Case Study 1: Reduced-order Linear Modelling of a SCIG-based WECS

This case study contains 4 different applications, described below.

1. Uses the m-file named `matrixlin5ord.m`

   Scope: to obtain the poles of the 5th-order model of a SCIG-based WECS around a specified operating point, `ist`.
   The steady-state vector, `ist`, is the input of the procedure, contains the electric generator *d*-*q* modelling currents and the rotational speed. It should be changed in the script-file as the operating point changes.

   Step 1: Change the assignment of vector `ist` according to your operating point.
   Step 2: Run `matrixlin5ord.m` in order to obtain the system poles.

2. Uses the mdl-files named `ord3mw2lin.mdl` and `ord5mw2lin.mdl`

   Scope: to simulate the WECS dynamic behaviour and to establish a steady-state operating point. This latter depends on the wind velocity and on the generator stator voltages. The linearization is to be done around such an operating point.
   A comparison between the dynamic behaviours of the two models can also be obtained.
   The application file `ord3mw2lin.mdl` works with the WECS parameters from the file `datawecs2Mw_3ord.m`.
   The application file `ord5mw2lin.mdl` works with the WECS parameters from the file `datawecs2Mw_5ord.m`.
   These files can be run by double-clicking on the corresponding block at the right of the application window.

   Step 1: Load parameters from the associated m-file.
   Step 2: Start the simulation of the mdl-file. For fixed stator voltages and wind velocity wait for the state values to reach steady regime. Then note their values and further use them as steady-state operating point.
   Step 3: Apply a step change in one of the stator voltage (for example, of 100 V amplitude) in both of the mdl-files, at the same time value. Then use the `Scopes` (or `To workspace` blocks) to save the currents and rotational speed evolutions. Then, superpose the evolutions (of the same variable) and thus obtain a comparison between the 3rd- and the 5th-order models.

3. Uses the mdl-file named `ord5mw2lin.mdl`

   Scope: to obtain the 5th-order pole configuration of the WECS.

   Step 1: The file `datawecs2Mw_5ord.m` must be run first.
   Step 2: The following MATLAB® commands should then be entered:

```
ist=[-1442 925.4 31.69 -948.7 157.2]
[A,B,C,D]=linmod('ord5mw2lin'), ee=eig(A),
figure; plot(real(ee),imag(ee),'xk');
```

In the first line a steady-state operating point is set (other suitable values can be obtained for different values of wind velocity and stator voltages). The second line contains the linearization command (*i.e.*, `linmod`) and pole constellation generation and plotting commands.

4. Uses the mdl-file named `ord3mw2lin.mdl`

Scope: to obtain the 3rd-order pole configuration of the WECS.

Step 1: Run the file `datawecs2Mw_3ord.m`.

Step 2: The following MATLAB commands should be entered:

```
ist=[4.215 0.239 157.2]
[A,B,C,D]=linmod('ord3mw2lin'), ee=eig(A),
figure; plot(real(ee),imag(ee),'xk');
```

In the first line a steady-state operating point is set (other suitable values can be obtained for different values of wind velocity and stator voltages). Please note that the rotor fluxes (in the *d*-*q* frame) and the rotational speed are system states in this case. The second line contains the `linmod` command and pole constellation generation and plotting commands.