Antonio Maria Sudoso

Sapienza University of Rome & Italian National Research Council – Rome, Italy
✉ antoniomaria.sudoso@uniroma1.it

Curriculum Vitae

Short Bio

Antonio Maria Sudoso is an Assistant Professor in the Department of Computer Control and Management Engineering "Antonio Ruberti" at Sapienza University of Rome. He also is a Research Associate at the Institute for Systems Analysis and Computer Science "Antonio Ruberti" of the Italian National Research Council.

He obtained his Master's degree in Computer Engineering in 2018 and his Ph.D. in Computer Science, Control, and Geoinformation in 2022, both from the University of Rome "Tor Vergata". In 2022, he was a Postdoctoral Researcher in the Department of Computer, Control, and Management Engineering "Antonio Ruberti" at Sapienza University of Rome, and in 2023, he held a Postdoctoral position at the Institute for Systems Analysis and Computer Science "Antonio Ruberti" of the Italian National Research Council. As a Ph.D. student, he visited the Department of Mathematics at Alpen-Adria-Universität Klagenfurt in 2020. In 2024, he visited the Department of Mathematical and Industrial Engineering at Polytechnique Montréal and the Research Group in Decision Analysis (GERAD) in Montréal.

His research interests include global optimization, optimization models and algorithms for machine learning, optimization methods for analyzing and forecasting large collections of time series, and the application of operations research to sustainable environmental management. He has published papers in relevant international journals such as Mathematical Programming, INFORMS Journal on Computing, and Computers & Operations Research.

At Sapienza University of Rome, he carries on the Laboratory course of Operations Research in Italian and teaches Integer Programming and Combinatorial Optimization in English.

He has worked as a local unit member in research projects funded by grants from research institutions such as ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development and CNR - Italian National Research Council. He has worked on a fixed-term basis for firms.

Education

PhD in Computer Science, Control and Geoinformation
University of Rome Tor Vergata, Rome, Italy *May 2022*
Thesis: "Global Optimization for Machine Learning Applications"
Advisor: Prof. Veronica Piccialli
Grade: Excellent with honors

MSc in Computer Engineering
University of Rome Tor Vergata, Rome, Italy *Oct 2018*
Thesis: "Deep Neural Networks for Time Series Analysis"
Advisors: Prof. Paolo Mancuso and Prof. Veronica Piccialli
Grade: 110 with honors

BSc in Computer Engineering
University of Rome Tor Vergata, Rome, Italy *Oct 2016*
Grade: 110

Work Experience

Research Experience

Visiting Researcher
Research Group in Decision Analysis (GERAD), Montréal, Canada *July 2024*
Hosted by: Prof. Daniel Aloise

Fixed-term Assistant Professor
Sapienza University of Rome, Rome, Italy *Aug 2023 – Present*
Department of Computer, Control and Management Engineering "Antonio Ruberti"

Research Associate
National Research Council (CNR), Rome, Italy *Aug 2023 – Present*
Institute for Systems Analysis and Computer Science "Antonio Ruberti"
Project: "Optimal placement of nature-based solutions in urban greening"

Postdoctoral Researcher
National Research Council (CNR), Rome, Italy *Nov 2022 – July 2023*
Institute for Systems Analysis and Computer Science "Antonio Ruberti"
Project: "UISH - Urban Intelligence Science Hub for City Network"

Postdoctoral Researcher
Sapienza University of Rome, Rome, Italy *Feb 2022 – Oct 2022*
Department of Computer, Control and Management Engineering "Antonio Ruberti"
Project: "Global Optimization Algorithms for Semi-supervised Minimum Sum-of-Squares Clustering"

Visiting PhD Student
Alpen-Adria-Universität Klagenfurt, Klagenfurt am Wörthersee, Austria *Jan 2020*
Department of Mathematics
Hosted by: Prof. Angelika Wiegele

Industry Experience

Data Scientist
Deix S.r.l., Rome, Italy *July 2021 – Dec 2021*
I developed optimization and machine learning algorithms for point cloud registration and segmentation.

