This file provides a guide of initialization for dynamic simulations.

The initialization procedure consists of two main stages. First, we run the load flow and compute a valid steady-state solution. Then, we use the previous result as initial state for the dynamic simulation.

In the following, some implementation details are provided:

1. Run load flow

For this analysis, we employ the Simulink toolbox "Powergui", specifically designed to run the load flow and automatically apply the steady-state solution as initial state for the dynamic simulation.

In this regard, it should be noted that, before running the load flow, the user has to specify:

a. bus type and load flow power for synchronous machines

- We set one of the synchronous machine buses as swing bus (generator 2, G2) and the other 9 synchronous machine buses as PV-type buses.
- We set the desired load flow power for the P-V type synchronous machines

b. load flow power for asynchronous machines

In the model we include type-3 DFIG wind power plants, where the asynchronous machine is characterized by a wound rotor (not compatible with load flow functionality in Simulink). In order to overcome this modeling issue:

- When we run the load flow, we change the rotor type from wound to squirrel-cage. In this way, we are able to set the load flow power also for the asynchronous machine. In this regard, it should be noted that the load power has to be negative, since it accounts for active power generation.
- In addition, we increase the reactive power produced by the capacitor connected with the asynchronous machine. In this way, we are able to make the total output of reactive power close to zero, and to suitably approximate the characteristics of a type-3 DFIG wind power plant. In this case, the bus type can be considered as similar to a traditional PQ bus.

Note: after running the load flow and applying the steady-state as the initialization state, the rotor type of asynchronous machines should be changed back as wound. As well as for the reactive power generated by the capacitor, it should be changed back to the original value.

c. Specify the initialization load flow power for dynamic loads

In the model, the load buses are P-Q type buses. It is thus possible to set their initial active and reactive power.

2. Apply the Load Flow result (i.e., steady-state solution) as initialization state.

After obtaining the load flow steady-state, we directly apply the steady-state to the model through the "Powergui Load Flow Tool". In this regard, it is worth noticing that, in the "Powergui Initial State Tool", the "force initial electrical state to steady state" has to be selected. Afterwards, it is possible to run the simulation - within 10 to 20 s, the computed load-flow steady-state condition is achieved.