

Sara Garbarino

Curriculum Vitae

Research Interests

- Theoretical mathematical modelling, inverse problems, graph theory, regularization theory, compartmental analysis
- Methodical computational modelling, variational Bayes methods, optimization
- Applications mechanistic and data-driven models for the progression of neurological diseases, biomedical imaging and computing

Position

- Apr 2018 – to date **Research Fellow of the Excellence Programme of Université Côte d'Azur**, EPIONE TEAM-PROJECT, *Inria*, with the project "A data-driven model of mechanistic brain Atrophy Propagation in Dementia (AtroProDem)".

Research Experience

- Mar 2016 – Mar 2018 **Research associate**, CMIC GROUP, *Computer Science Department, University College London*, on the H2020 European Projects "European Progression Of Neurodegenerative Disease initiative" (EuroPOND), supervisor: Prof. Daniel Alexander.
- Feb 2015 – Feb 2016 **Postdoctoral research fellow**, MIDA GROUP *Mathematics Department, Università di Genova*, on the project "Computational and inversion methods with applications to biomedical data", supervisor: Prof. Michele Piana.

Research Groups Membership

- 2018 – to date **Member of "Epione team-project"**, *Inria*, www.inria.fr/epione.
- 2016 – 2018 **Member of "Centre for Medical Image Computing (CMIC) group"**, *UCL*, www.ucl.ac.uk/cmhc.
- 2012 – 2016 **Member of "Methods for Image and Data Analysis (MIDA) group"**, *Unige*, www.mida.dima.unige.it.
- 2012 – to date **Research associate of GNCS – INdAM**.
- 2012 – 2016 **Research associate of CNR – SPIN**.

Education

- 2012 – 2014 **PhD in Mathematics and Applications**, *Università di Genova*.

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- 2009 – 2011 **MSc in Applied Mathematics**, *Università di Genova*, 110/100 magna cum laude.
2006 – 2009 **BSc in Pure Mathematics**, *Università di Genova*, final grade: 108/110.
2001 – 2006 **Secondary education (maturità scientifica)**, *Liceo L. Lanfranchi*, 100/100.

PhD Thesis

Title *Compartmental analysis in nuclear medicine: an inverse problem approach*
Supervisor Prof. Michele Piana
Reviewers Prof. Michele Piana and Dr. Stephen Nekolla
Sub./Defense Dec 2014 / 22.04.2015
Permalink http://fermat.dima.unige.it/~garbarin/images/PhDthesis_garbarino.pdf

Awards

- 2019 **Francois Erbsmann Prize**, *best paper presented at IPMI 2019*, for the paper “Modelling and inference of spatio-temporal protein dynamics across brain networks”.

Projects and Grants

PI

- 2019 **EWM European Women in Mathematics travel grants**, 400 Euro.
2019 **IPMI travel scholarship for young researchers**, 1100 USD.
2018 **LYSM International Associated Laboratory grant for conferences**, 750 Euro.
2018 **UCA Individual Support for Young Researchers**, 103k Euro.
2018 **EPSRC platform grant - CMIC pump priming award**, 9k GBP.
2015 **GNCS (National Group for Scientific Computation) Young Researcher Grant**, 950 Euro.
2013 **GNCS Young Researcher Grant**, 700 Euro.
2012 **GNCS Young Researcher Grant**, 900 Euro.
2012–2014 **PhD-Scholarship**, *Italian Ministry of Education, University and Research*.

Participation

- 2016–2018 **Co-Scientific Manager**, for the H2020 European Projects “European Progression Of Neurodegenerative Disease initiative” (EuroPOND), PI: Prof. Daniel Alexander.
2015–2016 **Participation**, in the “Software for LIDAR data analysis project” funded by ALA S.r.l (Advanced Lidar Applications, Napoli) (PI: Prof. Michele Piana).

Software

- 2018 **Mechanistic profiles of neurodegenerative diseases**, *Matlab and python2.7 software implementing techniques to estimate the combination of biological mechanisms underlying neurodegeneration in a variety of condition, such as Alzheimer’s Disease, Multiple Sclerosis, or ageing from Magnetic Resonance Imaging data:* <https://github.com/sgarbarino/mechanistic-profiles>.

