Context and Main Purpose

Guaranteeing efficient, resilient and sustainable mobility in modern large cities is very challenging due to growing transport demand, climate changes, industrialization and population increase [1, 2].

Smart and real-time monitoring of large-scale multi-modal transport networks is emerging as a solution to meet such demands, thus providing transport actors with decision-making tools for more effectively managing mobility, reducing costs and assuring higher transport resilience, as well as guaranteeing higher-quality, accessible and safer mobility experience for travelers.

The LICIT laboratory of University of Lyon, ENTPE and University Gustave Eiffel is working with academic (INRIA/INSA-Lyon, IMDEA, University of Illinois Chicago, University of Sannio, UNSW SYDNEY) and industrial partners (Orange, Lyon Metropole, BeMobile) in the framework of an innovative ANR (Agency of National Research, France) project, called "PROMENADE" (**Platform for Resilient Multi-modal Mobility via Multi-layer Networks & Real-time Big-Data Processing**).

The PROMENADE project aims to improve transport resilience via real-time big data and complex network mining and monitoring, by leveraging large-scale and diverse datasets available on the city of Lyon, France. An open source scalable, customizable and extensible platform [3] is proposed to address the different challenges related to engineering the resilience of large-scale urban transport networks, by integrating complex networks modelling, machine learning tools and algorithms [4] and visualization tools to perform heterogeneous data collection (sensors, server APIs, mobile networks, social networks, etc.), real-time big data processing and monitoring [5].

In this context, we are looking for an enthusiastic postdoc with strong background in Distributed Systems, IoT/Edge computing, Graphs and Big Data Processing, with interest and skills in Machine Learning and Data Analysis tasks.

Main activities

The primary goals of the postdoc will be:
- to contribute to finalizing the design and significantly advancing the prototyping of the architecture of the PROMENADE platform, which relies on IoT lambda/kappa architectures for automated deployment, scaling, and management of smart mobility resilience-related micro-services, based on the preliminary work from the team [3, 5];
- to develop services for mobility data collection. In particular, the postdoc will be involved in the design of multi-layer dynamic graph databases solutions (Neo4J) for collecting (and possibly emulating) data related to the multi-modal network of Lyon, France;
- to devise Graph processing solutions aimed at identifying and characterizing resilience properties of such dynamic graph, based on the preliminary work from the team [4, 6];

The postdoc will also be involved in supporting the activities of three related PhD thesis, whose topics are related respectively to:
- developing a data-driven modelling framework for (real-time) reconstruction and analysis of mobility practices from multi-source data [7, 8, 9, 10];
- complex network engineering of large-scale approaches for real-time computation of resilience metrics [4, 6];
- simulation-driven stress testing and dynamic control strategies for resilient transport networks [1, 2].

These activities will generate the building blocks of the platforms and their integration will be one of the responsibilities of the postdoc, in cooperation with the PhD students.

The Postdoc will have the opportunity to work on multi-source large-scale, including GPS floating car data, smart car data, samples of 2G, 3G and 4G network probe data.

The platform will be implemented by using multiple technologies suited for big data processing, machine learning and IoT integration (Kubernetes-OpenShift, Apache Spark, Apache Flink, Neo4J, etc.).

A minor involvement in teaching activities (data mining courses at ENTPE) could be envisaged during the postdoc.

Required skills

The candidate shall hold a PhD on a topic related to big data, cloud/IoT computing, software engineering, machine learning or data science.

Specifically, the candidate must have:
- proven experience on Big Data technologies (Big Data processing and management) and distributed programming frameworks and products (Hadoop, Spark, Scala, HBase, OpenShift, Kubernetes);
- knowledge of Machine Learning Tools and Frameworks (e.g., supervised/unsupervised/deep ML);
- knowledge of complex networks theory and toolkits (graph theory, multilayer networks, centrality measures, etc.);
- scripting and coding skills (e.g., bash, java, scala, python);
- autonomous and team working capabilities;
- a record of publications on Q1 journals (at least one) and top-tier A/A+ conferences (at least two)

All applications not satisfying the aforementioned requirements will be ignored.

