Alessandro Pasqui

Curriculum Vitae

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Personal information

Date of birth *29 - 11 - 1995*
Place of birth *Rome*
Nationality *Italian*

Education

Sep 2021 – present **MSCA PhD Candidate at PSL Université de Paris**
Collège de France and École Normale Supérieure (Paris)

Subject: Theoretical Physics (AI and biophysics)

Supervisors: Dr. Hervé Turlier, Dr. Mathieu Coppey, Dr. Bogdan Stanciulescu

The PhD project is divided in two parts. For the first part, I developed *ZA-ugNet*, a machine learning based algorithm that aims to improve the z-resolution of 3d-stacks (Pasqui et al., in preparation). The idea is to increase the total number z-slices per stack through non-linear interpolations for images. The method shows excellent results with a wide variety of microscopy techniques (fluorescence, transmitted light, etc.) and with samples of different sizes (from cell organelles to single cells, from tissues to embryos). For the second part, I am currently working on an innovative framework, a fully differentiable vertex model written in Google Jax to quickly and easily address the inverse problem of learning microscopic cellular parameters to achieve a given target behavior for a confluent tissue. This framework allows me to leverage bilevel optimization techniques to learn optimal parameters for the system in order to achieve target macroscopic behavior, such as specific patterns within the tissue, or specific system properties, or even infer the optimal cellular parameters to match some real microscopic data. Implementing this framework in Jax allows the model to be fully differentiable, which gives me the freedom to automatically differentiate any energy or loss function with respect to any parameter of the system. Thus, our framework allows us to address inverse problems using techniques from machine learning, such as automatic implicit differentiation and equilibrium propagation, and even use GPUs and TPUs to accelerate optimization processing time.

Sep 2018 – Mar 2021 **Master's Degree at Sapienza University of Rome**
Department of Physics and
Center For Life Nano Science at Italian Institute of Technology (CLNS-IIT)

Subject: Theoretical Physics (statistical mechanics)

Supervisors: Prof. Giancarlo Ruocco, Dr. Giorgio Gosti, Dr. Mattia Miotto

High performance matching algorithm based on orthogonal polynomials
The aim was to develop a computational algorithm able to detect portions of objects with complementary shapes: this algorithm was used to match the pieces of a puzzle and to combine them to rebuild the puzzle. In order to do that I used local shape descriptors in terms of different orthogonal polynomials. This thesis was my contribution to a larger project developed at the CLNS-IIT to study the interactions between spike proteins and the corresponding receptors involved in the viruses infection mechanisms (Milanetti et al. 2020).

Grade: 110 (with honors) / 110

Sep 2014 – Jan 2018 **Bachelor's Degree at Sapienza University of Rome**
Department of Physics

Subject: Physics

Supervisor: Prof. Federico Ricci-Tersenghi

Percolation in models with long-range interactions
The aim was to study with theory and numerical simulations the critical point and some critical exponents for particular models of percolation with long-range interactions.

Research experiences

Sep 2023 – Dec 2023 **Center for Life Nano Science at Italian Institute of Technology**
Supervisors: Prof. Giancarlo Ruocco, Dr. Matteo Paoluzzi, Dr. Giorgio Gosti, Dr. Mattia Miotto
Visiting period to collaborate on the development of a fully differentiable vertex model written in Google Jax to learning microscopic cellular parameters from confluent tissues.

Apr 2021 – Aug 2021 **Collège de France - Centre Interdisciplinaire de Recherche en Biologie**
Supervisors: Dr. Hervé Turlier and Dr. Bogdan Stanciulescu
Image-to-image translation via convolutional neural networks for microscopy images in the context of developmental biology: from transmitted light microscopy to fluorescence microscopy (and back).

Jun 2020 – Mar 2021 **Center for Life Nano Science at Italian Institute of Technology**
Supervisors: Prof. Giancarlo Ruocco and Dr. Giorgio Gosti
High performance matching algorithm based on orthogonal polynomials.

Jan 2020 – Feb 2020 **Sapienza University of Rome**
Supervisor: Dr. Francesca Colaiori
Connection properties of the directed graph related to the election results for new Wikipedia administrators.

Mar 2019 – Jul 2019 **Center for Life Nano Science at Italian Institute of Technology**
Supervisors: Prof. Giancarlo Ruocco and Dr. Giorgio Gosti
Pairwise correlation function for neural cells during neural rosettes development through automatic segmentation algorithms based on deep learning using convolutional neural networks.

Sep 2017 – Jan 2018 **Sapienza University of Rome**
Supervisor: Prof. Federico Ricci-Tersenghi
Percolation in models with long-range interactions.

Programming

Python	excellent
C	excellent
C++	excellent
Shell Scripting	excellent
LaTex	excellent

Languages

Italian	mother tongue
English	fluent
French	fluent
Spanish	advanced

Honors and Awards

Aug 2021 **Marie Skłodowska-Curie Actions (MSCA) - COFUND**
AI4theSciences Doctoral Program 2021 at PSL Université Paris
Paris (France)
I have been shortlisted for the interviews. I have passed all the steps of the selection process and I have been selected for the Cofund program.

Relevant conferences and courses

Apr 2023 **Interchall2023 Conference - Interdisciplinary challenges: from non-equilibrium physics to life sciences**
Centro Congressi Frentani, Rome, Italy
The conference gathered a large community of theoretical and experimental early career researchers in biophysics. It comprised 1 week of talks about active matter, collective behaviour, neural networks, cellular dynamics and morphogenesis, etc.

Dec 2022 **(Post)Modern Thermodynamics School and Workshop**
University of Luxembourg, Luxembourg
The school comprised 3 days of courses lectured by experts on distinct topics about thermodynamics based on stochastic processes. The workshop comprised 2 days of contributed talks to promote discussion on fundamental problems in non-equilibrium physics, cross-fertilizing areas such as stochastic thermodynamics, active matter, quantum thermodynamics, chemical reaction network theory, etc.

Nov 2021 **Multiscale Integration in Biological Systems Course**
Institut Curie, Paris, France
The course comprised 1 week of lectures on modern physical tools that have been developed to address the issue of scale integration and on how these tools can be applied to specific biological systems.

Other experiences

Jan 2016 – Dec 2016 **Librarian at Sapienza University of Rome**
Rome
I was selected for a merit-based student internship for activity support at the Library of the Department of Physics. The main duties were to assist library patrons in furnishing information, check books in and out of the library, classify and catalog books, publications and other library materials based on standard library classification systems.

Sep 2013 – Apr 2021 **High School Private Tutor**
Monterotondo (Rome)
I have tutored many high school students in maths and physics. I also have experiences with students with learning disabilities.

Sep 2009 – Apr 2021 **1st Trombone at Associazione Musicale Eretina**
Monterotondo (Rome)
I was the principal trombone in the orchestra of the music school.

Other skills

S.I.F. Member
I am a member of the Italian Physical Society.

Driving Licence
I have a B driving lincence.

References

Dr. Hervé Turlier
Group leader at Collège de France (CIRB).
email: herve.turlier@college-de-france.fr

Paris, 6 March 2024