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- 2015 **Inversion of LIDAR data**, *Matlab and C# software developed for Advanced Lidar Applications (ALA) Srl, implementing inversion techniques for reconstruction of aerosol particles properties from LIDAR data.*
- 2012 **Denoising of MRI images**, *Matlab software developed for Paramed Srl, implementing post-processing denoising of Magnetic Resonance images.*

Publications

Peer-reviewed journals

- 2019 **S. Garbarino, M. Lorenzi, N. Oxtoby, E. Vinke, R. Marinescu, A. Eshaghi, M. Ikram, W. Niessen, O. Ciccarelli, F. Barkhof, J. Schott, M. Vernooij, D. Alexander**, *Differences in topological progression profile among neurodegenerative diseases from imaging data*, eLife, UNDER REVIEW.
- 2019 **S. Garbarino and G. Caviglia**, *Multivariate Regularized Newton method for tumor hypoxia in kinetic framework*, Comm. App. Ind. Math. 10(2), 47-53.
DOI: 10.2478/caim-2019-0006
- 2019 **R. Marinescu, A. Eshaghi, M. Lorenzi, A. Young, N. Oxtoby, S. Garbarino, S. Crutch, D. Alexander**, *DIVE: A spatiotemporal progression model of brain pathology in neurodegenerative disorders*, NeuroImage 4(192), 166-177.
DOI: 10.1016/j.neuroimage.2019.02.053
- 2018 **F. Delbary and S. Garbarino ***, *Compartmental analysis of dynamic nuclear medicine data: regularization procedure and application to physiology*, Inverse Problems in Science and Engineering.
DOI: 10.1080/17415977.2018.1512603
- 2018 **M. Scussolini, S. Garbarino, M. Piana, G. Sambuceti and G. Caviglia**, *Reference Tissue Models for FDG-PET Data: Identifiability and Solvability*, IEEE Trans. Rad. Plasma Med. Sciences, 1-10.
DOI: 10.1109/TRPMS.2018.2801029
- 2017 **M. Scussolini, S. Garbarino, G. Sambuceti, G. Caviglia and M. Piana**, *A physiology-based parametric imaging method for FDG-PET data*, Inverse Problems 33, 125010.
DOI: 10.1088/1361-6420/aa9544
- 2017 **N. Oxtoby, S. Garbarino, N. Firth, J. Warren, M. Schott, D. Alexander**, *Data driven model of structural brain connectivity changes in sporadic Alzheimer's Disease*, Frontiers in Neurology 8, 580.
DOI: 10.3389/fneur.2017.00580
- 2017 **G. Denevi, S. Garbarino and A. Sorrentino**, *Iterative algorithms for a non-linear inverse problem in atmospheric lidar*, Inverse Problems 33, 085010.
DOI: 10.1088/1361-6420/aa7904
- 2016 **F. Delbary, S. Garbarino, V. Vivaldi ***, *Compartmental analysis of dynamic nuclear medicine data: models and identifiability*, Inverse Problems 32, 125010.
DOI: 10.1088/0266-5611/32/12/125010

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- 2016 **S. Garbarino, A. Sorrentino, A. M. Massone, A. Sannino, A. Boselli, X. Wuang, N. Spinelli and M. Piana**, *Expectation Maximization and the retrieval of the atmospheric extinction coefficients by inversion of Raman LIDAR data*, Optics Express, 24(19), 21497–21511.
DOI: 10.1364/OE.24.021497
- 2015 **S. Garbarino, V. Vivaldi, F. Delbary, G. Caviglia, M. Piana, C. Marini, S. Capitanio, I. Calamia, A. Buschiazio and G. Sambuceti**, *A new compartmental method for the analysis of liver FDG kinetics*, EJNMMI Res. 2015, 5–35.
DOI: 10.1186/s13550-015-0107-1
- 2014 **S. Garbarino, G. Caviglia, G. Sambuceti, F. Benvenuto and M. Piana**, *A novel description of FDG excretion in the renal system: application to metformin-treated models*, Phys. Med. Biol. 59, 2469–2484.
DOI: 10.1088/0031-9155/59/10/2469
- 2013 **S. Garbarino, G. Caviglia, M. Brignone, M. Massollo, G. Sambuceti and M. Piana**, *Estimate of FDG excretion by means of compartmental analysis and Ant Colony Optimization of nuclear medicine data*, Comput. Math. Method M. 2013, 793142.
DOI: 10.1155/2013/793142

* the authors are listed in alphabetical order.

