer-reviewed Workshop Papers / Others

R. D’Orazio, N. Loizou, I. H. Laradji, I. Mitliagkas

On Stochastic Mirror Descent: Convergence Analysis and Adaptive Variants

ICML 2021 - Workshop: Beyond first-order methods in ML systems

F. Hanzely, J. Konečný, N. Loizou, P. Richtárik, D. Grishchenko.

A Privacy Preserving Randomized Gossip Algorithm via Controlled Noise Insertion,

NeurIPS 2018 - Privacy Preserving Machine Learning Workshop

N. Loizou, P. Richtárik.

Linearly convergent stochastic heavy ball method for minimizing generalization error,

NeurIPS 2017 - Optimization for Machine Learning Workshop

N. Loizou.

Distributionally Robust Game Theory,

MSc Thesis, Imperial College London, 2015.

Achievements, Awards and Scholarships

- **2021:**

- **COAP 2020 Best paper prize:** Our paper “Momentum and stochastic momentum for stochastic gradient, Newton, proximal point and subspace descent methods” published in Computational Optimization and Application was voted by the editorial board as the best paper appearing in the journal in 2020.

- **2020:**

- **2019 OR Society’s Doctoral Award** (Runner-up) for the “Most Distinguished Body of Research leading to the Award of a Doctorate in the field of Operational Research” in the UK.
- ICML 2020 Top Reviewer

- **2019:**

- **IVADO Fellow Postdoctoral Scholarship:** 270000\$ scholarship + 45000\$ research fund + 10000\$ other expenses, fully funded by IVADO, 2020-2023.
- **ICML Travel Award:** Travel support for attending ICML 2019 (Los Angeles).
- Travel award from **Amazon Scalable Machine Learning, Berlin** for attending International Conference on Continuous Optimization (ICCOPT) , Berlin, Germany.

- **2018:**
 - **Edinburgh University Travel Award** for visiting Optimization and Machine Learning Research Group, Lehigh University, 10 Apr – 15 May 2018.
 - Travel award from **Amazon Scalable Machine Learning, Berlin** for attending 23rd International Symposium on Mathematical Programming , Bordeaux, France
 - Travel award from **Amazon Scalable Machine Learning, Berlin** for attending DIMACS/TRIPODS/MOPTA, Lehigh University, Bethlehem, PA, USA
- **2017:**
 - **Grant, Edinburgh Research and Development Fund** (cover my expenses for the attendance of Conference on Computational Management Science, Bergamo Italy)
 - Travel award from **Laura Wisewell Travel Fund** for attending SIAM Conference on Optimization
 - **SIAM Student Travel Award** for attending SIAM Conference on Optimization
- **2016:**
 - **IEEE Signal Processing Society Travel Grant** for attending GlobalSip
 - **PCMI Scholarship.** Cover almost all of my expenses for the attendance of the PCMI Summer School in Utah "Mathematics of Data"
 - Scholarship from the **A.G. Leventis Foundation** for PhD studies at University of Edinburgh (2016–2017)
 - **Grant, Edinburgh Research and Development Fund** (cover my expenses for the attendance of Machine Learning Summer School in Cadiz, Spain)
 - **ICORES Travel Award**
- **2015:**
 - Travel award from **Laura Wisewell Travel Fund** for attending International Conference on Operations Research and Enterprise Systems in Rome
 - Scholarship from **A.G. Leventis Foundation** for PhD studies at University of Edinburgh (2015-2016)
 - **Principal's Career Development Scholarship:** Highly competitive PhD scholarship awarded to several students across University of Edinburgh
- **2014:**
 - **MSc Full Scholarship from Imperial College London Department of Computing** (Scholarships are awarded on academic merit to outstanding applicants.)
 - Scholarship from **A.G. Leventis Foundation** for MSc studies at Imperial College (2014-2015)
- **Before 2014:**
 - Undergraduate student with higher grades and specialization in Statistics and Operations Research (National and Kapodistrian University of Athens)

Presentations (Upcoming and Past)

