Vehicle Sharing Systems: Stochastic models, approximations and optimization

The number of cities equipped with Vehicle Sharing Systems (VSS, BSS, VLS) is increasing rapidly. VSS are viewed as a promising way to reduce the usage of personal car and improve the quality of life by reducing traffic, noise and air pollution. Despite the growing number of VSS, they are still poorly understood and often suffer from congestion problems (absence of a vehicle or of a parking spot at the destination).

- The goal of the internship will be to contribute to the understanding of VSS by developing mathematical and numerical methods.

Vehicles sharing systems are naturally represented as stochastic systems, more specifically, queuing networks. Large-scale stochastic systems of these types are a challenge to evaluate without simulation. The goal of this part is to study which approximation techniques are most useful for studying vehicles sharing systems represented by queuing networks. Mathematically, we seek proofs of the validity of such approximations under certain assumptions, as well as bounds on their errors in general. Numerically, we also use such approximations to design heuristic rules for operational optimization problems, such as fleet sizing, station location, pricing and incentives or truck regulation. The efficiency of such heuristics is usually evaluated using simulations (see section on modeling and simulation). We also try to design simple intuitive heuristics to compare them with those derived by mathematical approximations, since it is not suitable to increase to complexity of a system without improving slightly its performances.

Keywords: Queuing networks, fluid and mean field approximations, linear and convex programming, simple heuristics.

Webpage of the project:

http://mescal.imag.fr/membres/nicolas.gast/news/2014/10/10/intership-BSS/index.html