Irene Balelli

Ph.D.

Inria Center of University Côte d'Azur,
Epione Team
2004 Route des Lucioles,
06902 Valbonne, France
0033 602082747
irene.balelli@inria.fr
ibalelli.github.io

Biographical Information

Birth **November 3, 1988**, in Forlimpopoli - Italy.

Citizenship **Italian**.

Marital status **Under PACS**.

Family situation **Two children** (2015 and 2018).

Research Interests

Modeling/ Statistics: Bayesian Statistics. Latent variable models. Generative models. Mixed effects models. Identifiability analysis. Sensitivity analysis. Parameter estimation with population approach. Expectation Maximization. PK/PD. In-silico trials. Meta-modeling.

Machine Learning: Federated learning. Distributed learning. Causal learning.

Data governance: Differential privacy. Large-scale heterogeneous biomedical data. Missing data.

Biomedical Applications: *Immunology:* Immune response dynamics. Immune system. Antibody affinity maturation. B-cells. Immune memory. Vaccination.
Cardiology: Drugs' cardiac safety. Pro-arrhythmic risk.
Neurodegenerative diseases: Alzheimer Disease. Parkinson Disease. Imaging data.

Applied Probability: Random walks on graphs. Markov chains. Graph theory. Galton-Watson processes. Evolutionary landscapes

Current Position

2021–now **Research scientist (ISFP) in mathematical modeling for computational biomedicine**, EPIONE team - Centre Inria d'Université Côte d'Azur, Valbonne - France.

Experience

2020–2021 **Post-doctoral research fellowship in federated statistical learning for new generation meta-analyses of large-scale and secured biomedical data**, EPIONE team - Inria Sophia Antipolis Méditerranée, Valbonne - France.

2017–2019 **Post-doctoral research fellowship in modeling of the immune response to Ebola vaccine**, SISTM team - Inserm U1219 Bordeaux Population Health, Bordeaux - France.

Education

2013–2016 **PhD in Applied Mathematics with teaching activities**, LAGA - Université Paris 13, Villetaneuse - France.

Title: *Mathematical foundations of antibody affinity maturation*.

Supervisors: Vuk Milišić, Gilles Wainrib, Hatem Zaag.

Defense date: November 30, 2016.

2011–2013 **Master Degree in Mathematics Applied to Biology and Medicine**, *Master thesis:* A mathematical model of somatic hypermutation *(Supervisors: V. Milišić, G. Wainrib)*, Université Paris 6, Paris - France.

2010–2011 **Erasmus Program**, Universidad Complutense, Department of Mathematics, Madrid - Spain.

2007–2010 **Bachelor degree in Mathematics**, *Bachelor thesis:* Il modello di Bressloff e Cowan: allucinazioni visive come stati stabili di attivazione corticale *(Supervisor: G. Citti)*, Universitá di Bologna, Bologna - Italy.

Papers and Preprints

S. Al-Ali, J. Llopis-Lorente, M. T. Mora, M. Sermesant, B. Trénor, **I. Balelli**., *A causal discovery approach for streamline ion channels selection to improve drug-induced TdP risk assessment*, Submitted to CinC 2023.

F. Cremonesi, M. Vesin, S. Cansiz, Y. Bouillard, **I. Balelli**, L. Innocenti, S. Silva, S.S. Ayed, R. Taiello, L. Kameni, R. Vidal, F. Orlhac, C. Nioche, N. Lapel, B. Houis, R. Modzelewski, O. Humbert, M. Onen, and M. Lorenzi, *Fed-BioMed: Open, Transparent and Trusted Federated Learning for Real-world Healthcare Applications*, [arXiv:2304.12012].

I. Balelli*, A. Sportisse*, F. Cremonesi, P.A. Mattei, M. Lorenzi., *Fed-MIWAE: Federated Imputation of Incomplete Data via Deep Generative Models*, Submitted to MICCAI 2023.
[hal-04069795]

Q. Clairon, C. Pasin, **I. Balelli**, R. Thiébaut, M. Prague., *Parameter estimation in nonlinear mixed effect models based on ordinary differential equations: an optimal control approach*, Accepted for publication in Computational Statistics (COST), [arXiv: 2102.11543].

