Master project, 2018-2019

— Optimal Sizing and energy management of a solar house with uncertainty —

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Context

The system studied is a solar house in Australia including photovoltaic panels and energy storage. The power flows are expressed in Figure 1. Solar irradiance and power demand data is available for a large time horizon.

In order to find the best sizing for the photovoltaic panels and the energy storage, the energy management has to be considered. This leads to a challenging optimization due to the high number of variables that is one for each time step within time horizon. Unfortunately, the performance found by this optimization cannot be met in practice because the future is not known and only forecast is available.

Objective

The idea is to consider the forecast as an uncertain variable with mean value and standard deviation. They can determined by using the weather of the last hours and the large amount of data.

Then, several probabilistic optimization approaches can be performed to minimize the expectation of life-cycle cost of the house under constraint to provide the power demand and to stay within storage limits with a given probability. The probabilistic approaches have to be compared among then and with the deterministic approach.

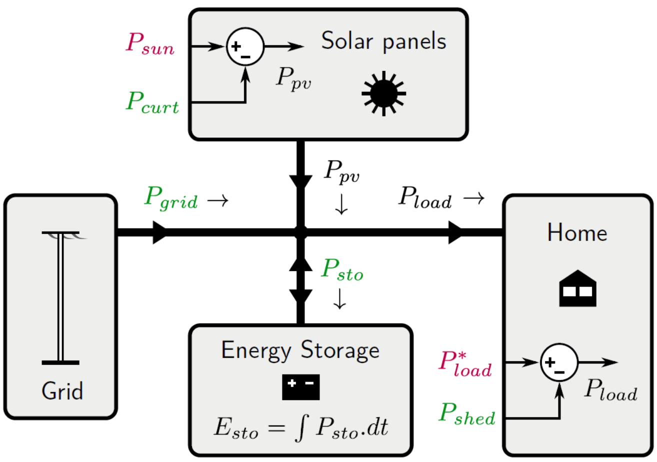

Figure 1 – Power flows in the solar house

Work steps

1. Deterministic optimization over one day / week / month / year
2. Assess the variability due to the day / week / month / year considered
3. Model the power demand and solar irradiance as random variables, and build forecast models
4. Use the forecast in probabilistic optimization approaches