LABORATOIRE D'ELECTROTECHNIQUE ET D'ELECTRONIQUE DE PUISSANCE DE LILLE

L2EP Laboratoire d'électrotechnique et d'électronique de puissance de Lille

Master project, 2020-2021

— Smart grid Integration of Self Driving Vehicles in urban distribution networks —

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Context

With the increasing number of electric vehicles, the additional electric demand will cause technical problems on the existing distribution network, especially in terms of capacity and nominal currents. The general objective is to establish the concept and the framework allowing autonomous electric vehicles (AEV) or semi-autonomous ("Autopilot" option by telephone) to interact and communicate in symbiosis with an intelligent electrical network. *https://youtu.be/jIbgeToCPkM*

The project consists of designing a tool for indicating and guiding unoccupied autonomous vehicles to an available charging infrastructure which, moreover, will not cause a local constraint in the distribution network (exceeding the maximum capacity, under voltage, etc.). By helping in the decision of the place of recharging and / or the most appropriate times, the idea is to use the AEVs as flexible loads to better use the distribution network according to its existing dimensioning and also to neighboring customers (other loads, renewable production, etc.) and other stakeholders in the electricity system. AEVs can also contribute to grid balance and ancillary services (similar to V2G technology). The experimental simulation framework and concept will adopt established techniques from the field of artificial intelligence, in particular optimization by Computational Intelligence (CI) to find the appropriate routes and loading decisions, as well as forecast / estimates at the time. 'using support vector machines and reinforcement learning. Coordination mechanisms must also be devised for recharging electric vehicles using forecasts of renewable energy production and dynamic pricing of electric energy.

Work steps

- Bibliography study on "Technical constraints in an urban distribution network and their stochastic analysis"
- Scientific project on the simulation and energy management implementation of power ev charging stations with Matlab
- Internship on "stochastic optimization and coordination of load demand from ev charging stationsIssues for the student

Issues for the student

Skills for developing and mastering optimization solvers, skill for formulations an optimization problem.
Knowledge in operation of distribution electrical networks, decision-making and optimization algorithms, Internet of Things, collaborative and transactive intelligence.
Prospective PhD in collaborations with Centre for Advanced Low Carbon Propulsion Systems (Cambridge), INRIA, Polytechnic Porto

Objective

The tasks are as follows:
1. Develop an AEV decision support tool to find a charging station.
2. Take into account the constraints of the distribution network and the availability of renewable energy sources,
3. Define incentives (and potentially new services) for optimal use of charging infrastructure

Key Words

Stochastic optimization, Autonomous electrical vehicles, distribution networks, load demand management

References

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