

ICT PHD

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

Tutor: Laura Po

(*) Italian [Industrial] Co-tutor:

() Foreign Co-tutor:**

Proposed Title of the research:

Big Data Analytics and Digital Twin for Traffic Modelling: Boosting energy saving and emission reduction in Smart Cities

Keywords: (5)

Traffic Models, Digital Twin, Energy saving, Emission Model, Big Data Analytics

Research objectives: --(max 10 rows)

This PhD project aims to study and test simulation models of traffic flows to improve city energy efficiency with regard to street lighting, and air quality through intelligent management of red and green times of traffic lights. The study and application of enabling technologies, such as machine learning algorithms, deep learning, anomaly detection methods, simulation models, predictive analysis algorithms, and statistical analysis methodologies are envisaged.

The results of this research will be proposed for publication in at least 3 conference papers and 2 articles in journals with high impact factors. The PhD student will be included in an international network of researchers and research centers working on trafficking issues. The research activities will determine the advancement of basic knowledge towards the application and transfer of technology.

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 traffic models, adaptive lighting systems and intelligent management of traffic lights.
2. Implementation of a Digital Twin (DT) for semi-real time urban vehicular traffic modeling (on 1 or more cities) which includes the traffic light logic and which provides an image of road congestion with particular attention to the main streets (it will include origin-destination matrices, public transport data, crowdsourcing and open data).
3. Testing of the DT and refinements in order to obtain reliable results in line with real data.
4. Extraction and display of summary information from the traffic model in order to identify the most critical traffic situations (daily peaks, daily trends, high congested roads).
5. Evaluation, through simulations, of changes to the traffic light logic (based on statistical analyses or based on real-time flows) to improve traffic flow and mitigate critical issues.
6. Development of a model to allow a reduction of street lighting adapted to the decrease in traffic flows (based on statistical analysis or based on real-time flows).
7. Definition and calculation of indicators (eg estimation of queue lengths, times, average speeds, pollution emitted, energy and fuel consumption, estimation of energy savings due to lighting adaptation).
8. Verification of the performance of the developed model.

A working period (at least 6 months) is expected to be carried out at the Hera Luce s.r.l where the performance of traffic models and the efficiency of an adaptive lighting system based on urban traffic flows will be verified, as well as the improvements introduced by changes to the traffic light logic in order to reduce the traffic emissions.

Supporting research projects (and Department)

Possible connections with research groups, companies, universities:

The research involves a collaboration with Hera Luce s.r.l. (Registered office: via A. Spinelli, 60 47521 Cesena (FC))

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

(*) optional

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