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## Social Navigation in Grenoble Urban Area

**Supervisors:** [Carlos Canudas-de-Wit](#) (DR-CNRS, main supervisor), [Maria Laura Delle Monache](#) (co-supervisor, INRIA) [Giacomo Casadei](#) (co-supervisor, CNRS)

**Application type:** Internship

**Start:** any time from January 2018 **Duration:** 4-6 months. **Employer:** CNRS. **Location:** Grenoble, France

**Applications:** <http://scale-freeback.eu/openings/>

**Context.** Large scale traffic networks are a popular topic nowadays due to the impact traffic has in our everyday life, both economically and health-wise. City management are interested in understanding the evolution of traffic and its patterns over the city in order to take decision on potential changes and to design new and more functional infrastructure. However, monitoring the current state of a large-scale traffic network is a demanding task. The heterogeneity of available measures poses several question on how to merge different sources of information coming from private and public sources. Furthermore, sparsity is an intrinsic issue related to large scale systems: independently from the source we choose to rely on, we cannot expect the measurements to be sufficiently dense to cover the full network in detail. In recent years, more and more data are becoming available from new sources, such as smart phones, GPS navigators, and their technological penetration nowadays allows to have an impressive amount of real-time traffic information. The main advantage of these new sources is that they do not require the placement of physical sensors over the network, reducing incredibly costs due to installation and maintenance: in other words, each user becomes a moving sensor inside the network. However not necessarily many data implies meaningful information, since their interpretation, analysis, treatment and display is becoming more and more challenging.

From a city management point of view, the availability of huge numbers of GPS traces can be used in a aggregated fashion to determine macro-movements and origin/destination patterns of interest, to estimate the evolution of the pollution and the usage of the overall network. This information become of great importance in order to monitor and when possible adapt the traffic infrastructure to the traffic evolution. Today, most navigation systems and traffic apps are based on these big-data traffic measurements and can calculate the best route taking into account real-time traffic flow data, as well as historic data to predict traffic flow. For example, Google Maps calculates the current traffic condition using both real-time data from anonymous GPS-enabled device users and historic traffic data to provide optimal routes. Despite this, if users have had access to more information, such as the road condition or the fluidity (start and stop), the pollution, the noise impact and many other metrics, their decisions might be completely different.

**Topic description.** The goal of this stage is to exploit modern tools of analysis of big data in order to extract recursive patterns in the traffic evolution from the huge amount of data available of the Grenoble traffic network. First, from velocities measurements we aim to reconstruct different parameters of interest in traffic such as travel times and shortest paths but also estimate acceleration profiles, emission and thus pollution patterns, noise and many more. By reconstructing and estimating these parameters, it would be possible to create a new map of the city which does not simply represent the topology of the network and the shortest path in terms of length and time: it would be possible to incorporate many more information that are of interest to many potential users. Following the research of the group NeCS and in the context of the ERC Scale-FreeBack, the student will explore the possibility of looking at a complex network by means of aggregation/clustering, allowing to represent the urban networks in a expressive way by means of characteristic zones.

**Objective.** One of the objective is to look at the data available and try to discover/define patterns in the daily evolution of traffic in such a way they can be used to estimate the evolution of these traffic parameters. In view of the huge amount of data available, machine learning is the natural approach the student is asked to use. As a first step, supervised learning will be investigated in order to quantify the consistency of the approach with respect to the traffic parameters. In a second step, unsupervised learning will be investigated so that the definition of the labels will be autonomously defined by the learning architecture

**Requested Background.** Traffic networks, statistics, machine learning, data science.

**Contacts :** G. Casadei, [giacomo.casadei@gipsa-lab.fr](mailto:giacomo.casadei@gipsa-lab.fr), M. L. Delle Monache, [ml.dellemonache@inria.fr](mailto:ml.dellemonache@inria.fr).