Talks

- 06-14 Dec 2021: **NeurIPS 2021**, (virtual conference)
title: "Stochastic Gradient Descent-Ascent and Consensus Optimization for Smooth Games: Convergence Analysis under Expected Co-coercivity"
- 24-27 Oct 2021: **INFORMS annual meeting**, (virtual conference)
title: "Stochastic Gradient Descent-Ascent and Consensus Optimization for Smooth Games: Convergence Analysis under Expected Co-coercivity"
- 20-23 Jul 2021: **Siam Conference On Optimization**, (virtual conference)
title: "Stochastic Polyak Step-size for SGD: An Adaptive Learning Rate for Fast Convergence"
- 07-09 Jul 2021: **18th International Workshop on Continuous Optimization**, (virtual conference)
title: "Stochastic Polyak Step-size for SGD: An Adaptive Learning Rate for Fast Convergence"
- 28 April 2021: **Computer Science department, Rice University**.
title: "Large-Scale Optimization for Machine Learning and Data Science"
- 13-15 Apr 2021: **24th International Conference on Artificial Intelligence and Statistics (AISTATS)**
title: "Stochastic Polyak step-size for SGD: An adaptive learning rate for fast convergence"
title: "SGD for structured nonconvex functions: Learning rates, minibatching and interpolation"
- 23 Feb 2021: **University of British Columbia (Okanagan campus)**.
title: "Large-Scale Optimization for Machine Learning and Data Science"
- 16 Feb 2021: **ECE Rising Star Seminar Series, University of Wisconsin-Madison**.
title: "Large-Scale Optimization for Machine Learning and Data Science"
- 28 Jan 2021: **MINDS 2021 Winter Symposium, Johns Hopkins University**.
title: "Large-Scale Optimization for Machine Learning and Data Science"
- 11 Dec 2020: **Optimization for Machine Learning Workshop, NeurIPS**, Spotlight Talk.
title: "Stochastic Polyak Step-size for SGD: An Adaptive Learning Rate for Fast Convergence"
- 02 Dec 2020: **Montreal Machine Learning and Optimization (MTL MLOpt) Seminar**.
title: "SGD for Modern Machine Learning: Practical Variants and Convergence Guarantees"
- 30 Nov 2020: **Smooth Games - Reading Group EPFL**, Virtual Talk.
title: "Stochastic Hamiltonian Gradient Methods for Smooth Games"
- 07-13 Nov 2020: **INFORMS annual meeting**, Virtual Conference.
title: "Stochastic Polyak Step-size for SGD: An Adaptive Learning Rate for Fast Convergence"
- 12-18 Jul 2020: **37th International Conference on Machine Learning (ICML)**, Virtual Conference
title: "Stochastic Hamiltonian Gradient Methods for Smooth Games"
title: "A Unified Theory of Decentralized SGD with Changing Topology and Local Updates"
- 06-09 Jul 2020: **SIAM Conference on Imaging Science**, Virtual Conference
title: "Revisiting Randomized Gossip Algorithms: A Novel Framework through Kaczmarz-type Methods"
- 19 March 2020: **54th Annual Conference on Information Sciences and Systems (CISS)**, Virtual Conference.
title: "Revisiting Randomized Gossip Algorithms: A Novel Framework through Kaczmarz-type Methods"

