**General description**

**Context:** the city of tomorrow, equipped infrastructure, connected vehicles and users

Cities currently account for 50% of the population and account for 70% of greenhouse gas emissions. The problem for officials is to anticipate future developments of urban space and transportation services, with new modes of governance for the connected city of the future, more responsive to its citizens.

In such a context, with smart vehicles and infrastructure equipped to communicate with each other for better reactivity (V2I and V2V), the objectives of urban governance will be to: take an integrated and sustainable solution; promote the development of infrastructure and increase its flexibility (spaces used to varying purposes: lanes / bus parking areas / delivery, multimodal); customize the service offering, responding to requests dynamically even anticipate users’ expectations; take into account the views of users about their use of the transport network and priorities.

For that officials must design and develop innovative transport governance policies and adapt to new user behavior. This raises questions such as which service to focus on and how? How to organize the space of road works on different days of the week, hours of the day? Is it better to create a low-emission zone or penalize vehicles with heavy CO2 emissions? What transport mode will be preferred by users when their usual mode (ex. Tram) is down? What to communicate using existing infrastructure for better traffic control? What would be the impact of a policy encouraging the sharing of vehicles for professional e-commerce delivery?

Mobility officials are demanding solutions enabling them to design, develop and test various policies, from real and simulated mobility data, giving them an idea of the possible scope and impact on the urban network. The proposal is to build and test policies on the environment while obtaining the views of users on their implementation through a participatory governance mechanism.

As part of this PhD project, in partnership with research centre XEROX Europe (XRCE), we propose to develop a tool to develop participatory governance policies involving users and decision makers based on available data from mobility users (needs, uses and opinions) and in the field (infrastructure, urban data, political decisions, etc.). We propose to adopt a systemic approach, following a holistic vision (general system) that incorporates a mechanism to develop and simulate urban governance policies.

**Objective and Methodology**

The objective of this thesis is to propose a multi-agent model simulation for participatory policy development governance of mobility in an urban environment. The model incorporates a learning
process for developing models of representative credible agents of mobility data by exploiting existing datasets in the field and integrating feelings and opinions of the users. The simulation aims to develop participatory governance policies, including users and decision makers. The decision process is informed by a mechanism based on scientific evidence (Evidence Based Policy Making), based on analytical tools and data mining (social media data, and mobility data collected in the field).

The methodology proposed for this work will follow an incremental approach in cycles, with the following main steps:

- Development of a generic multi-agent simulation modeling the user mobility, integrating the characteristics and constraints of the environment, and also a system for creating participatory governance policies, involving users and decision makers.
- A learning module which learns from data extracted from social media and mobility data, and enables constructivist learning, for evolving agents and policies.
- Define a validation process of simulations and policies. This process involves the definition of a set of indicators and a set of scenarios, based on the experience of our partner (XEROX) in the field.

As in any thesis, the PhD student will study the research area and the application field through a comprehensive study of the state of the art. This work will continue throughout the thesis.

**The main aspects covered**

All aspects of the governance of urban transport will be considered: Tariff policies, targeted policies (transport of persons and / or goods, subscriptions favoring certain profiles, etc.), the user-centered policies (combining professional and individual, public / private), dynamic allocation of spaces (roads, parking spaces, parking lots), etc. For this, we imagine a metropolis with great freedom of action and real legislative power, which will consider all kinds of urban policies for the cities of tomorrow.

The views of users will be captured via data in social networks, and integrated into the system to better meet the expectations of users.

Heterogeneous models will allow to take all aspects of urban transport into consideration: transportation network model, environment model, the model of mobility of users and their expectations (micro level), modeling of urban policies (macro level), etc.

At the level of the transportation network, we seek to model the complete eco system to represent the dynamics at 3 levels: (Quang Anh et al) physical flow, information flow, communicational and control flow as well as their dynamic coupling.

The modeling will be made realistic by the dynamic learning of modes of traffic, from the observation of real and simulated data, and the dynamic learning of user profiles.

The proposed system aims to promote the emergence of mobility patterns, which, combined with policies, will learn the context in which policies can be effective, etc.

**Positioning of the subject vis-à-vis corporate strategy**

The Xerox Services branch has become since 2010 a major player in the transport sector and Xerox Research Centre Europe (XRCE), located in Grenoble area, has a strong expertise in the design and use on real cases of scientific methods and computer technologies for innovative management of urban mobility.

The thesis will be interacting with the team Data Intelligence for whom the urban network simulation problem is an important issue.

http://www.xrce.xerox.com
http://www.xrce.xerox.com/Research-Development/Industry-Expertise/Transportation

**Tutors**
Candidate profile

She/he should have a master M2 in Computer Science (or equivalent).

Expected competencies

- Knowledge of Java or Python, and an integrated development environment; experience in development other than school (internship, work experience, personal achievements, etc.) highly appreciated.
- All other developing knowledge (design / testing) and / or multi agent modeling tools, data mining and machine learning will be appreciated.
- Knowledge of data mining methods and data extraction of social networks is a plus.
- Autonomy, curiosity and openness will be useful for the research phase.
- Rigor and methodology are essential for the management of the state of the art and at the drafting stage (articles or final thesis).
- Dynamism, creative and having good communications skills.
- A good (or very good) command of English is required. Communications within Xerox will mostly be in English.

Advantages for the student

You will be working with a research and development team recognized for their strong expertise in the fields of transportation and micro-simulation. The research center will provide the doctoral student a satisfactory working environment (hardware, office supplies) so that she/he can work with existing teams and learn their current modeling methods and work with real data.

The candidate will equally allocate its time between the LIRIS laboratory and the XEROX research centre, on a schedule defined beginning of each year of the thesis.

Technical means available (data processing, micro-simulation platform, machine clusters).

This is a thesis subject which enables different careers in research (ecosystem modeling, dynamic coupling, machine learning, and use of social networks).

Application procedure

Candidates will send by email their CV + cover letter + grades (M1 and M2) to Salima Hassas (salima.hassas@liris.cnrs.fr) and Luis Ulloa (luis.ulloa@xrce.xerox.com) 25 June 2015 at the latest. Interviews will be held during the first half of July.

Beginning of the thesis: 1 October 2015

Contract

ADR allowance - Rhône-Alpes Region (monthly salary of about € 1,300 net). Subscription to the Graduate School InfoMaths (ED 512) from the University of Lyon.
Selected publications of supervisors