Peer-reviewed proceedings

- 2019 **S. Garbarino, M. Lorenzi**, *Modeling and inference of spatio-temporal protein dynamics across brain networks*, Information Processing in Medical Imaging. Lecture Notes in Computer Science 11492, 37-69.
- 2018 **S. Garbarino, M. Lorenzi, N. Oxtoby, E. Vinke, R. Marinescu, A. Eshaghi, M. Arfan Ikram, W. Niessen, O. Ciccarelli, F. Barkhof, M. Vernooij, D. Alexander**, *Mechanistic profiles of neurodegeneration: a study in Alzheimer's disease, healthy ageing and primary progressive multiple sclerosis*, Alzheimer's and Dementia 14(7), P1280-P1281.
- 2017 **R. Marinescu, S. Primativo, A. Young, N. Oxtoby, N. Firth, A. Eshaghi, S. Garbarino, J. Cardoso, K. Yong, N. Fox, M. Lehmann, T. Shakespeare, S. Crutch, D. Alexander**, *Analysis of the heterogeneity of Posterior Cortical Atrophy: data-driven model predicts distinct atrophy patterns for three different cognitive subgroups*, Alzheimer's & Dementia 13(7), P1379-P1380.
- 2017 **R. Marinescu, A. Eshaghi, M. Lorenzi, A. Young, N. Oxtoby, S. Garbarino, T. Shakespeare, S. Crutch and D. Alexander**, *A vertex clustering model for disease progression: Application to cortical thickness images*, Information Processing in Medical Imaging. Lecture Notes in Computer Science 10265, 134-145.
- 2015 **A. Buschiazio, G. Sambuceti, A. Orengo, S. Ravera, F. Fais, S. Bruno, E. Monteverde, L. Garaboldi, G. Bottoni, L. Raffaghello, G. Bianchi, M. Piana, S. Garbarino, G. Caviglia and C. Marini**, *Effect of Metformin on Cancer Glucose Metabolism: Correlation Between FDG Escape and Glucose-6-Phosphatase Activity in the Endoplasmatic Reticulum*, Eur. J Nucl. Med. Mol. Imag. 42, S454–S454.

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- 2014 **F. Bongioanni, F. Fiz, R. Piva, S. Garbarino, G. Bottoni, M. Riondato, C. Campi, F. Frassoni, A. Bacigalupo, C. Marini, M. Piana and G. Sambuceti**, *Compact bone erosion and bone marrow metabolic stunning in multiple myeloma treated by transplantation of autologous hematopoietic stem cells*, Eur. J Nucl. Med. Mol. Imag. 41, S183–S184.

Workshop organisation

- Feb 19, 2018 **POND2018**, *2nd International Workshop on Progression of Neurodegenerative Diseases*, Campus Biotech, Geneva.

Invited Seminars

- Jul 25, 2017 **Asclepios Research team-project, INRIA Sophia Antipolis**, *Mechanistic models of atrophy progression*, INRIA Sophia Antipolis.
- Feb 10, 2017 **INdAM Mathtech Workshop: A place where mathematics, clinics, and industry meet Biomedical Imaging**, *Modelling the progression of neurological diseases*, Università La Sapienza, Roma.
- Jan 22, 2016 **Vision and Imaging Science Group, CMIC Seminar programme**, *An inverse problem approach to compartmental analysis in Positron Emission Tomography*, UCL, London.
- Aug 12, 2015 **2015 LIDAR atmosphere data applications academic discussion**, *Retrieval of optical coefficients of the atmosphere by inversion of LIDAR data*, Beihang University, Beijing.

Talks on Conferences

- Jul 8, 2019 **2019 AIP**, *Spatio-temporal dynamics of protein propagation in neurodegenerative diseases: an inverse problem approach*, Université Grenoble-Alpes, Grenoble.
- Jul 1, 2019 **2019 NeuroMod meeting**, *Modeling and inference of protein dynamics in neurodegenerative diseases*, Villa Clithia, Frejus.
- Jun 3, 2019 **2019 IPMI**, *Modeling and inference of spatio-temporal protein dynamics across brain networks*, The Hong Kong University of Science and Technology, Hong Kong.
- Jul 3, 2018 **2018 Simai Conference**, *Data-driven profiles of neurodegeneration across multiple subject groups*, Università La Sapienza, Roma.
- Jun 6, 2018 **2018 SIAM Conference on Imaging Science**, *Predicting brain atrophy progression from the healthy brain connectome*, Università di Bologna, Bologna.
- Dec 9, 2015 **2015 Inverse Days**, *An inverse problem approach to compartmental analysis in Positron Emission Tomography*, Lappeenranta Technical University, Lappeenranta.
- Aug 10, 2015 **2015 ICIAM International Congress on Industrial and Applied Mathematics**, *Image reconstruction and interpretation in Positron Emission Tomography for small animals*, Beijing.
- May 13, 2014 **2014 SIAM Conference on Imaging Science**, *Quantification of Glucose Metabolism with Nuclear Medicine PET data*, Hong Kong.

