Sara Garbarino

Curriculum Vitae

Research Interests

Theoretical	mathematical modelling, inverse problems, graph theory, regularization theory, compartmental analysis, image processing
Methodical	computational modelling, statistical methods, convex optimization
Applications	mechanistic and data–driven model for the progression of neurological diseases, biomedical imaging and computing: data from PET and micro-PET, X-ray CT and MRI

Position

Apr 2018 – to date **Research Fellow of the Excellence Programme of Université Côte d'Azur**, EPIONE TEAM-PROJECT, *INRIA Sophie Antipolis, UCA*, 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*, H2020 European Projects "European Progression Of Neurodegenerative Disease initiative" (EuroPOND), supervisor: Prof. Daniel Alexander.

Jan 2015 – Feb 2016 **Postdoctoral research fellow**, MIDA GROUP *Mathematics Department, University of Genoa*, supervisor: Prof. Michele Piana, Computational and inversion methods with applications to biomedical data.

Research Groups Membership

2018 – to date **Member of "Epione team-project"**, *INRIA Sophia Antipolis, UCA*, www.inria.fr/epione.

2016 – 2018 **Member of "Centre for Medical Image Computing (CMIC) group"**, *Computer Science Department, University College London (UCL)*, www.ucl.ac.uk/cmic.

2017 – 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)*.

2012 – 2016 **Member of "Methods for Image and Data Analysis (MIDA) group"**, *Mathematics Department, University of Genoa*, www.mida.dima.unige.it.

2012 – to date **Research associate of GNCS – INdAM**.

2012 – 2016 **Research associate of CNR – SPIN**.

work: room 207, second floor, Fermat Building – INRIA Sophia Antipolis
(0039) 3387745086 • *sara.garbarino@inria.fr*

Education

2012 – 2014 **PhD in Mathematics and Applications**, *University of Genoa*.

2009 – 2011 **MSc in Applied Mathematics**, *University of Genoa*, final grade: 110/100 magna cum laude.

2006 – 2009 **BSc in Pure Mathematics**, *University of Genoa*, final grade: 108/110.

2001 – 2006 **Secondary education (maturità scientifica)**, *Gymnasium L. Lanfranconi*, final grade: 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`

Projects and Grants

PI

2018 **LYSM International Associated Laboratory grant for conferences**, *750 Euro*.

2018 **UCA Excellence Project - Individual Support for Young Researchers**, *103,222.64 Euro*.

2018 **EPSRC platform grant - CMIC pump priming award**, *9,150 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 variaty of condition, such as Alzheimer's Disease, Multiple Sclerosis, or ageing from Magnetic Resonance Imaging data: https://github.com/sgarbarino/mechanistic-profiles,*.

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

My research is primarily concerned with applications of mathematical modelling and inverse problem in a biological framework. During my PhD, I developed compartmental models to study the physiological and pathological behaviour of glucose metabolism in tissue, using micro-PET data. I have dealt with modelling the hepatic and the renal metabolism, under normal or cancerous conditions. I have studied the impact of anticancer drugs by measuring the effects on the parameters estimated by my models. During my first PostDoc, I have been involved into a collaborative project between the MIDA group, ALA srl and the Beijing Meteorologic Centre to develop inversion techniques for reconstructing aerosol profile from atmospheric LIDAR data. Nowadays my major interest is in the application of inverse problem and graph theory techniques for modelling neurodegenerative diseases development and progression. In particular I am interested in the construction of spatio-temporal propagation models, whose attempt is to explain disease progression in terms of pathogens propagation through anatomical or functional networks in the brain, which thus induce measurement changes sequentially along the nodes of a network. The pattern of propagation depends on, and can thus reveal, mechanisms of propagation. In the following my publications.

Under review

Nov 2018 (Editorial decision to send to review) **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, and the Alzheimer's Disease Neuroimaging Initiative**, *Data-driven profiles of neurodegenerative mechanisms from neuro-imaging data sets*, Nature Neuroscience.

In press

Jul 2017 (Accepted) **S. Garbarino and G. Caviglia**, *Multivariate Regularized Newton method for tumor hypoxia in kinetic framework*, Communications in Applied and Industrial Mathematics.

Published

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 and the Alzheimer's Disease Neuroimaging initiative**, *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.
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: 0.1088/0266-5611/32/12/125010

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.

2015 **S. Garbarino, V. Vivaldi, F. Delbary, G. Caviglia, M. Piana, C. Marini, S. Capitanio, I. Calamia, A. Buschiazzo 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.

Conference proceeding

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 neurodegenerati: 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, for the Alzheimers Disease Neuroimaging Initiative**, *A vertex clustering model for disease progression: Application to cortical thickness images*, International Conference on Information Processing in Medical Imaging, 134-145.

2015 **A. Buschiazzo, 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.

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, Centre for Medical Image Computing (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 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.

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.

Participation in meeting/workshop/schools

Nov 7–9, 2018 **SophI.A. Summit, Springboard for Artificial Intelligence**, *Sophia Antipolis*.