- 06 Aug 2019: **International Conference on Continuous Optimization (ICCOPT)** , Berlin, Germany
title: "Stochastic Gradient Push for Distributed Deep Learning"
- 11 Jun 2019: **36th International Conference on Machine Learning (ICML)** , Los Angeles, USA
title: "SGD: General Analysis and Improved Rates"
- 28 Apr 2019: **All Hands Meetings on Big Data Optimization** , KAUST, Saudi Arabia
title: "SGD: General Analysis and Improved Rates"
- 8 Dec 2018: **Privacy Preserving Machine Learning Workshop, NIPS 2018** , Montreal , Canada
title: "A Privacy Preserving Randomized Gossip Algorithm via Controlled Noise Insertion"
- 16 Nov 2018: **MILA Tea Talks** , University of Montreal , Montreal , Canada
title: "Stochastic Heavy Ball Method, Average Consensus and Distributed Deep Learning"
- 13 Nov 2018: **Mathematics in Machine Learning Seminar** , McGill University, Montreal , Canada
title: "Momentum and stochastic momentum for stochastic gradient, Newton, proximal point and subspace descent methods"
- 04 Oct 2018: **56th Annual Allerton Conference on Communication, Control, and Computing (Allerton)** , Monticello, IL, USA
title: "Accelerated Gossip via Stochastic Heavy Ball Method"
- 04 Sept 2018: **Facebook Montreal Research Seminar** , Montreal , Canada
title: "Randomized Optimization Methods for Large Scale Problems"
- 13-17 Aug 2018: **DIMACS/TRIPODS/MOPTA** , Lehigh University, Bethlehem, PA, USA
title: "Revisiting the Foundations of Randomized Gossip Algorithms"
- 1-6 Jul 2018: **International Symposium on Mathematical Programming** , Bordeaux, France (**invited**)
title: "Convergence Analysis of Inexact Randomized Iterative Methods"
- 11 Apr 2018: **OptML group Seminar** , Lehigh University, Bethlehem, PA, USA
title: "Momentum and Stochastic Momentum for Stochastic Gradient, Newton, Proximal Point and Subspace Descent Methods"
- 05 Feb 2018, **Optimization and Big Data 2018, KAUST**, Thuwal, Saudi Arabia,
talk: "Momentum and Stochastic Momentum for Stochastic Gradient, Newton, Proximal Point and Subspace Descent Methods"
- 05 Oct 2017, **RISELab, Department of Computer Science, UC Berkeley**, California, USA
talk: "Stochastic and Doubly Stochastic Dual Heavy Ball Methods for Quadratic Optimization with Low-Rank Hessian"
- 31 May 2017, **Conference on Computational Management Science**, Bergamo, Italy, (**invited**)
talk: "Distributionally Robust Games with Risk-Averse Players "
- 22 May 2017, **SIAM Conference on Optimization**, Vancouver, British Columbia, Canada (**invited**)
talk: "Stochastic Heavy Ball Method for Solving Linear Systems"
- 09 Dec 2016, **IEEE Global Conference on Signal and Information Processing (GlobalSIP)**, Washington D.C, USA
talk: "A new Perspective on Randomized Gossip Algorithms"
- 07 Sept 2016, **5th IMA Conference on Numerical Linear Algebra and Optimisation**, Birmingham, UK, (**organizer of 2 mini-symposia**)
talk: "Randomized Gossip Algorithms: Complexity, Duality and New Variants"

- 01 Aug 2016, **Young Researchers in Mathematics Conference (YRM)**, Saint Andrews, UK
talk: "A new Perspective on Randomized Gossip Algorithms"
- 23 Feb 2016: **5th International Conference on Operational Research and Enterprise Systems (ICORES)**, Rome Italy
talk: "Distributionally Robust Games with Risk Averse Players"

Posters

- 12 Jun 2019: **36th International Conference on Machine Learning (ICML)**, Los Angeles, USA
title: "Stochastic Gradient Push for Distributed Deep Learning"
- 11 Jun 2019: **36th International Conference on Machine Learning (ICML)**, Los Angeles, USA
title: "SGD: General Analysis and Improved Rates"
- 14 May 2019: **IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)**, Brighton, United Kingdom
title: "Provably Accelerated Randomized Gossip Algorithms"
- 8 Dec 2018: **Privacy Preserving Machine Learning Workshop, NIPS 2018**, Montreal , Canada
title: "A Privacy Preserving Randomized Gossip Algorithm via Controlled Noise Insertion"
- 13-17 Aug 2018: **DIMACS/TRIPODS/MOPTA**, Lehigh University, Bethlehem, PA, USA
poster: "Accelerated gossip via stochastic heavy ball method."
- 5-8 Feb 2018, **Optimization and Big Data 2018, KAUST**, Thuwal, Saudi Arabia,
poster: "Linearly convergent stochastic heavy ball method for minimizing generalization error"
- 8 Dec 2017, **NIPS Workshop on Optimization for Machine Learning**, Los Angeles, USA
poster: "Linearly convergent stochastic heavy ball method for minimizing generalization error"
- 12 April 2017, **KAUST Research Conference 2017: Visual Computing - Modeling and Reconstruction**, KAUST, Saudi Arabia
poster: "A New Perspective on Randomized Gossip Algorithm"
- 12 Jan 2017, **SIAM UKIE Annual Meeting 2017**, Glasgow, UK
poster: "Randomized Gossip Algorithms: Complexity, Duality and New Variants"
- 12 Oct 2016, **Data Science Research Day 2016**, Edinburgh, UK
poster: "Randomized Gossip Algorithms: Complexity, Duality and New Variants"
- 26 May 2016, **3DT and Friends Student Conference**, Edinburgh, UK
poster: "Randomized Gossip Algorithms: New Insights"
- 16 May 2016, **Machine Learning Summer School (MLSS)**, Cádiz, Spain
poster: "Randomized Gossip Algorithms: New Insights"