Data Scientist
Wsense S.r.l., Rome, Italy *June 2021 – Dec 2021*
I developed machine learning algorithms for anomaly detection of fish behavior in aquaculture monitoring systems.

Publications

Journal Papers

[J6] V. Piccialli and A. M. Sudoso (2023). Global Optimization for Cardinality-constrained Minimum Sum-of-Squares Clustering via Semidefinite Programming. *Mathematical Programming*, online.
doi: https://doi.org/10.1007/s10107-023-02021-8

[J5] V. Piccialli, A. Russo Russo and A. M. Sudoso (2022). An exact algorithm for semi-supervised minimum sum-of-squares clustering, *Computers & Operations Research*, 147, 105958.
doi: https://doi.org/10.1016/j.cor.2022.105958

[J4] V. Piccialli, A. M. Sudoso and A. Wiegele (2022). SOS-SDP: An Exact Solver for Minimum Sum-of-Squares Clustering, *INFORMS Journal on Computing*, 34(4):2144-2162.
doi: https://doi.org/10.1287/ijoc.2022.1166

[J3] M. Balletti, V. Piccialli and A. M. Sudoso (2022). Mixed-Integer Nonlinear Programming for State-based Non-Intrusive Load Monitoring, *IEEE Transactions on Smart Grid*, vol. 13, no. 4, pp. 3301-3314.
doi: https://doi.org/10.1109/TSG.2022.3152147

[J2] P. Mancuso, V. Piccialli and A. M. Sudoso (2021). A machine learning approach for forecasting hierarchical time series, *Expert Systems with Applications*, 182, 115102.
doi: https://doi.org/10.1016/j.eswa.2021.115102

[J1] V. Piccialli and A. M. Sudoso (2021). Improving Non-Intrusive Load Disaggregation through an Attention-Based Deep Neural Network, *Energies*, 14(4), 847.
doi: https://doi.org/10.3390/en14040847

Submitted Papers

[S6] A. M. Sudoso and D. Aloise (2024). A column generation algorithm with dynamic constraint aggregation for minimum sum-of-squares clustering.

[S5] A. M. Sudoso (2024). An SDP-based Branch-and-Cut Algorithm for Biclustering.
arXiv: https://arxiv.org/abs/2403.11351

[S4] V. Piccialli, J. Schwiddessen and A. M. Sudoso (2023). Optimization meets Machine Learning: An Exact Algorithm for Semi-Supervised Support Vector Machines.
arXiv: https://arxiv.org/abs/2312.09789

[S3] G. Felici and A. M. Sudoso (2023). Optimizing accuracy and diversity: a multi-task approach to forecast combinations.
arXiv: http://arxiv.org/abs/2310.20545

[S2] D. Piermarini, A. M. Sudoso and V. Piccialli (2023). Predicting financial distress in Italian municipalities: a machine learning approach enhanced by domain expertise.
arXiv: https://arxiv.org/abs/2302.05780

[S1] M. Locatelli, V. Piccialli and A. M. Sudoso (2022). Fix and Bound: An efficient approach for solving large-scale quadratic programming problems with box constraints.
arXiv: https://arxiv.org/abs/2211.08911

Teaching

Regular Courses

Integer Programming and Combinatorial Optimization
Sapienza University of Rome, Rome, Italy *Feb 2024 – Present*
MSc in Management Engineering, 60 hours

Laboratory of Operations Research
Sapienza University of Rome, Rome, Italy *Sep 2023 – Present*
BSc in Management Engineering, 30 hours

Machine Learning
University of Rome Tor Vergata, Rome, Italy *Sep 2023 – Oct 2023*
1st level Master degree in Data Science, 16 hours

Operations Research
Sapienza University of Rome, Rome, Italy *Oct 2022 – Dec 2022*
2nd level Master degree in "Servizi Logistici e di Comunicazione per Sistemi Complessi", 16 hours

Laboratory of Machine Learning
University of Rome Tor Vergata, Rome, Italy *Jun 2022 – Jul 2022*
1st level Master degree in Data Science, 16 hours