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Apr 5, 2013 **CIMAB GASVA SIMAI: Workshop on Theoretical Approaches and Related Mathematical Methods in Biology, Medicine and Environment**, *A Computational Approach to Compartmental Analysis of Nuclear Medicine data based on Maximum Likelihood: application to renal physiology*, University of Milan, Milan.

Poster

July 2019 **AAIC 2019**, *Los Angeles*.
July 2018 **AAIC 2018**, *Chicago*.
June 2018 **2nd C@UCA meeting**, *Frejus*.
Feb 2018 **POND2018**, *Geneva*.
Jul 2017 **AAIC 2017**, *London*.
Oct 2014 **EANM 2014**, *Göthenburg*.

Participation in schools/workshops/meetings

Nov 2018 **SophI.A. Summit, Springboard for Artificial Intelligence**, *Sophia Antipolis*.
Apr 2018 **STATLEARN2018**, *Nice*.
Sep 2015 **1st Applied Mathematics Symposium Münster: Variational Methods for Dynamic Inverse Problems and Imaging**, *Münster*.
Jun 2015 **Calcolo scientifico e modelli matematici alla ricerca delle cose nascoste attraverso le cose manifeste**, *Genoa*.
Jun 2013 **TECNOBIONET Conference: themes and problems in stem cells and imaging tools and development**, *Genoa*.
Jun 2013 **MPF 2013: Modelling of Physiological Flows**, *Cagliari*.
Mar 2013 **Application course in PMOD software**, *Zürich*.
Jun 2012 **Simai Conference 2012**, *Turin*.

Research visits

Jun 26 – Jul 7, 2017 **Erasmus Medical Centre, Rotterdam, The Netherlands**, Reference: Prof. Meike Vernooij.

Supervision

2017 **PhD Thesis in Computer Science at UCL**, *Ms. Maura Bellio*, co-supervision with Prof. Daniel Alexander, Prof. Ann Blandford, Dr Annemie Ribbens, Dr Dominic Furniss.
2017 **MSc Thesis in Machine Learning at UCL**, *Mr. Ban Chao*.
2016 **BSc Thesis in Medical Physics at UCL**, *Mr. Ashkan Pakzad*.
2016 **MSc Thesis in Mathematics at Unige**, *Ms. Giulia Denevi*.
2016 **MSc Thesis in Mathematics at Unige**, *Mr. Andrea Raffo*.
2015 **MSc Thesis in Mathematics at Unige**, *Ms. Mara Scussolini*.
2014 **BSc Thesis in Mathematics at Unige**, *Mr. Giovanni Chiappori*.

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Teaching

- 2015/6 **Numerical Analysis**, *Department of Computer Science*, Unige, lab exercises.
- 2014/5 **Mathematics in Medicine**, *Department of Mathematics*, Unige, lectures and lab exercises.
- 2013/4 **Mathematical Analysis and Geometry**, *Department of Mechanical Engineering*, Unige, class exercises.
- 2012/3 **Mathematical Analysis and Geometry**, *Department of Mechanical Engineering*, Unige, tutoring first and second year students.
- 2011/2 **Fourier Analysis**, *Department of Mathematics*, Unige, lab exercises.
- 2011/2 **Mathematical Analysis and Geometry**, *Department of Mechanical Engineering*, Unige, tutoring first and second year students.
- 2009/10 **Mathematics**, *Department of Biology*, Unige, tutoring first year students.

Related scientific activities

- 2019 – to date **Member of the "European Women in Mathematics" international association.**
- 2016 – 2018 **Post-doc representative at the "Athena Swan for Gold Award Committee" for promotion of gender equality and women in science**, *Computer Science Department, University College London (UCL)*.
- 2014 – to date **Revisor**, for *Inverse Problems*, *Inverse Inverse Problems in Science and Engineering*, *Journal of Chemical Information and Modeling*, *Scientific Reports*, *International Journal for Numerical Methods in Biomedical Engineering*, *International Journal of Computer Vision*.

Computer skills

- Basic C#, JAVA
- Intermediate C/C++, HTML
- Advanced MATLAB, PYTHON \LaTeX , GNU/Linux

Languages

- Italian Mother-tongue
- English Professional
- French Basic

References

Prof. Daniel Alexander, *Professor of Imaging Science, Director of Research in UCL-CS and Chair of the board of Directors of CMIC*, d.alexander@ucl.ac.uk.

Prof. Michele Piana, *Professor of Numerical Analysis at Università di Genova*, piana@dima.unige.it.

MD Prof. Gianmario Sambuceti, *Head of Nuclear Medicine Laboratory at Università di Genova and IRCCS-IST San Martino of Genova*, sambuceti@unige.it.

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