Jun 14–15, 2018 **2nd C@UCA meeting**, *Frejus*.

Apr 4–6, 2018 **STATLEARN2018**, *Nice*.

Sep 28–30, 2015 **1st Applied Mathematics Symposium Münster: Variational Methods for Dynamic Inverse Problems and Imaging**, *Münster*.

Jun 3–5, 2015 **Calcolo scientifico e modelli matematici alla ricerca delle cose nascoste attraverso le cose manifeste**, *Genoa*.

Jun 27–28, 2013 **TECNOBIONET Conference: themes and problems in stem cells and imaging tools and development**, *Genoa*.

Jun 11–14, 2013 **MPF 2013: Modelling of Physiological Flows**, *Cagliari*.

Mar 11–13, 2013 **Application course in PMOD software**, *Zürich*.

Jun 25–29, 2012 **Simai Conference 2012**, *Turin*.

Poster

July 24, 2018 **Sara Garbarino, Marco Lorenzi, Neil Oxtoby, Eline Vinke, Razvan Marinescu, Arman Eshaghi, Olga Ciccarelli, Frederik Barkhof, Meike Vernooij, and Daniel Alexander, for the Alzheimer's Disease Neuroimaging Initiative**, *AAIC 2018*, Chicago.

June 19, 2018 **Sara Garbarino, Marco Lorenzi**, *2nd C@UCA meeting*, Frejus.

Feb 19, 2018 **Neil P Oxtoby, Sara Garbarino, Nicholas Firth, Jason Warren, Jonathan M Schott, and Daniel C Alexander, for the Alzheimer's Disease Neuroimaging Initiative**, *POND2018 - 2nd International Workshop on Progression of Neurodegenerative Diseases*, Campus Biotech, Geneva.

Feb 19, 2018 **Sara Garbarino, Marco Lorenzi, Eline J Vinke, Razvan V Marinescu, Neil P Oxtoby, Arman Eshaghi, Olga Ciccarelli, Frederik Barkhof, Meike Vernooij, and Daniel C Alexander, for the Alzheimer?s Disease Neuroimaging Initiative**, *POND2018 - 2nd International Workshop on Progression of Neurodegenerative Diseases*, Campus Biotech, Geneva.

Jul 18–21. 2017 **R. Marinescu, S. Primativo, A. Young, N. Oxtoby, N. Firth, A. Eshaghi, S. Garbarino, M. Modat, J. Cardoso, K. Yong, N. Fox, M. Lehmann, T. Shakespeare, S. Crutch, D. Alexander**, *Data-driven Model Predicts Distinct Atrophy Patterns for Three Different Cognitive Subgroups*, AAIC.

Oct 18–22, 2014 **S. Garbarino, G. Bottoni, V. Vivaldi, A. Buschiazzo, F. Delbary, I. Calamia, G. Caviglia, M. Massollo, G. Sambuceti, C. Marini and M. Piana**, *Effects of Metformin and dietary Intervention on FDG Physiology in Mouse Liver: an Enhanced Compartmental Analysis*, Annual Congress of the European association of Nuclear Medicine, Göthenburg.

Research visits

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

Supervision

2017 **MSc Thesis in Machine Learning at University College London**, *Mr. Ban Chao*.

2016 **BSc Thesis in Medical Physics at University College London**, *Mr. Ashkan Pakzad*.

2016 **MSc Thesis in Mathematics at University of Genoa**, *Mrs. Giulia Denevi*, (now PhD at Istituto Italiano di Tecnologia IIT, Genoa).

2016 **MSc Thesis in Mathematics at University of Genoa**, *Mr. Andrea Raffo*, (now PhD at Oslo University, Norway).

2015 **MSc Thesis in Mathematics at University of Genoa**, *Mrs. Mara Scussolini*, (now PhD at University of Genoa).

2014 **BSc Thesis in Mathematics at University of Genoa**, *Mr. Giovanni Chiappori*.

Teaching

2015/6 **Numerical Analysis**, *Department of Computer Science*, Universitá degli Studi di Genova, lab exercises.

2014/5 **Mathematics in Medicine**, *Department of Mathematics*, Universitá degli Studi di Genova, lectures and lab exercises.

2013/4 **Mathematical Analysis and Geometry**, *Department of Mechanical Engineering*, Universitá degli Studi di Genova, class exercises.

2012/3 **Mathematical Analysis and Geometry**, *Department of Mechanical Engineering*, Universitá degli Studi di Genova, tutoring first and second year students.

2011/2 **Fourier Analysis**, *Department of Mathematics*, Universitá degli Studi di Genova, lab exercises.

2011/2 **Mathematical Analysis and Geometry**, *Department of Mechanical Engineering*, Universitá degli Studi di Genova, tutoring first and second year students.

2009/10 **Mathematics**, *Department of Biology*, Universitá degli Studi di Genova, tutoring first year students.

Revision

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*.

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 University of Genoa*, piana@dima.unige.it.

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