

Exercise: Fuzzy logic applied to energy management

Let's consider a Hybrid Energy System (HES) composed of two different sources and storage systems: a wind generator (WTG), short and long term storage systems and a foreseeable generator (FDG) like micro gas turbine or diesel generator (figure 1). This HES is connected to a power grid.

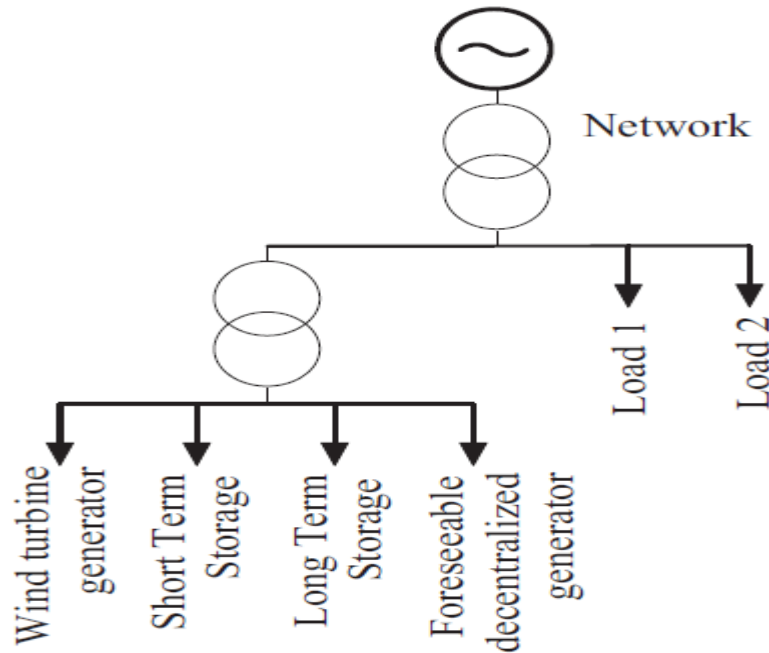


Figure 1: HES with two sources and two storage systems.

The HES is managed with a fuzzy logic supervisor as shown in the following block diagram:

(G_1 , G_2 , and G_5 are normalization gains; β_{ref} is wind generator pitch angle reference).

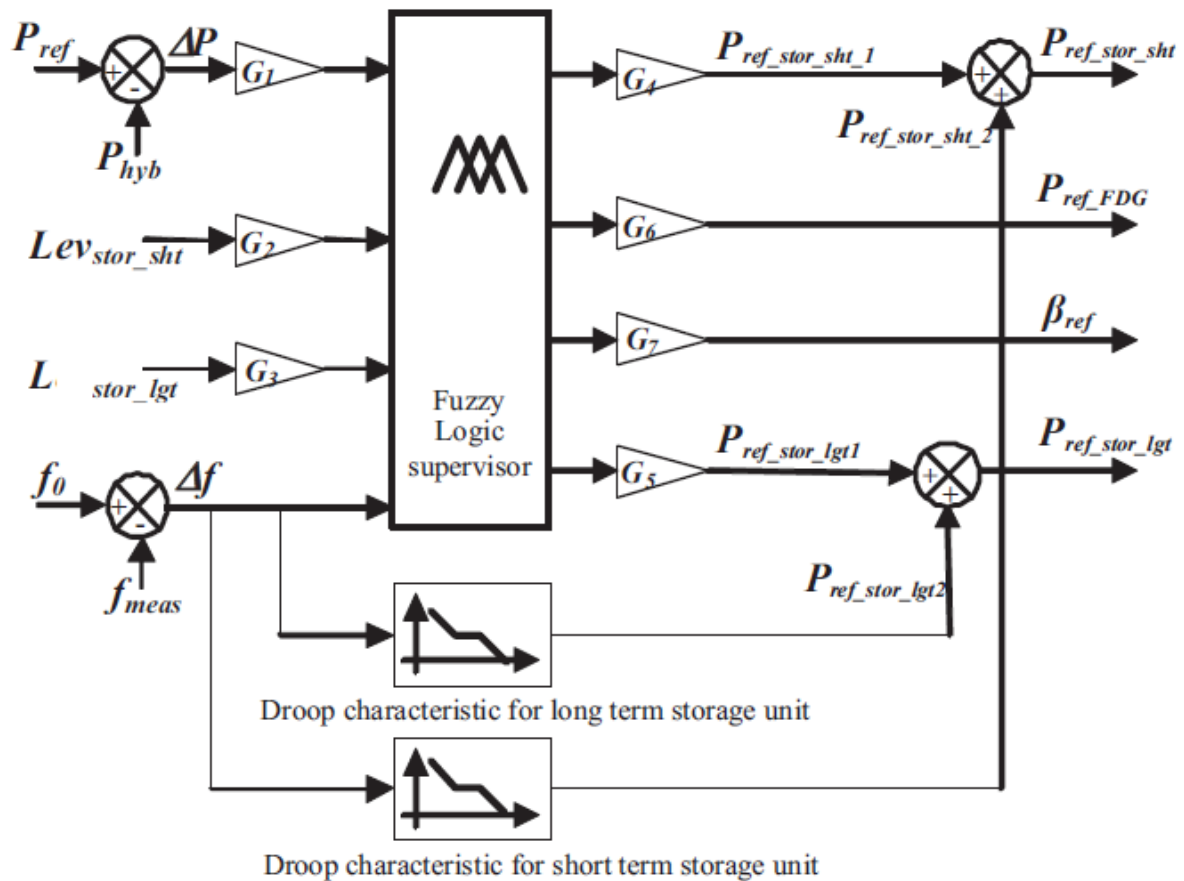


Figure 2: Block diagram of the supervisor.

- 1) In your mind, what are the objectives of the supervisor?
- 2) What are the main constraints?
- 3) What are the means of action?
- 4) What are fuzzy supervisor inputs and outputs?

Correction

1) The objectives are:

- To achieve a reference power determined by the network manager;
- To provide a regular primary power reserve and to participate in primary frequency control;
- To maximize wind power and to minimize the use of fossil fuel;

2) The main constraints are:

- The wind power fluctuation,
- The size of the storage units.

3) The control means are:

- The reference power of the storage systems,
- The reference power of the foreseeable unit,
- The reference of the wind generator pitch angle to reduce the generated wind power if necessary.

4) Inputs :

- Short term storage level
- Long term storage level
- Frequency error Δf
- Power error Δp

Outputs:

- Short term storage power reference
- Long term storage power reference
- FDG power reference
- β_{ref} wind generator pitch angle reference