I. Balelli, S. Silva, M. Lorenzi., *A Differentially Private Probabilistic Framework for Federated Heterogeneous Multi-View Datasets Variability*, Journal of Machine Learning for Biomedical Imaging (MELBA). 2022:012.

I. Balelli, S. Silva, M. Lorenzi., *A Probabilistic Framework for Modeling the Variability Across Federated Datasets of Heterogeneous Multi-View Observations*, International Conference on Information Processing in Medical Imaging. Springer, Cham, 2021. p. 701-714..

M. Prague, J. Gerold, **I. Balelli**, C. Pasin, J. Li, D. Barouch, J. Whitney, A. Hill., *Viral rebound kinetics following single and combination immunotherapy for HIV/SIV*, [bioRxiv 700401; doi: https://doi.org/10.1101/700401].

I. Balelli, C. Pasin, M. Prague, F. Crauste, T. Van Effelterre, V. Bockstal, L. Solforosi, R. Thiébaut, *A model for establishment, maintenance and reactivation of the immune response after vaccination against Ebola virus*, Journal of Theoretical Biology, 2020, DOI: 10.1016/j.jtbi.2020.110254.

C. Pasin, **I. Balelli**, T. Van Effelterre, V. Bockstal, L. Solforosi, M. Prague, M. Douoguih, R. Thiébaut, *Dynamics of the humoral immune response to a prime-boost Ebola vaccine: quantification and sources of variation*, Journal of Virology, 2019, **DOI:** 10.1128/JVI.00579-19.

I. Balelli, V. Milišić, G. Wainrib, *Multi-type Galton-Watson processes with affinity-dependent selection applied to antibody affinity maturation*, Bulletin of Mathematical Biology, 2019, vol. 81, no 3, p. 830-868.

I. Balelli, V. Milišić, G. Wainrib, *Random walks on binary strings applied to the somatic hypermutation of B-cells*, Mathematical Biosciences, 2018, vol. 300, p. 168-186.

I. Balelli, V. Milišić, G. Wainrib, *Branching random walks on binary strings for evolutionary processes in adaptive immunity*, [arXiv: 1607.00927].

Attended Conferences, Meetings and Seminars

2023 **Innovaheart 2023**, *Invited talk*, Bordeaux.

3IA Seminar, *Invited talk*, Sophia Antipolis.

2022 **Inria-DFKI workshop 2022**, Bordeaux.

BoostUrCareer Doctoriales 2022 – AI in HEALTHCARE, *Invited talk*, Nice.

2021 **Information Processing in Medical Imaging (IPMI) 2021**, *Poster*, Online event.

2020 **3IA Scientific Days**, *Poster*, Nice - France.

SophI.A Summit 2020, *Talk*, Sophia Antipolis - France.

2019 **4$^{\text{th}}$ EBOVAC1/2 Annual meeting**, *Invited talk*, Nairobi - Kenya.

VRI Annual meeting, *Invited talk*, Paris - France.

2018 **IMI 10$^{\text{th}}$ Anniversary Scientific Symposium**, *Talk*, 3$^{\text{rd}}$ committee prize "best presentation", Brussels - Belgium.

CROI 2018, *Poster (J.M. Gerold, C. Pasin, **I. Balelli**, S. Lim, C. Osuna, J.B. Whitney, D.H. Barouch, M. Prague, A.L. Hill)*, Boston - United States.

3$^{\text{rd}}$ EBOVAC1/2 Annual meeting, *Invited talk (with C. Pasin)*, Amsterdam - Nederland.

2017 **Systems Immunology and Vaccine design**, Heidelberg - Germany.

2016 **Probabilities and Statistics seminar (LAGA)**, *Invited talk*, Villetaneuse - France.

1$^{\text{st}}$ Challenges in inflammation meeting, Florence - Italy.

Les probabilités de demain, *Invited talk*, IHÉS - Bures-sur-Yvette - France.