Advances in Operations Research - Clustering and Optimization
Sapienza University of Rome, Rome, Italy *May 2022*
PhD program in Automatic Control, Bioengineering and Operations Research, 4 hours

Laboratory of Machine Learning
University of Rome Tor Vergata, Rome, Italy *Jun 2021 – Jul 2021*
1st level Master degree in Data Science, 16 hours

Laboratory of Machine Learning
University of Rome Tor Vergata, Rome, Italy *Jan 2021 – Feb 2021*
Advanced course in Data Science for the employees of "Corte dei Conti", 16 hours

Laboratory of Machine Learning
University of Rome Tor Vergata, Rome, Italy *Jun 2020 – Jul 2020*
1st level Master degree in Data Science, 16 hours

Teaching Assistant

As PhD student at the University of Rome Tor Vergata, he was involved in the following teaching activities:
- Machine Learning (2020-2021), MSc in Computer Engineering.
- Optimization Methods for Big Data (2020-2021), MSc in Computer Engineering.
- Machine Learning (2019-2020), MSc in Computer Engineering.
- Optimization Methods for Big Data (2019-2020), MSc in Computer Engineering.
- Web Algorithms (2018-2019), MSc in Computer Engineering.
- Optimization Methods for Big Data (2018-2019), MSc in Computer Engineering.

Service

Reviewer for Journals

He reviewed manuscripts submitted to the following international journals:
- Computers & Operations Research
- Journal of Optimization Theory and Applications

- INFORMS Journal on Computing
- EURO Journal on Computational Optimization
- Computational Optimization and Applications
- Journal of Global Optimization
- International Journal of Forecasting
- Soft Computing
- Applied Energy

Thesis Supervision

I have co-supervised 12 Master's Degree theses:

- M. Capozzi, "An alternating minimization algorithm for biclustering", MSc in Pure and Applied Mathematics, University of Rome Tor Vergata, March 2023.
- L. Vaiana, "An end-to-end meta-learning framework for time series forecasting", MSc in Computer Engineering, University of Rome Tor Vergata, February 2022.
- G. Caruso, "Machine learning for cross-temporal forecast reconciliation", MSc in Mathematics, University of Rome Tor Vergata, April 2021.
- S. Bassani, "Ensemble learning for energy disaggregation", MSc in Computer Engineering, University of Rome Tor Vergata, April 2021.
- T. Villa, "Transfer learning for non-intrusive load monitoring", MSc in Computer Engineering, University of Rome Tor Vergata, February 2021.
- G. Fabozzi, "Clustering energy consumption patterns in residential buildings", MSc in Computer Engineering, University of Rome Tor Vergata, February 2021.
- M. Balletti, "Load disaggregation by means of binary quadratic optimization", MSc in Computer Engineering, University of Rome Tor Vergata, February 2021.
- A. Russo Russo, "A branch-and-cut algorithm for k-means clustering", MSc in Computer Engineering, University of Rome Tor Vergata, October 2020.
- S. Nedia, "Machine learning algorithms for forecasting hierarchical time series", MSc in Computer Engineering, University of Rome Tor Vergata, July 2020.
- E. Di Natale, "A meta-learning classifier for time series forecasting", MSc in Computer Engineering, University of Rome Tor Vergata, February 2020.
- G. Di Cosmo, "Deep learning for non-intrusive load monitoring", MSc in Computer Engineering, University of Rome Tor Vergata, February 2020.
- M. Celi, "Forecasting energy consumption with machine learning", MSc in Computer Engineering, University of Rome Tor Vergata, February 2020.

Member of research projects

- He was involved in research activities as part of collaboration agreements between the Italian National Agency for Territorial Cohesion and the Italian National Research Council.

  Project: UISH - Urban Intelligence Science Hub for City Network
  Principal investigator: Emilio Fortunato Campana

  Report:
  - A. M. Sudoso, G. Felici (2023). "Forecasting methods for the DSS: analysis and design".

- He was involved in research activities as part of collaboration agreements between ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development and the University of Rome Tor Vergata.

