Hierarchical Energy Management System for Optimising Self-consumption in Building MicroGrids

Daniela Yassuda Yamashita, Ionel Vechiu, Jean-Paul Gaubert

Journées SEEDS 11-14 Juin 2019 - Ile d'Oléron

GT Micro-Réseau

Hierarchical Energy Management System for Optimising Self-consumption in Building MicroGrids

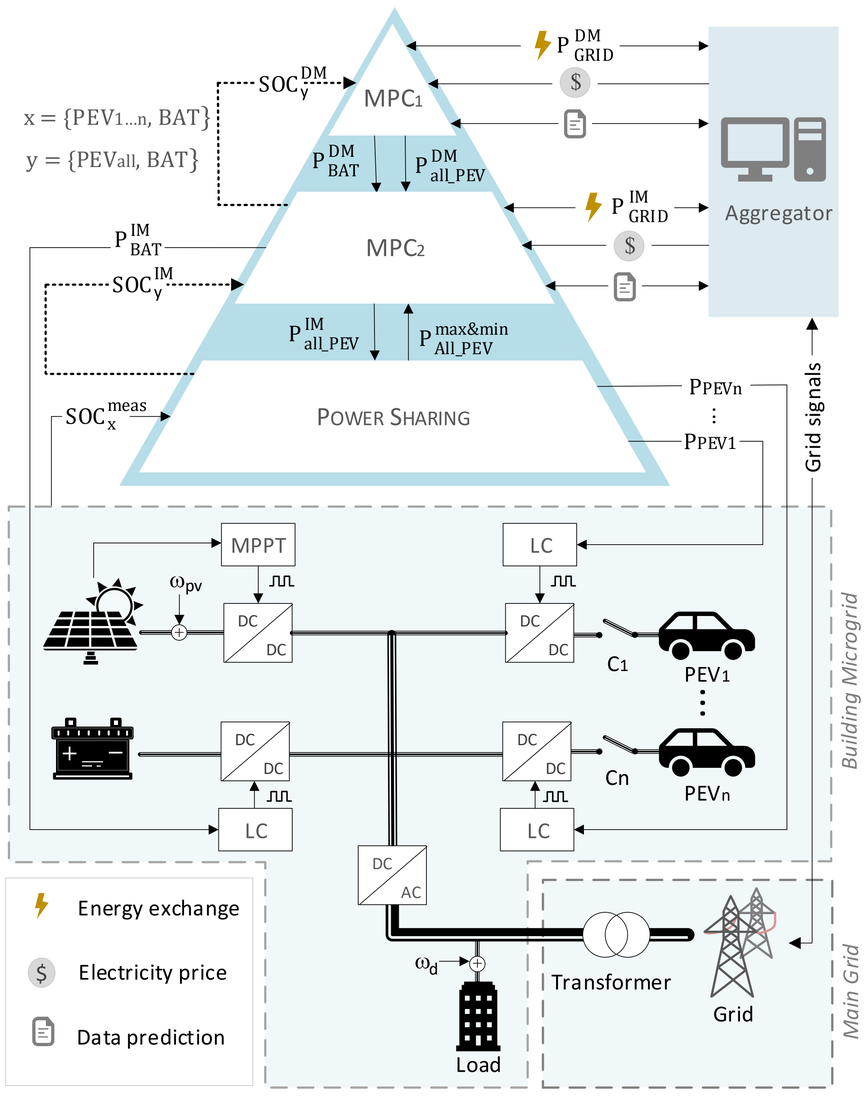
D. Y. Yamashita[1,2], I. Vechiu[1], J. P. Gaubert[2]

(1) ESTIA Institute of Technology

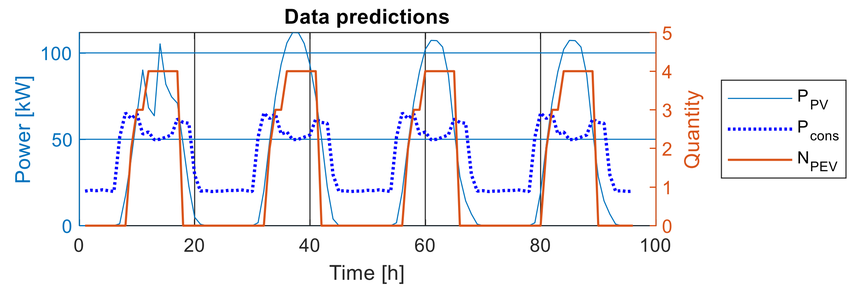
(2) Université de Poitiers, Laboratoire d'Informatique et d'Automatique pour les Systèmes (LIAS) – ENSIP

Building MicroGrid Overview

Renewable energy sources are increasingly deployed as distributed generators, restructuring the traditional electrical grid toward smart grids. Their intermittent power generation makes difficult the development of a complete carbon-free MicroGrid. The Hierarchical Control structure has demonstrated very suitable to manage multivariable systems with different time frames like those of Building MicroGrids (BMG).

