**PhD position at Inria and IFP Energies nouvelles in Mathematics or Electrical Engineering, specialization Control Systems**

**Optimal urban mobility network design for sustainable space sharing between vehicles and soft transport modes**

**Context.** Nowadays, we are witnessing a rapid spread of multimodal mobility in our cities and a willingness on the part of communities to promote new mobility behaviors. These changes are causing road networks to evolve and grow with modifications that are often far from being optimally designed, and public authorities are beginning to investigate how to integrate new paths and roads for the new soft transportation modes (bicycles, e-scooters, etc.). This is a very critical and relevant problem for cities and traffic authorities, which do not have updated nor easy-to-use tools to evaluate the impact of their network design decisions. In practice, several questions remain unanswered such as which road network structure is best suited to support new changes in its capacity, to ease space sharing, and eventually to sustain the replacement of certain roads in favor of soft-mobility dedicated lanes.

**Scientific problem.** From a scientific perspective, modeling and merging different mobility graphs while ensuring a complexity compatible with optimization applications is a challenge. Mathematical transformations of the real road graph topology into a new topology preserving specific connectivity properties would be useful to reduce the modeling domain and simplify the system analysis. The different graph transformations require a calibration and a parameter identification that will be conducted by analyzing real mobility data. Then, the topological design of the multi-modal road graph will focus on optimizing the mobility of people in urban areas with respect to safety, environmental impact, and exposure to pollutant concentrations. In practice, the optimization variables would be the location and size of new roads or lanes, new public transport lines, the size of low emission zones, etc.

**Short provisional plan:**
- Review of the relevant start of the art
- Road graph model of vehicles and soft mobility
- Model reduction and merge of the two graphs (multi-class)
- Graph topology design to maximize mobility flows, maximize safety, minimize environmental impact
- Numerical simulation of the proposed strategy on the Grenoble or Lyon mobility network

**Keywords:** Graph theory, topological optimization, machine learning, sustainable mobility

**Academic supervisor**
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**Doctoral School**
ED EEATS, [Web page](https://www.univ-grenoble-alpes.fr/ed-eeats)

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**PhD location**
Inria Grenoble Rhône-Alpes, Grenoble, France and
IFP Energies nouvelles, Lyon, France

**Duration and start date**
3 years, starting in November 2022

**Employer**
Inria Grenoble Rhône-Alpes

**Academic requirements**
University Master’s degree in Mathematics or Electrical Engineering, specialization in Control Systems

**Language requirements**
Fluency in English. Fluency in French or willingness to learn French is a plus

**Other requirements**
Good programming skills in Matlab/Python

To apply, please send your CV, cover letter and transcript of records to both supervisors.