UNIVERSITÀ DI TRENTO
Dipartimento di Ingegneria Industriale

European Research Council
Established by the European Commission

Postdoctoral Positions available within the ERC project:
Integrated Structural and Probabilistic Approaches for Biological and Epidemiological Systems

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We are looking for **motivated, talented, outstanding Postdoctoral Researchers** with a PhD degree (or close to completion) in Systems and Control or Applied Mathematics, or related field, with a **strong Mathematical background** and experience in the areas of **Systems and Control**, **Optimisation**, as well as interest and passion for interdisciplinary research at the interface between systems and control theory, engineering and life sciences. Experience in **Mathematical Biology/Epidemiology** is a strong plus.

The successful candidates will work on the ERC project INSPIRE, "Integrated Structural and Probabilistic Approaches for Biological and Epidemiological Systems", led by Prof. Giulia Giordano.

Job Details:
Type of contract: Postdoctoral Research Fellowship
Salary: 39,600 euros/year gross (about 3000 euros/month after taxes)
Starting date: flexible, within 2023
Duration: 1 year, renewable for additional 2-3 years upon successful performance

Qualifications:
Required
- PhD title in Engineering, Mathematics, Computer Science, Physics or equivalent (or close to completion).
- Strong mathematical skills and excellent expertise in Dynamical Systems and in Mathematical Systems and Control Theory, Uncertain and Nonlinear Systems, Optimisation.
- Research experience in Systems and Control Theory and in Uncertain Systems, Robustness, Optimisation, Nonlinear Systems.
- A track record of publications in high-quality journals and conferences.
- Excellent knowledge of the English language.
- Professional-scientific CV in line with the research programme (see description below).

Preferential
- Knowledge of applied and computational mathematics, programming skills.
- Experience with mathematical modelling in Mathematical Epidemiology and Systems Biology.
- Proven ability and interest to obtain scientific achievements in an interdisciplinary context.

Goal:
Development of the integrated structural and probabilistic framework, which requires a strong background in mathematical systems and control theory, spanning robust and probabilistic frameworks, nonlinear and uncertain systems, robust approaches and probabilistic/randomised methods.

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General description of the ERC INSPIRE project:

Systems in nature are extremely robust, despite huge uncertainties and variability. Studying their nonlinear dynamic behaviour is challenging, due to their complexity and the many parameters at play, but crucial to understand important phenomena, such as cellular dynamics, onset of diseases, epidemic spreading.

Parameter-dependent simulations can predict the behaviour of natural systems case by case. Yet, the exact models and parameter values are poorly known, while qualitative behaviours are often preserved even with huge parameter variations, because they rely on the system interconnection structure. Parameter-free structural approaches can check whether a property is preserved for a whole family of uncertain systems exclusively due to its structure. However, when an expected property fails to hold structurally, novel approaches are needed to understand why, which system features prevent it, which key parameters must be finely tuned to enforce it.

INSPIRE will develop a unifying framework to analyse and control families of uncertain dynamical systems in biology and epidemiology, which integrates for the first time structural, robust and probabilistic methods, tailored to the peculiarities of natural systems.

The project will provide: i) methodologies to assess (practically) structural properties and unveil the mechanisms that enable/prevent a property, identifying the key parameters or motifs; ii) control paradigms that leverage such an insight to guarantee a desired global property through targeted local interventions; iii) scaling and aggregation approaches that exploit the properties of subsystems to mitigate computational complexity. The project outcomes, a mathematical theory as well as algorithms to analyse and control complex uncertain systems in nature, will strongly support the analysis and design of biomolecular feedback systems with a desired behaviour, the identification of therapeutic targets, the prediction and control of epidemic phenomena.

Selected references:

- F. Blanchini and G. Giordano, “Structural analysis in biology: a control-theoretic approach”, Automatica, 126(4), 109376, 2021.
- B. R. Barmish. New tools for robustness of linear systems. McMillan, 1994.
- R. Tempo, G. Calafiore, F. Dabbene. Randomized Algorithms for Analysis and Control of Uncertain Systems, With Applications. 2nd ed., Springer, 2012.

Where will you work?

The **University of Trento** is an international university in the heart of the Alps. Established in 1962, with its 15 departments and centers, it provides an ideal environment for education and research to more than 16,000 students and 600 faculties.

The **Department of Industrial Engineering**, diverse and interdisciplinary, has been labelled twice as “**Department of Excellence**” by the Ministry of University (2018-2022 and 2023-2027) and provides a vibrant and dynamic atmosphere.

Trento is a great place to be if you like: nature and wildlife, mountains, rivers and lakes; sport and outdoor activities; history, castles and cute villages; good food and good living. The cultural scene (museums, music, theatres, concerts) is rich, and still you can find a green, quiet and relaxing atmosphere – larger cities like Milan and Venice are nearby.