Somacal Agustín

I'm very enthusiastic about science and the possibility of using artificial intelligence to improve society. I have a strong background in physics, networks, data science and modelling. I'm particularly interested open science and new ways of creating and sharing knowledge.

Personal Details

Nationality:
Argentinian, Italian

Contact

agustin.somacal@ec-nantes.fr

Languages

Spanish (native),
English (fluent),
French (fluent),
Italian (advanced),
Arabic (basic)

Programming languages

Python, C++, R, Matlab.

GitHub

`www.github.com/agussomacal`

Other technologies

Ubuntu/Debian Linux, GIT (Version control), Latex, Unix shell

Education

2020–2024 **PhD in Mathematics: Model reduction for forward simulation and inverse problems: towards non-linear approaches** Paris, France
Sorbonne Université, ISCD Institut des Sciences du Calcul et des Données
Thesis Advisors: Albert Cohen, Olga Mula Thesis: `https://theses.hal.science/tel-04646204`

2018 **BSc/MSc in Physics (6.5 years program)** Buenos Aires, Argentina
Integration of information in biological networks
University of Buenos Aires
Thesis Advisor: Dr. Ariel Chernomoretz
GPA: 9.74/10

Professional Experience

2024-currently **Ecole Centrale Nantes, Laboratoire de Mathématiques Jean Leray** Nantes, France
Post-doctoral position Project: COFNET Advisor: Anthony Nouy

2020 **Sorbonne Université, Laboratoire Jacques-Louis Lions** Paris, France
Research engineer Forward reduce modelling and inverse problems

2016–2019 **Aristas S.R.L.** Buenos Aires, Argentina
Data Scientist Machine Learning and Statistical Learning

2014, 2015 **University of Buenos Aires, Physics department.** Buenos Aires, Argentina
Scientific popularizer

Teaching Experience

2020–2023 **Teacher assistant** Paris, France
Sorbonne Université
- Pyhton for mathematics: `https://python.guillod.org/`

2015–2018 **Teaching Assistant** Buenos Aires, Argentina
Department of Physics, *University of Buenos Aires*
- Complex networks applied to social and biological systems
- Electricity and magnetism
- Optics and thermodynamics

2016 **Teaching Assistant** Buenos Aires, Argentina
Héctor Ottonello Observatory
Colegio Nacional de Buenos Aires

Other Experiences

2018, 2019 **Tai Chi Chuan Teacher** Buenos Aires, Argentina
Secretaría de Extensión, Cultura Científica y Bienestar
University of Buenos Aires

Publications

- Albert Cohen, Olga Mula, Agustin Somacal.
  High order recovery of geometric interfaces from cell-average data.
  ESAIM: Mathematical Modelling and Numerical Analysis, 2025
  `http://arxiv.org/abs/2402.00946`.

- Dolbeault Matthieu, Olga Mula, Agustin Somacal.
  State estimation of urban air pollution with statistical, physical, and super-learning graph models.
  Advances in Computational Science and Engineering (Vol. 2, No. 2), 20 May 2024.
  `https://arxiv.org/abs/2402.02812`.

- Albert Cohen, Charbel Farhat, Agustín Somacal, Yvon Maday.
  Nonlinear compressive reduced basis approximation for PDE's.
  `https://hal.science/hal-04031976v1/file/nonlinear_CRB.pdf`
  CRAS: Comptes Rendus Academie des Sciences, 2023.

- Albert Cohen, Matthieu Dolbeault, Olga Mula, Agustin Somacal.
  Nonlinear approximation spaces for inverse problems, 2023.
  `http://export.arxiv.org/pdf/2209.09314`
  Analysis and Applications.

- A. Beguinet, V. Ehrlacher, R. Flenghi, M. Fuente, O. Mula, A. Somacal.
  Deep Learning-based Schemes for Singularly Perturbed Convection-Diffusion Problems
  `https://arxiv.org/abs/2205.04779`
  Manuscript accepted in ESAIM: Proceedings and Surveys, 2023.

- Cohen A., Dolbeault M. and Somacal A.
  Reduced order modeling for elliptic problems with high contrast diffusion coefficients
  `https://hal.archives-ouvertes.fr/hal-03549810`
  ESAIM: Mathematical Modelling and Numerical Analysis, 2023.

- Somacal A., Boechi L., Jonckheere M., Lefieux V., Picard D, Smucler E.
  Uncovering differential equations from data with hidden variables.
  Physical Review E (Vol. 105, No. 5), 2022.
  `https://arxiv.org/abs/2002.02250`

- Barrera Y., Boechi L, Jonckheere M., Lefieux V., Picard D., Smucler E., Somacal A., Umfurer A.
  Clustering high dimensional meteorological scenarios: Results and performance index
  `https://arxiv.org/abs/2012.07487`
  International Journal of Approximate Reasoning 139, 1-11, 2021

- Vasquez C, Sapienza F, Somacal A, Fazzito S.
  Anhysteretic remanent magnetization: model of grain size distribution of spherical magnetite grains
  Studia Geophysica et Geodaetica 62 (2), 339-351, 2018.

