Postdoctoral Proposal 2021

University - Location: Aix-Marseille Université – Marseille - France	
Laboratory: Laboratoire d'Informatique & Systèmes	Web site: https://www.lis-lab.fr/
Title: Optimal energy management in virtual power plant	
Key words: Virtual power plant, Multi-Agent System, Distributed coordinated control, Multi-objective optimization	
Starting date: December 2020 – January 2021	

Background and motivation

The rapid and large-scale deployment of various renewable energy systems impacts considerably the electric grid structure by moving from conventional generation to variable distributed energy production. This creates a new grid architecture characterized by a growing variability and uncertainties. Moreover, the growth in renewable's share of total energy is one of the major origins of the increasing fluctuations in the whole load system and highly affects the supply quality of the electricity network. Therefore, the key challenge lies in developing new concepts to ensure the effective integration of distributed energy resources (DERs) in existing and future market structures.

Virtual Power Plants (VPP) are considered as an efficient solution to provide operational flexibility to the grid [1]. Based on aggregation and optimal control of DERs, a VPP increases the profitability of its installations by guaranteeing various ancillary services for the power system on different levels. However, communication networks typically connect VPPs and the traditional centralised control is inadequate to address the network-induced challenges of VPPs. The overall vision of this proposal is to address the network aspects of VPPs through innovative hierarchical controller development. This has the potential to make VPPs robust and resilient, which will contribute towards renewables heavy power grid, leading to a greener future for all.

Description of the work

In this research work, a novel hierarchical control framework for distributed and networked control of VPPs, will be investigated. This will be achieved through the development of a distributed optimization strategy for networked VPPs based on multi-agent system paradigm. Where each agent uses the information available through the communication networks to compute a distributed control action and achieve some objectives defined according to its position in a local hierarchy [2]. The proposed approach will be applied to achieve the primary and secondary controller under arbitrary communication topologies and delays.

In the framework of the European "VPP4ISLANDS" project, the practical impact of the developed control strategy on the VPP performances will be evaluated on an island user case according to some

predefined scenarios. The consumption demand of this island is about 6 MWh and its installed energy production capacity is around 2 MWh. The production capacities are guaranteed by two 900 kW capacity wind turbines and 200 kW solar power.

We look for candidates with a strong background in control systems, optimization and communications technology and Hardware-in-the-loop simulation (Opal-RT, Typhoon, RTDS…).

Please send CV and motivation letter to:

Contact

Seifeddine BEN ELGHALI: seifeddine.benelghali@lis-lab.fr

References

[1] O. Palizban, K. Kauhaniemi, J. M. Guerrero, Microgrids in active network management—Part I: Hierarchical control, energy storage, virtual power plants, and market participation, in Renewable and Sustainable Energy Reviews, vol. 36, pp. 428-439, 2014.

[2] Han, Y., Zhang, K., Hong, L., Coelho, E. A. A., & Guerrero, J. M. (2018). MAS-based Distributed Coordinated Control and Optimization in Microgrid and Microgrid Clusters: A Comprehensive Overview. IEEE Transactions on Power Electronics, 33(8), 6488-6508.