

ICT PHD

Research project for a PhD curriculum in ICT – Computer Engineering and Science

**Tutor:** Laura Po

**(\*) Italian Co-tutor:**

**(\*\*) Foreign Co-tutor:**

**Proposed Title of the research:**

Artificial intelligence techniques to tackle urban air pollution

**Keywords: (5)**

**Air Quality Sensors, Anomaly Detection and Repairing, Deep Learning, Air Pollutant Dispersion and Emission Models, Digital Twin**

**Research objectives: --(max 10 rows)**

The aim of this project is to develop a framework and a model to help decision makers rapidly evaluate proposed strategies to reduce air pollution by unveiling the correlation between emission sources and observed urban air quality.

The study must be conducted on environmental data that provide a fine-grained picture of urban air quality. Several environmental datasets will be used. Wiseair's widespread low-cost sensor network (<https://www.wiseair.vision/>) will be exploited.

Artificial intelligence and digital twin will be the enabling technologies to make sense of the complex problem of urban air quality and emission reduction strategies. Deep learning and machine learning techniques will be used to perform the analysis between emissions and AQ levels over space and time.

Simulation models (e.g. traffic models) could be used to create a digital twin of emission sources. Air quality models will be used and their results will be compared with the results of deep learning and machine learning techniques. These models, widely used by agencies charged with controlling air pollution, simulate the physical and chemical processes that affect air pollutants as they disperse and react in the atmosphere. Artificial intelligence techniques and simulation models will help identify the contributions of sources to air quality problems and help design effective strategies to reduce harmful air pollutants. Finally, interpolation maps and infographics will be generated to communicate the obtained results to Public Administrations and citizens.

**Proposed research activity -- (max 10 rows)**

Activities that the PhD student will carry out in line with the topics indicated in Ministerial Decree 1061 of 10 August 2021:

1. Analysis of the state of the art of emission models and artificial intelligence techniques applied in the field of air quality monitoring
2. Implementation of a framework capable of revealing the impact of emission sources on urban air quality.
3. Development of a Digital Twin for modelling emission sources in 10 Italian cities.
4. Testing and refinement of the framework.
5. Definition and calculation of indicators (eg estimates of the emissions generated by the different sources, calculation of daily and weekly trends, comparison between neighbourhoods, etc.).
6. Visualization of the obtained results through interpolation maps and infographics.

7. Verification of the performance of the framework with respect to the measurements collected by sensors.

A working period (at least 6 months) is expected to be carried out in the Company Wiseair S.r.l. In this period, the results elaborated by the framework will be integrated with the digital air quality monitoring platform developed by the company.

#### **Supporting research projects (and Department)**

This project will be carried out at the Department of Engineering “Enzo Ferrari” and will be supported by research funds provided by Prof. Laura Po.

#### **Possible connections with research groups, companies, universities:**

The research involves a collaboration with Wiseair S.r.l. (Registered office: Via Andrea Costa n.8, 20131 Milan)

Furthermore, it may exploit the undergoing collaborations with:

National University of Ireland (NUI) Galway (Prof. John Breslin);

Universidade de Santiago de Compostela (Prof. José Ramón Ríos Viqueira );

Universidad de Zaragoza (Spain – Prof. Raquel Trillo Lado )

Fundación Centro Tecnológico de Supercomputación de Galicia, CESGA (Spain- Dr. Ignacio López Cabido)

Comune di Modena

Comune di Milano

(\*) optional

(\*\*) optional/to be completed on the second year