Honours and Awards

2020 **PhD thesis** scolarship
Sorbonne Université, ISCD
Institut des Sciences du Calcul et des Données

2019 **Hackathon TechTreck** Buenos Aires, Argentina
1st prize in Finance

2016 **UAM-Santander scholarship**
1 semester of studies
Universidad Autonoma de Madrid

2016 **Hackathon Agro** Tandil, Provincia de Buenos Aires, Argentina
1st prize

2011 **III Latinamerica Olympiad of Astronomy and Astronautic** Passa Quatro, Brasil
Silver medal

2010 **XV Iberoamerican Physics Olympiad** Panamá, Panamá
Silver medal

2004–10 **National Olympiads in Mathematics**
Annual Honourable Mentions

2009 **International Mathematical Olympiad Selection Process**
7th and 1month training

2013–2015 **National Programming Tournament**
Finalist

2014 **International Collegiate Programming Contest**
South American Regionals finalist

2010-11 **National Physics Olympiads**
1st Prize and Best solution in the Theory exam

2010 **Argentina Astronomy Olympiad**
1st place

2008-9 **Argentina Chemistry Olympiad**
Bronze medal, Silver medal

Conferences

2025 **ENUMATH.** Heidelberg, Germany
Talk on minisymposium: Geometric Optimization Methods for Scientific Machine Learning
Natural gradient descent with momentum.

2025 **Workshop: Computation and Learning in High Dimensions.** Oberwolfach, Germany

2025 **Workshop in honor of Albert Cohen.** Paris, France
Plenary talk:
Natural gradient descent with momentum.

2025 **SMAI.** Carcans, France
Coorganize minisimposium:
Apprentissage Automatique pour la Résolution de Problèmes Directs et Inverses en Équations aux Dérivées Partielles.

2023 **ICIAM.** Tokyo, Japan
Talk on minisymposium:
Edge adaptive schemes and machine learning for high-accuracy finite volume schemes.

2023 **CEMRACS: Scientific Machine Learning** Marseille, France
Practical session: Linear and Nonlinear Schemes for Forward Model Reduction and Inverse Problems

2023 **First International Conference Math 2 Product (M2P 2023)**
Emerging Technologies in Computational Science for Industry, Sustainability and Innovation Taormina, Italy
Talk:
Modeling air pollution at a city scale.

2023 **Khipu: Latinoamerican meeting of Artificial Intelligence.** Uruguay
Poster Presentation

2022 **Research stay** Valencia, Spain
With F. Arandiga *on adaptive schemes for hyperresolution.*

2022 **YAMC: Second Conference of Young Applied Mathematicians**
Arenzano, Italy
Mini-course: Reduced models and machine learning
for forward modelling and inverse problems

2022 **Curves and Surfaces.** Arcachon, France
Talk:
Edge adaptive schemes and machine learning for high-accuracy finite volume schemes.

2021 **CEMRACS: Data assimilation and model reduction** Marseille, France
Practical session: Approximation of multivariate functions
Project: Graph diffusion equation and model reduction
for modeling city pollution
Project: Resolution of high-dimensional PDEs
by means of neural networks and greedy algorithms

2019 **Khipu: First Latinoamerican meeting of Artificial Intelligence.** Montevideo, Uruguay
Poster Presentation:
Uncovering differential equations from data with hidden variables.

2018 **Machine Learning Summer School** Buenos Aires, Argentina
Poster Presentation Multiplex network integration.

Talks

2024 **Applied mathematics seminar at Laboratoire de Mathématiques Jean Leray** Nantes, France
Non-linear inverse problems and applications to image reconstruction

2023 **Instituto de Tecnologías Emergentes y Ciencias Aplicadas (ITECA) seminar** Buenos Aires, Argentina
Metodos lineales y machine learning para modelado de sistemas fisicos mediante ecuaciones diferenciales

2022 **Séminaire Jeunes Chercheurs de Reims** Reims, France
Edge adaptive schemes and machine learning for high-accuracy finite volume schemes

2022 **Jacques Luis-Lions PhD student's seminar** Paris, France
Modelling air pollution at a city scale

2021 **Universidad de Chile PhD student's seminar** virtual
Non linear reduced models for forward modelling and inverse problems: applications to model air pollution.

2020 **Club of Rome Global Youth Summit** Paris, France
Moderator

2018 **Seminar of Machine Learning at Calculus Institute** Buenos Aires, Argentina
Neworks: from comunities to learning and biology

Projects

currently **Gradient descent Gym** Python
An environment for testing different gradient descent strategies

currently **PerplexityLab** Python
Environmentally friendly package for science reproducibility, systematic experimentation, visualisation and results exploration
`https://github.com/agussomacal/PerplexityLab`
`https://github.com/agussomacal/PerplexityLab2`

2024 **Interface reconstruction** Python
Package for image reconstruction and Finite Volumes Schemes
`https://github.com/agussomacal/SubCellResolution`

2023 **Tutorial for linear inverse Reduce Order Modelling** Python
`https://github.com/agussomacal/ROMHighContrast`

2023 **City pollution modeling** pytorch geometric, tensorflow spektral
Modeling pollution with Graph Convolution Neural Networks
`https://github.com/agussomacal/CityPollutionModeling`

2021 **Physics Informed Neural Networks** tensorflow
`https://github.com/agussomacal/ConDiPINN`

2019 **Online order logistics** Random Forest, Xgboost

2019 **Hyperbolic distance metrics for fragrance similarity**

2019 **Forecasting supermarket sales** Prophet, ARMA, Exponential Smoothing

2018 **Natural Language Processing to cluster fragrances ingredients** Word2vec

2018 **Recommendation system for fragrance synthesis** Label propagation

2018 **Products segmentation** Market Basket Analysis, crosscat