

# UNIVERSITÀ DEGLI STUDI DI GENOVA



Scuola di Scienze Matematiche, Fisiche e Naturali

Corso di Dottorato in Fisica  
Curriculum BioNanoscienze

## **Annual Report**

**Candidate:**  
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**Advisor:**  
Prof. Alberto Diaspro

Anno Accademico 2020/2021

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## Research activity

My research activity deals with the design, implementation and application of a multimodal optical microscope. The aim is to integrate simultaneous acquisition mechanisms coupled computational analysis to foster a brand-new way of forming a new image reducing the possibility of being biased. The project is focus on to merge different data through information theory and machine learning algorithms. I'm looking for an approach to fuse differing data types together to automatically find patterns of related changes across multiple modalities. In particular I'm exploring two possible approaches:

1. **Information Theory:** the goal is to find the points that maximizes the information in the images and merge them all together;
2. **Machine Learning:** the aim is to build a "Linked Independent Component Analysis (ICA)" model for discovering common features across multiple modalities.

In the first case the advantage is to obtain a "*scanning rule*" that allows to optimize the microscope imaging, but all data are processed independently; instead, in the second one, the model take into account the *linked* component across different methods of acquisition.

Another part of my research concerns the analysis of biomedical data and the development of tools able to offer a numerical quantification of variables of interest.

## Attended courses

The following table summarizes the list of attended courses:

Title	Type	Date	Prof.	Exame
Optical Microscopy at the Nanoscale	PhD	February - March 2021	Diaspro	Done
Biofisica	Master	I semester 2020/2021	Pesce	Done
Fisica Computazionale	Master	II semester 2020/2021	Ferrando	To Do
Convex Optimization	PhD	II semester 2020/2021	Villa	Done
Advanced Optical Fluorescence Microscopy Methods	PhD	May - June 2021	Bianchini	Done

## Presentations at conferences

Apr 13-16, 2021

XXV Congresso Nazionale SIBPA – Online

XXV Congresso Nazionale della Società Italiana di Biofisica Pura e Applicata.

The SIBPA National Congress addresses several topics range from molecular to integrative biophysics, through cellular and sensory biophysics. In addition, nanobiophysics and advanced microscopies have been added among cutting-edges research fields and applications.

As a personal contribution, I collaborated in the organization of the event and I presented a poster with the title "*An automated tool to quantify chromatin compaction in 3D fluorescence images*".

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Sep 13-17, 2021

107° Congresso Nazionale SIF – Online

107° Congresso Nazionale della Società Italiana di Fisica.

I presented a talk entitled "*An automated tool to estimate chromatin compaction in stained nuclei*" within the Section 5: Biophysics and medical physics, whose themes are:

- Physical aspects of living systems;
- New concepts and quantitative approaches for the study of biological phenomena;
- Function and structure of biological systems;
- Biomimetic systems, cellular processes, multicellular systems;
- Biological networks;
- Application of ionizing and non-ionizing radiation physics

31 Oct - 4 Nov, 2021

2021 FiO + LS Conference – Online

Frontiers in Optics + Laser Science Conference.

The FiO+LS National Congress addresses several topics, from Lasers Fabrication to Fiber Optics, from Optics in Biology and Medicine to Information Acquisition, Processing and Display.

I submitted an accepted paper with the title "*An Automated Tool to Analyse 3D Fluorescence Images of Stained Nuclei*" within the section "Machine and Deep Learning in Biomedical Applications". A Poster will be upload to OSA Publishing's Digital Library as supplemental material to the paper.

## Attended Conferences

Feb 22 - 26, 2021

BPS 2021 Annual Meeting – Online

The Biophysical Society Virtual Annual Meeting.

Key subjects for the conference series are the theory and practice of 3D optical imaging, related 3D image processing, and especially developments in resolution and imaging modalities. The conference series covers also the rapidly advancing fluorescence labeling techniques for confocal and multi-photon 3D imaging of -live- biological specimens.

Mar 28 - 31, 2021

FOM conference 2021 – Online

Focus on Microscopy 2021.

As science becomes increasingly interdisciplinary, the Biophysical Society Annual Meeting continues its' long-held reputation for bringing together leading scientists from all over the world who work at the interface of the life, physical, and computational sciences.

Sep 6 - 7, 2021

OIP workshop – Online

Optimization Techniques for Inverse Problems 2021.

The workshop is made by talks held by international experts in numerical optimization and inverse problems. It focus on theoretical and applied aspects of optimization techniques, with particular attention to related developments in specific inverse problems as image restoration, compressive sensing, and machine learning.