**Topic:** Adoption dynamics in social networks for green mobility

**Advisors:** Alain Kibangou and Paolo Frasca

**Duration:** 3 years, starting asap

**Application procedure:** Contact the supervisors at alain.kibangou@gipsa-lab.fr and paolo.frasca@gipsa-lab.fr

**Candidate profile:** The candidate will have a MS degree in Automatic Control, Applied Mathematics, or related disciplines. Openness to interact with civil engineers, economists and behavioral scientists.

**Thesis’ context:**
This work will be carried out in the DANCE team (Dynamics and Control of Networks), a research team of GIPSA-Lab research center in Grenoble, France. The team’s research concerns modeling, estimation and control of network systems, with a broad spectrum of theoretical and applied topics including traffic networks, intelligent vehicles, social dynamics, and analysis of large-scale complex networks.

The thesis is part of the FORBAC project funded by the French government within the PEPR “DATA TECHNOLOGY for MOBILITY IN THE TERRITORIES”. The activities of the PhD thesis will be hosted at the Grenoble INRIA Center.

**Scientific scope and objectives:** Tomorrow's mobility is being reinvented by the increased usage of less polluting modes of transport, the diffusion of shared means of transportation, and the provision of information to users who must be actors of their mobility. The various mobility or communication technologies require time to be adopted and the full spectrum of their consequences must be understood. In order to analyze the long-term effects of a technology on overall mobility, models with different time scales must be integrated: on the one hand, the daily mobility that can be captured by macroscopic models such, and on the other hand, the gradual adoption of the technology, whose dynamics can be accelerated by the incentives from policy makers.

Adoption dynamics for green or shared means of transportation are also challenging because they involve, together with human choice, physical dynamics and constraints. A new technology, such as hydrogen vehicles, requires a significant investment in terms of infrastructure. How to achieve an optimal deployment in time and space of the infrastructure in view of the uncertainty of the adoption of the technology? In the face of the recurrent discussion about free public transport, how can the overall system be impacted in a sustainable way?

Coupling technology adoption models (such as the Bass model) with traffic models is a crucial research issue for understanding the complex systems of multi-modal transport. Taking into account the specificities of suburban areas is also a fundamental issue. The adoption of a technology is also strongly dependent on space and on various socio-economic factors. We will study adoption dynamics that involve various components: an adoption model, possibly game-theoretic in nature in order to readily account for incentives; a social network, where dynamics of social influence takes place; and the dynamics of infrastructural changes and
investments. These dynamics involve time-scales in the order of months (or longer) and spatial scales from the neighborhood to the whole country.

Our contribution will have strong focus on the network aspects (transportation networks and, where relevant, social networks), with due consideration to their structure: we will for instance investigate when and where incentives are most effective to deploy (Bini 2022). Considering the PEPR focus on large scales, suitable averaging techniques need to be used for the model to be tailored to the right geographical scale: candidate techniques developed by the team include continuation (Nikitin 2022) and graphon-based models (Vizuete 2020).

**Literature**


