UNIVERSITÀ DI TRENTO

PhD in Mathematics – Cycle 38
Research topics 2022

Bando 2022/Call 2022

COSBI – Università di Trento
Borse di studio/ Scholarships

A	**Inference of cell and tissue specific regulatory networks from genomic data**
Topic: Inference of cell and tissue specific regulatory networks from genomic data	
P.I.: **Mario Lauria**	
Contacts: **mario.lauria@unitn.it**	
Synthetic description of the activity and expected research outcome Gene regulatory networks (GRNs) model the relationship between transcription factors and their target genes in a biological system of interest. Recently, there has been a growing interest in the inference of GRNs from gene expression data generated by single-cell sequencing technologies. This PhD project aims to develop or validate novel methods for context-specific GRN inference. The project will tackle the challenges of this type of data, such as the high heterogeneity and sparsity of the data to improve the performance of currently available tools.	
Ideal candidate (skills and competencies) The ideal candidate will be a highly motivated student, possessing a MSc in Mathematics, Bioinformatics, Biostatistics, Computer Science, Computational Biology or equivalent degrees, with a strong interest in developing and applying statistical methods for omics data analysis, ideally with previous experience in data analysis and solid programming skills, who will be willing to explore a rapidly advancing and interdisciplinary field of research.	

B	**Applications of multi-scale mathematical modelling to complex biological systems**
Topic: Applications of multi-scale mathematical modelling to complex biological systems	
P.I.: **Andrea Pugliese**	
Contacts: **andrea.pugliese@unitn.it**	
Biological systems are a complex and multifaceted set of processes that interacts at different levels, both in terms of dynamics and hierarchy. Mathematical modelling can help investigating non-trivial aspects of the underlying mechanisms by applying different formalisms to describe the biology. The PhD project objective is to develop new holistic mathematical approaches that can piece together fast reactions (e.g. kinases), slow processes (e.g. transcription) or bottom up emerging properties (e.g. cell to tissue interactions) enabling the exploration of these high-dimensional problems.	
Ideal candidate (skills and competencies) The ideal candidate will be a highly motivated student, possessing a MSc in Mathematics, Bioinformatics, Biostatistics, Computer Science, Computational Biology or equivalent degrees, ideally with some experience in mathematical modelling and scientific programming, who will be willing to explore a rapidly advancing and interdisciplinary field of research.	

UNIVERSITÀ DI TRENTO

ERC Starting Grant CHANGE - European Union's Horizon 2020 Research and Innovation Programme

Borsa di studio/ Scholarship

C	**Analisi Geometrica / Geometric Analysis**

Topic: Geometric Analysis

P.I.: **Alessandro Carlotto**

Contacts**: alessandro.carlotto@math.ethz.ch**

Synthetic description of the activity and expected research outcome
The fellowship is meant for distinguished candidates wishing to be introduced to some central themes of research in the field of Geometric Analysis under the direction of Prof. Alessandro Carlotto, who serves as principal investigator for the European project in question. Some focus topics are the study of minimal surfaces (in different contexts), the study of scalar curvature constraints, and the interplay between the two things possibly in connection with the investigation of initial data sets for the Einstein field equations.

Further information: potential candidates are referred to the project webpage https://people.math.ethz.ch/~ac/erc

Ideal candidate: fluency with the ideas and methods of Riemannian Geometry on the one hand, and partial differential equations (mainly of elliptic and parabolic type, plus standard background on Functional Analysis and Sobolev spaces) on the other hand are a must. Additional, more specific background (such as, for instance: some working knowledge of Geometric Measure Theory, variational and Morse-theoretic methods for nonlinear problems, or perhaps a first exposure to mathematical aspects of General Relativity) although not strictly necessary, may be a plus. The ideal candidate is expected to display a high degree of commitment and motivation for mathematical research.

Fondazione Bruno Kessler – FBK

Borsa di studio/ Scholarship

D	**Modeling approaches to investigate the transmission of emerging pathogens**

Topic: Computational modeling of infectious diseases

P.I.: **Andrea Pugliese and Piero Poletti**

Contacts: **andrea.pugliese@unitn.it, poletti@fbk.eu**

Synthetic description of the activity and expected research outcome
Research activity conducted during the Ph.D. will focus on the development of mathematical and statistical models to investigate the transmission of emerging and re-emerging pathogens in human populations. This may include the analysis of spatio-temporal patterns characterizing an observed epidemic, the estimation of the contribution of different settings (e.g., households, schools, workplaces, hospitals) in the spread of an infectious diseases, the forecast of potential epidemic trajectories, and the exploration of alternative intervention scenarios (e.g., social-distancing measures, vaccination). Envisioned approaches range from the development and simulation of mechanistic transmission models to the use of statistical inference applied to epidemiological data.

References
Marziano, V., et al. "Retrospective analysis of the Italian exit strategy from COVID-19 lockdown."Proceedings of the National Academy of Sciences 118.4 (2021).

Marziano, V., et al. "The impact of demographic changes on the epidemiology of herpes zoster: Spain as a case study."Proceedings of the Royal Society B: Biological Sciences 282.1804 (2015): 20142509.

Bosetti, P., et al. "Heterogeneity in social and epidemiological factors determines the risk of measles outbreaks." Proceedings of the National Academy of Sciences 117.48 (2020): 30118-30125.

Ideal candidate (skills and competencies)
Ideal candidates will have a degree in applied mathematics or related areas, some experience in mathematical modelling, and scientific programming; a good knowledge of basic statistical methods.