The postdoc will have the opportunity to work in a stimulating research environment including both academic and industrial collaborations, to participate to both computer science and transportation conferences, as well as spending short abroad research periods in the partner institutions.

Duration: **12** months (with possibility of an extension to **18 months**)
Net Salary: 2,000 – 2,300 € per month depending on the experience.
Start Date: flexible starting from Sept 2020.
Hosting team: LICIT laboratory (http://licit.ifsttar.fr)
Application instructions: to apply, please send a mail and CV to angelo.furno@univ-eiffel.fr

Benefits package

- Fully reimbursed abroad visiting periods in Europe;
- Subsidized catering service;
- Partially reimbursed public transport;
- Social security;
- Paid leave;

- Flexible working hours;
- Access to sports facilities.

Recruiters' Contacts

- Dr. Angelo FURNO / angelo.furno@univ-eiffel.fr
- Prof. Nour-Eddin EL FAOUZI / nour-eddin.elfaouzi@univ-eiffel.fr

Required documents

- A curriculum vitae;
- The complete record of master grades (relevé de notes M1 and M2 for French candidates)
- The Phd Thesis manuscript;
- A two-page research statement discussing how the candidate's background and research interests relate to the proposed subject and bibliographic references.

About the Transport and Traffic Engineering Lab, UGE - ENTPE

The Transport and Traffic Engineering Laboratory (LICIT) is a Joint Research Unit under the dual administrative supervision of the University Gustave Eiffel (UGE) and the National Post-Graduate School of Public Civil Engineering (ENTPE) of University of Lyon. The LICIT lab is internationally recognized for its work in traffic modelling and engineering. The laboratory has already developed many successful applications for both traffic information and simulation tools

Relevant References

[1] Gauthier P., Furno A., El Faouzi N.E. (2018, August). Road network resilience: how to identify critical links in presence of day-to-day disruptions? In Transportation Research Record (TRR).
[2] Henry E., Bonnetain L., Furno A., El Faouzi N.E., Zimeo E. (2019, June). Spatio-temporal Correlations of Betweenness Centrality and Traffic Metrics. In 6th International Conference on Models and Technologies for Intelligent Transportation Systems (MT-ITS).
[3] De Iasio, A., Furno, A., Goglia, L., & Zimeo, E. (2019, December). A Microservices Platform for Monitoring and Analysis of IoT Traffic Data in Smart Cities. In 2019 IEEE International Conference on Big Data (Big Data) (pp. 5223-5232). IEEE.
[4] Daniel, Cecile, Angelo Furno, and Eugenio Zimeo. "Cluster-based Computation of Exact Betweenness Centrality in Large Undirected Graphs." 2019 IEEE International Conference on Big Data (Big Data). IEEE, 2019.
[5] Castiello A., Fucci G., Furno A., Zimeo E. (2018, December). Scalability Analysis of Cluster-based Betweenness Computation in Large Weighted Graphs. In 2018 IEEE International Conference on Big Data (Big Data).
[6] Furno A., El Faouzi N.E., Sharma R., Zimeo E. (2018, December). Fast Approximated Betweenness Centrality of Directed and Weighted Graphs. In 2018 International Conference on Complex Networks and their Applications. Springer International Publishing.
[7] Bonnetain L., Furno A., Krug J., El Faouzi N.E. (2019, January). Can we map-match individual cellular network signaling trajectories in urban environments? A data-driven study. In 98th Transportation Research Board Annual Meeting (TRB),
[8] Furno, A., Fiore, M., Stanica, R., Ziemlicki, C., & Smoreda, Z. (2016). A tale of ten cities: Characterizing signatures of mobile traffic in urban areas. IEEE Transactions on Mobile Computing, 16(10), 2682-2696.
[9] Katsikouli P., Fiore M., Furno A., Stanica R. (2019, June). Characterizing and Removing Oscillations in Mobile Phone Location Data. In 2019 IEEE 20th International Symposium on "A World of Wireless, Mobile and Multimedia Networks" (WoWMoM).
[10] Fekih, M., Bellemans, T., Smoreda, Z. *et al.* A data-driven approach for origin–destination matrix construction from cellular network signalling data: a case study of Lyon region (France). *Transportation* (2020).