

Research Activity

The project of a city digital twin has to cope with the complexity of the interactions among the many different components that form a city as a single entity. A city digital twin is not only a virtual representation of a city, but an ensemble of data-driven forecasting models addressing city issues holistically. The multiplex network theory provides a natural framework to represent the interaction structure of city components with different time a spatial scale, where the city dynamics is realized. The development of a statistical physics approach to analyse the big data sets and to interpret the simulation results of the dynamical models, needs methodologies that consider the relevance of the intralayer and interlayer interactions in the emergence of statistical laws. The urban mobility is a paradigmatic problem in this framework: the traffic dynamics can be simulated by stochastic dynamical systems on a transport network, but the individual paths depend on the mobility demand and the individual behaviour. The presence of a multimodal mobility introduces a multilayer structure associated to the different transport networks and the data collection is performed by systems of distributed sensors and the ICT technologies. The City Science Laboratory of the DIFA department has a consolidated experience in the application of Statistical Mechanics methods to the data analysis of georeferenced datasets and modelling problem human mobility.

Research Project

The candidate will contribute to the development of data driven models for urban mobility that can be interfaced with the available dataset of traffic flows recorded by a system of magnetic coils (<https://opendata.comune.bologna.it/>). The models have to be integrated within the data-lake platform developed by FBK (Bruno Kessler Foundation) for the Bologna Digital Twin project. In particular, the research activity will concern:

- 1) Understanding the relation among the mobility demands and the recorded traffic flows in the road network using 'gravitational model';
- 2) Studying the congestion transition of the Bologna road network and defining a congestion degree index for a city;
- 3) Defining strategies to optimize the traffic flows and to reduce congestion degree by controlling the traffic light dynamics.

During the research activity the candidate will collaborate with all the member of the UNIBO team involved in the Bologna Digital Twin project.