  Project: Technologies for the efficient penetration of electrical energy in end uses
  Principal investigator ENEA: Claudia Snels
  Principal investigator University of Rome Tor Vergata: Veronica Piccialli

Report:
- G. Oriolo, V. Piccialli, A. M. Sudoso (2022). "Disaggregation of household electricity consumption through machine learning models integrated with electricity consumption forecasting techniques".

- He was involved in research activities as part of collaboration agreements between ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development and the University of Rome Tor Vergata.

  Project: Development of an integrated model for a smart urban district
  Principal investigator ENEA: Claudia Snels
  Principal investigator University of Rome Tor Vergata: Veronica Piccialli

  Report:
  - C. La Riccia, V. Piccialli, A. M. Sudoso (2019). "Clustering of housing types to select disaggregation models of electricity consumption using deep networks".

Conference and workshop organization

- Co-organizer of the session "Optimization Techniques for Hard Problems", *International Conference on Optimization and Decision Science 2023*, Ischia, Italy.

Conference Presentations

[ISMP 2024] Dynamic constraint aggregation for solving the minimum sum-of-squares clustering problem.
International Symposium on Mathematical Programming 2024, Montréal, Canada.

[EURO 2024] A branch-and-cut algorithm for biclustering via semidefinite programming.
European Conference on Operational Research 2024, Copenaghen, Denmark.

[ODS 2023] Dynamic constraint aggregation and column generation for solving the minimum sum-of-squares clustering problem.
International Conference on Optimization and Decision Science 2023, Ischia, Italy.

[ODS 2022] Global optimization for cardinality-constrained minimum Sum-of-squares clustering via semidefinite programming.
International Conference on Optimization and Decision Science 2022, Firenze, Italy.

[ODS 2021] SOS-SDP: an exact solver for minimum sum-of-squares clustering.
International Conference on Optimization and Decision Science 2021, Roma, Italy.

[SIOPT 2021] An SDP-based approach for minimum sum-of-squares clustering.
SIAM Conference on Optimization 2021, Online.

Seminars

He has been invited to give the following talks:

[T2] Fix and Bound: An efficient approach for solving large-scale quadratic programming problems with box constraints, *IASI-CNR - The Young Experts Seminars*, February 2023, Rome, Italy.
(Invited by Dr. Giovanni Felici - `https://www.iasi.cnr.it/yes-seminars/`).

[T1] SOS-SDP: An Exact Solver for Minimum Sum-of-Squares Clustering, *Machine Learning NeEDS Mathematical Optimization - Young Seminar Series*, December 2021, Online.
(Invited by Prof. Dolores Romero Morales - `https://congreso.us.es/mlneedsmo/`).

Awards and Grants

G2 Winner of 2,000€ as part of the European Social Fund Plus (ESF+) 2021-2027 "Contributi premiali per i ricercatori e assegnisti di ricerca per rafforzarne la condizione professionale e potenziare il sistema della ricerca del Lazio".

G1 Winner of 1,000$ Google Cloud Research Credits with the funding number GCP19980904 for the research project "Global Optimization for Semi-supervised Sum-of-Squares Clustering".

Software

He is the main developer and maintainer of the following global optimization solvers:

- Minumum sum-of-squares clustering problem
  - `https://github.com/antoniosudoso/sos-sdp`
  - `https://github.com/antoniosudoso/mssc-dca`
- Minumum sum-of-squares clustering problem with constraints
  - `https://github.com/antoniosudoso/pc-sos-sdp`
  - `https://github.com/antoniosudoso/cc-sos-sdp`
- k-densest-disjoint biclique problem
  - `https://github.com/antoniosudoso/bicl-sdp`
- Non-convex quadratic programming with box constraints
  - `https://github.com/antoniosudoso/bb-boxqp-fixing`

Schools and Workshops

- New Advances in Optimization, Machine Learning and Data Science, 4th AIROYoung Workshop 2020, Bozen, Italy.
- Optimization Big Data and Applications 2019, Summer School, Veroli, Italy.

September 23, 2024