Postdoc position: Ride-sharing for transit

Keywords. Intelligent Transportation Systems, Routing Algorithms, Multimodal Transportation; Smart Cities; Digital Society

Institutions. The Postdoctoral Researcher will be hired for 12 months at Télécom SudParis and/or École des Mines de Saint-Étienne. Télécom SudParis is member of Institut Polytechnique de Paris. Both schools are members of Institut Mines-Télécom.

The Postdoctoral Researcher will work with Prof. Dominique Feillet, Assoc. Prof. Andrea Araldo, Assoc. Prof. Vincent Gauthier.

Context and motivation

The advent of Information Technology is disrupting the transportation ecosystem. One of the most visible revolutions is the success of ride sharing platforms, as Uber and Lyft, which provide on-demand service at low cost, thanks to (i) immediate communication between riders and drivers through easy-to-use smartphone apps and (ii) intelligent algorithms to optimize vehicle routing. On the other hand, the type of service offered by public transit has not evolved at the same pace over the last years. The contrast between "user-centric" on-demand services offered by private companies and "fixed-line-centric" public transit risks to penalize the latter, as users often prefer the former [Sad17]. However, on-demand services are not the answer to all mobility problems. Araldo, one of the holders of this project, has shown [Bus18] that they are not suitable to serve dense demand (in terms of trip requests per km^2 per second). On the other hand, fixed schedule transit is not efficient when demand is sparse [Qua09] as, in order to catch a sufficient number of passengers per vehicle, which justifies the cost of operating it, the frequency of the corresponding line and the density of stations must be low enough, which would result in poor quality of service for passengers. This problem is evident in suburbs and is one of the reasons for geographical inequity in modern society [Cag17]. Therefore, a combination of on-demand and fixed-schedule services is needed in order to guarantee high throughput for dense demand and, at the same time, the flexibility needed to guarantee quality of service in sparse-demand areas. For these reasons, in recent years public authorities have launched pilots to experiment with different ways to complement their offers with on-demand services, by subsidizing ride-sharing companies [Laz17] or proposing flexible route buses.

In current literature and in the practice the design of transit schedules and the design of routing algorithms for on-demand transportation have been treated as separate problems. The novelty of this project is to explore instead the inter-relation between the two design problems. In particular, we study how to adapt ride-sharing routes to the schedules of fixed transit in order to improve travelers' quality of service while limiting the operational cost for the operator.

Scientific goal and activity

The project aims to integrate on-demand services into public transit, by making vehicle routing algorithms aware of the transit schedules. By doing so, users can travel efficient

multi-modal routes that include both on-demand transportation and mass transit. The broader goal is to offer a transportation service able to adapt to travelers' demand and to combine the advantages of fixed-schedule transit and on-demand services, thus improving human mobility.

The postdoctoral researcher will devise simplified models of public transit, e.g., [Dag15] and [Wal15]. He/She will implement ride sharing employing state of the art algorithms [Alo17] to match travelers to vehicles and create vehicle routes. He/She will devise methods to create efficient multi-modal routes for users. He/She will devise methods to modify vehicle routes in order to improve the quality of multi-modal routes.

The research will be performed in collaboration with a company in the field of transportation, which will provide data and use cases.

Dates

The Postdoctorate covers a period of 12 months. The starting date is flexible, but not later than Spring 2020.

Candidate requirements

The candidate must hold a PhD in Computer Science, Transportation, Systems, Applied Mathematics or any other domain related to the position. Required skills are experience in optimization, algorithm design and testing, simulation. He/She must be proficient with at least one programming language (C++ is a plus, but other languages are fine).

To candidate, please be sure to include the following elements: (i) CV, (ii) complete list of publications (separating journals and conferences), (ii) 5 "best" publications that best fit this position, (iv) motivation letter, (v) research statement related to this position, (vi) references or recommendation letters, (vii) all the marks of higher education, (viii) the text of the deliberation of the PhD commission, (ix) the reviews of the PhD thesis from the PhD reviewers.

Contact

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References

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[Bas18] Basu, **Araldo** et Al. (2018) Implementation and Policy Applications of AMoD in multi-modal activity driven agent-based urban simulator SimMobility, in Trans. Res. Records

[Cag17] Caggiani et Al. (2017) Facing Equity in Transportation Network Design Problem: a Flexible constraints based model.

[Dag15] Chen, H., Gu, W., Cassidy, M., & Daganzo, C. (2015). Optimal Transit Service atop Ring-radial and Grid Street Networks: A Continuum Approximation Design Method and Comparisons. Transportation Research Part B: Methodological

[Qua09] Quadrifoglio et Al. (2009) A methodology to derive the critical demand density for designing and operating feeder transit services. Transportation Research Part B: Methodological

[Sad17] Sadowsky et Al. (2017) The Impact of Ride-Hailing Services on Public Transportation Use: A Discontinuity Regression Analysis. Economics Department, Bowdoin College

[Sha16] Shahriari, B., Swersky, K., Wang, Z., Adams, R. P., & De Freitas, N. (2016). Taking the Human Out of the Loop : A Review of Bayesian Optimization. Proceedings of the IEEE, 104(1), 1–24.

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