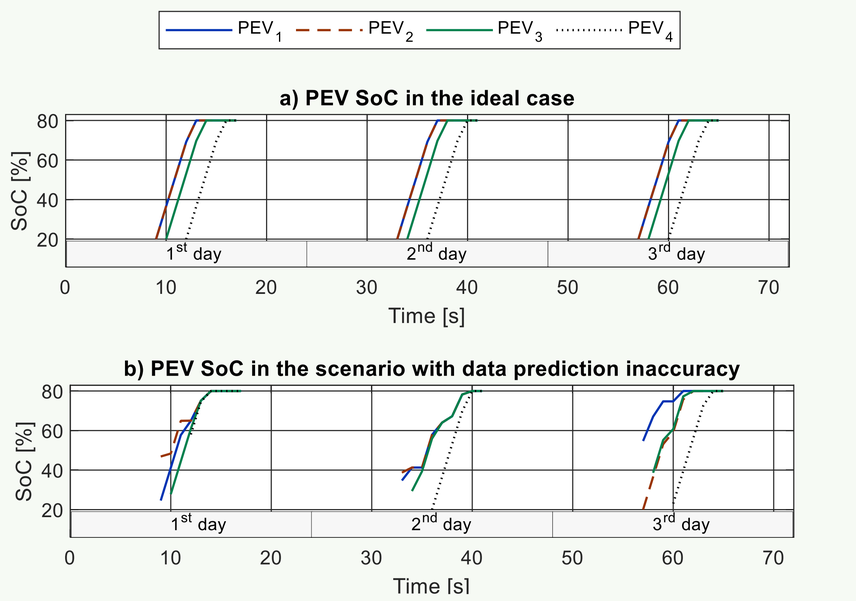


Three-level hierarchical control structure for a grid-connected building microgrid.



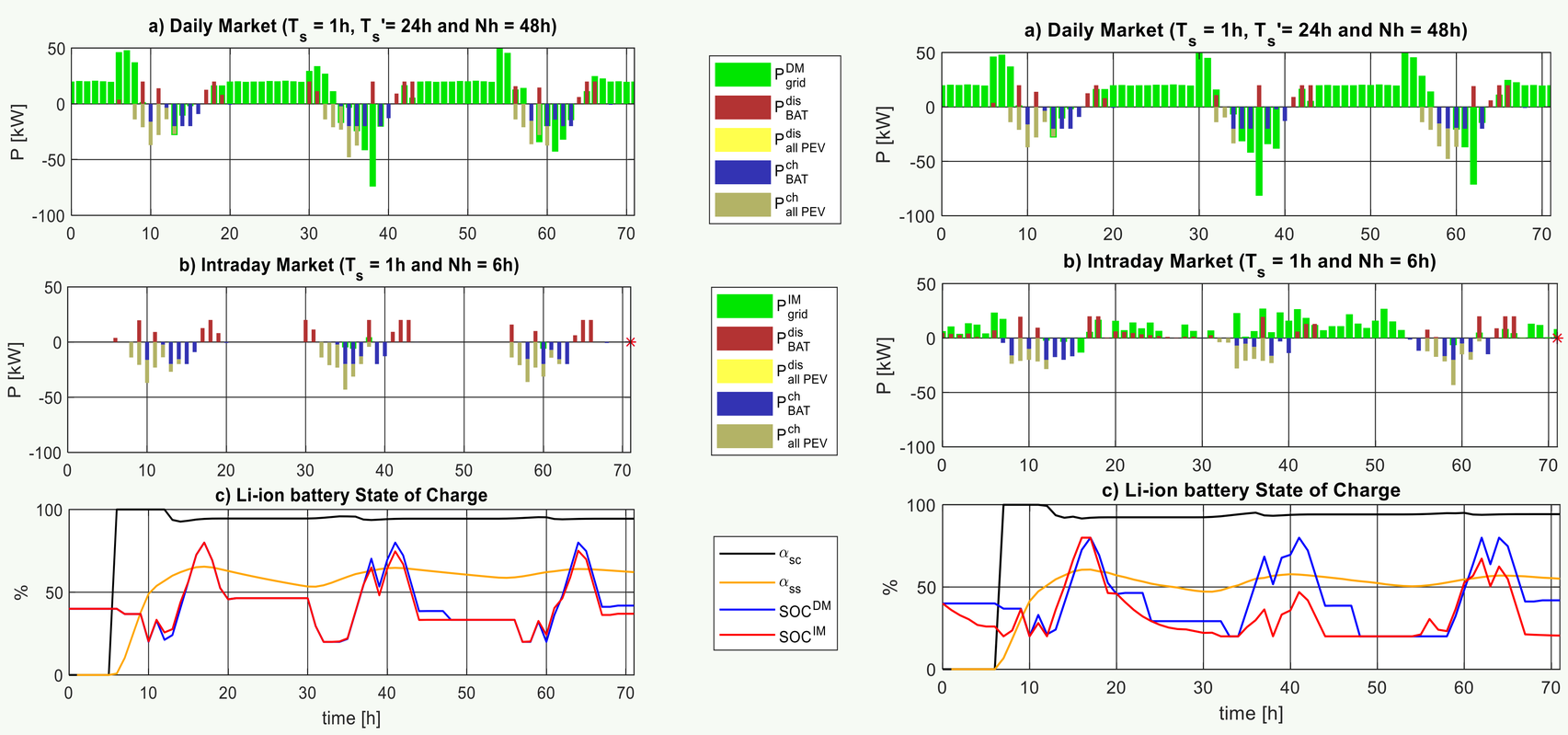
Data prediction of PV power generation (P_{PV}), building power consumption (P_{cons}) and number of PEVs plugged to the BMG (N_{PEV})

Power sharing



State of charge of each Plug-in Electric Vehicle (PEV). (a) Ideal case without any disturbance.(b) Case with error in data prediction.

Hierarchical MPC



Hierarchical Control MPC. (a) MPC_1 variables in Daily Market time frame. (b) MPC_2 variables in Intraday Market time frame. (c) Li-ion batteries SoC, self-consumption and self-sufficiency index in the three days.

Control Strategy

Aiming to keep adequate ranges of **self-consumption** and **self-coverage** indexes under PV power generation and building power consumption uncertainties, the EMS was divided into three modules:

- Upper Model Predictive Control (MPC_1)
- Lower Model Predictive Control (MPC_2)
- Power Sharing Module with state machine