Summer school: "PDE and Probability for Life Sciences", *Poster*, CIRM - Marseille - France.

2015 **EDP-Normandie**, *Poster*, Havre - France.

2014 **InflaConf: Mathematical modeling in immunology and inflammation**, *invited talk*, Paris - France.

CANUM 2014, *Poster*, Carry-le-Rouet - France.

Inflamex day, *Invited talk*, CIEP Sèvres - France.

2013 **GDR Métice: Inflammation and Treatment Resistance**, *invited talk*, Lyon - France.

Thematic schools

2022 **AI4Health Winter School**, *Workshop:* Fed-BioMed, an open source framework for federated learning in real world healthcare applications, Online event.

2021 **AI4Health Winter School**, *Workshop:* Handling heterogeneity in the analysis of biomedical information, Online event.

First Inria-DFKI European Summer School on Artificial Intelligence, *Workshop:* Federated learning methods and frameworks for collaborative data analysis, Online event.

Supervised students

Post-Doc **S. Al-Ali**, *Causal data analysis of in-silico trials*, Projet SimCardioTest, Since Oct. 2022.

PhD **E. Gaymard**, *Innovative mathematical methodologies in pharmacometric meta-modeling from highly heterogeneous sources*, industrial PhD (CIFRE) with Exact-Cure, co-directed with M. Sermesant, Since Nov. 2022.

Master **B. Ramudu Manam**, *Multichannel longitudinal PPCA*, Since Apr. 2023.

Teaching Activities

2020-2023 **Bayesian learning**, *Lectures and tutorials*, M2 MSc Data Science & Artificial Intelligence, University Côte d'Azur.
Sophia Antipolis - France

Modeling of biological systems, *Lectures and tutorials*, M2 BIM, University Côte d'Azur.
Nice - France

Analysis and Modeling, *Tutorials*, 1st year bachelor's degree, University Côte d'Azur.
Nice - France

Statistics and Modeling, *Tutorials*, 3rd year bachelor's degree, University Côte d'Azur.
Nice - France

2013-2016 **Probability and Statistics 2**, *Tutorials*, 2nd year bachelor's degree in Mathematics and MIEF, University Paris 13.
Villetaneuse - France

Probability and Statistics 1, *Tutorials*, 2nd year bachelor's degree in Mathematics, University Paris 13.
Villetaneuse - France

Probability and Statistics, *Tutorials*, 1st year Engineering degree (Apprentissage énergétique), Engineering School Sup Galilée.
Villetaneuse - France

Statistics, *Tutorials*, 1st year Engineering degree MACS (Mathématiques Appliquées et Calcul Scientifique), Engineering School Sup Galilée.
Villetaneuse - France

Probability, *Tutorials*, 2nd year IUT-Info, University Paris 13.
Villetaneuse - France

Inferential statistics, *Tutorials*, 2nd year DUT-GEA, University Paris 13.
Bobigny - France

Review Activities

2020-2023 Vaccine (Elsevier), Medical Image Analysis (Elsevier), Neuroimage (Elsevier), SMAI J. of Computational Mathematics

Softwares

Fed-BioMed Open-source federated learning framework: `http://fedbiomed.org`

Responsabilities

Administration In charge of the pedagogical organization of the AI for Health track of the Data Science&AI Master 2, Université Côte d'Azur, Sophia Antipolis - France

Projects WP leader in the European project SimCardioTest and in the RHU project TALENT.

Computer Skills

Programming Languages **Python, Matlab, R**

Operating Systems **Mac 0SX, Linux, Windows**

Parameter estimation softwares **Monolix, NIMROD**

Numerical Simulations **Stochastic processes, Monte Carlo methods, ODE system (simulation / sensitivity analysis)**

Editing & Office **OpenOffice, Office, LaTeX**

Others **IdentifiabilityAnalysis (Mathematica), DAISY (Reduce3.8)**

Languages

Italian **Mother tongue**

English **Fluent**

French **bilingual**

Spanish **Fluent**