



## Offre de Stage Master 2 (Recherche) (ou 3A), susceptible de conduire à une thèse de doctorat

### Title: Algorithms for Searching Electric Vehicle Charging Stations

#### Context and Objectives:

Consider a set of electric vehicles (EV) in an urban area, where some of the EVs are going to run out of battery. It is quite normal that they are looking for a station to charge the vehicle's battery. However, charging an EV can be quite time consuming, and using fast charging spots comes with a high cost. Moreover, in the current state of the cities, the number of the available charging spots is quite limited. In this context, the problem of an EV driver can consist in looking for the closest charging spot with the minimal cost. This project aims at providing solutions for this problem. For this purpose, we want to design a research platform based on mathematical models that should be solved by optimization algorithms. More precisely, we formulate optimization problems and design solution methods that suggest the closest available charging spots as well as the corresponding cost to minimize simultaneously energy consumption and costs.

Once models are formulated, we focus on design of algorithms, which can be, e.g., heuristics and/or machine learning algorithms.

The algorithms will be tested on publicly available as well as randomly generated test instances.

Moreover, some new features will be introduced to the models and solutions methods to bridge the gaps in the scientific literature.

#### Research steps:

- State-of-the-art literature review.
- Understanding and identifying the optimization problems.
- Modeling the identified optimization problems.
- Design and implementation of efficient solution methods.
- Conducting extensive computational experiments.
- Preparing a final report and a presentation file (in preference in English).

#### Required skills:

- Student in the last year of a Master's program (or 3A of an engineering school) in computer science, applied mathematics, or similar domains.
- Holding effective teamwork skills.
- Excellent programming skills, in preference in Julia or Python.
- Familiarity with a MIP solver, e.g., Gurobi.
- Excellent communication and writing skills in English.

#### Complementary information:

- **Supervisor:** Mahdi MOEINI, Associate Professor in Computer Science (Operations Research) at the ENSIIE and the research lab. SAMOVAR (Télécom SudParis, Institut Polytechnique de Paris).

- **Location:** At the research lab. SAMOVAR of the Télécom SudParis (Institut Polytechnique de Paris), Evry (20km distance to Paris, reachable by RER D, etc.).
- **Dates:** The starting date of the internship is flexible, but it should not be later than March 1, 2023.
- **Salary:** Standard internship salary in France for a duration of 5-6 months.  
The project is supported by the EDF and the PGMO (Programme Gaspard Monge pour l'Optimisation).

### How to apply:

Please send the following documents as a **single pdf file**, as soon as possible (soft deadline: 30<sup>th</sup> of November 2023) to the indicated e-mail addresses:

- A detailed CV (maximum 2-4 pages).
- A couple of recommendation letters.
- Official list of your exam grades in your Master's courses.

### Contacts:

Mahdi MOEINI, Associate professor (<https://sites.google.com/view/mahdi-moeini>)

- [mahdi.moeini@ensiie.fr](mailto:mahdi.moeini@ensiie.fr)
- [moeini.mahdi@gmail.com](mailto:moeini.mahdi@gmail.com)

### Some references:

- [1] K. B. Lee, M. A. Ahmed, D. K. Kang, and Y. C. Kim. Deep Reinforcement Learning Based Optimal Route and Charging Station Selection. *Energies* 13(23), 2020.
- [2] W. Mo, C. Yang, X. Chen, K. Lin, and S. Duan. Optimal Charging Navigation Strategy Design for Rapid Charging Electric Vehicles. *Energies*, 12, 962, 2019.
- [3] F. Wu and R. Sioshansi, A two-stage stochastic optimization model for scheduling electric vehicle charging loads to relieve distribution-system constraints, *Transportation Research: Part B, Methodology*, vol. 102, pp. 55-82, 2017.
- [4] B. Yagcitekcin and M. Uzunoglu. A double-layer smart charging strategy of electric vehicles taking routing and charge scheduling into account. *Applied energy*, 167:407-419, 2016.