Teaching

- **The University of Edinburgh:**
Tutor for the courses:
Spring 2018: Modern Optimization Methods for Big Data Problems.
Spring 2017: Modern Optimization Methods for Big Data Problems, Optimization in Finance.
Autumn 2016: Fundamentals of optimization, Simulation, Probability.
Spring 2016: Proofs and Problem Solving.

- **National and Kapodistrian University of Athens:**

Main Instructor:

Autumn 2013 - Spring 2014: Computer Science laboratories (Matlab and Python). I was the sole person responsible for designing and executing these labs during two semesters.

- **Other Teaching Experience:**

Summers 2013-2020: Lifeguard/First-Aid trainer for adult classes (District administration Larnaca, Cyprus).

Professional Service

- **Reviewer for:**

Journals: *European Journal of Operational Research*,
Numerical Algorithms (2),
Numerical Linear Algebra with Applications,
IEEE Transactions on Signal and Information Processing over Networks,
SIAM Journal on Mathematics of Data Science (SIMODS),
Mathematical Programming,
Journal of Machine Learning Research (JMLR)

Conferences: *International Conference on Machine Learning (ICML): 2019-2021*
Annual Conference on Neural Information Processing Systems (NeurIPS): 2020-2021
International Conference on Learning Representations (ICLR): 2019-2022

Workshops: *Smooth Games Optimization and Machine Learning Workshop, NeurIPS 2019*
Optimization for Machine Learning Workshop, NeurIPS: 2020-2021

- **Mini-symposium Organizer:** "Recent Advancements in Optimization Methods for Machine Learning". SIAM Conference on Optimization, Virtual Conference, 20-23 Jul 2021
- **Session Chair:** "Stochastic Optimization Algorithms". INFORMS Annual Meeting, Phoenix AZ, USA, November 2018
- **Mini-symposium Organizer:** "Optimization Methods in Machine Learning". 5th IMA Conference on Numerical Linear Algebra and Optimisation, University of Birmingham, UK, September 2016
- **Mini-symposium Organizer:** "Randomized Numerical Linear Algebra". 5th IMA Conference on Numerical Linear Algebra and Optimisation, University of Birmingham, UK, September 2016
- **Seminar Organizer:** "All Hands Meetings on Big Data Optimization" The University of Edinburgh, Scotland, 2015-2017

Research Visits

- 10 Apr – 15 May 2018,
Optimization and Machine Learning Research Group, Lehigh University (Dr. Martin Takac)
- 15 Mar – 5 May 2017, 01 Feb – 15 Mar 2018, 07 April – 15 May 2019
Visual Computing Center, KAUST, Thuwal, KSA (Dr. Peter Richtarik)
- 20-30 of July 2016,
Machine Learning and Optimization Group, Microsoft Research, Seattle, USA. (Dr. Lin Xiao)

Skills and interests

- **Computer Skills:**

- Operating systems: Microsoft Windows, Linux, Mac OSX
- Programming languages: Julia, Python, Matlab, \LaTeX
- Deep Learning: PyTorch
- Optimization Software: Yalmip, CVX

- **Interests:**

- Swimming: Avid swimmer, competing in countless Pancyprrian competitions and gaining numerous medals.
- Music, film, reading and traveling.
- Member of: SIAM, INFORMS, MOS (Mathematical Optimization Society), EMS (Edinburgh mathematical society), SPS (Signal Processing Society)

- **Languages:**

- Greek (native)
- English (fluent)

Last updated: November 4, 2021