Title: Test set-up to validate constant PSAT PQ load under OpenIPSL

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Abstract:

The simulation represents the test set-up to validate the constant PQ load of PSAT under OpenIPSL library. The test system is composed of three buses under. The generator connected to Bus1 is the third order PSAT synchronous machine. The generator is subjected to the following Perturbation.

1. Vf pulse of 0.0005 at t = [2-2.1] seconds.
2. Vf oscillation 0.001sin(0.2) at t =[0-5] seconds.
3. Pm pulse of 0.005 at t = [7-7.1] seconds.
4. Pm oscillation 0.001sin(0.2) at t = [5-10] seconds.

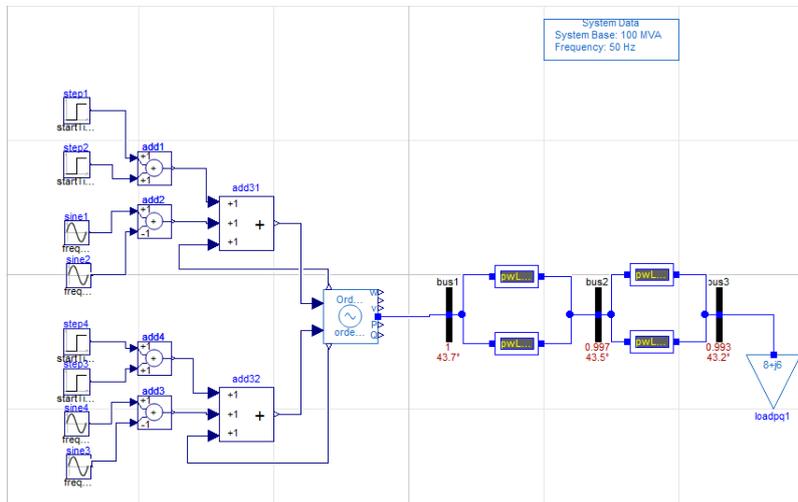Modelica implementation of the test set-up is shown in Figure 1. The simulation results are shown in Figure 2.

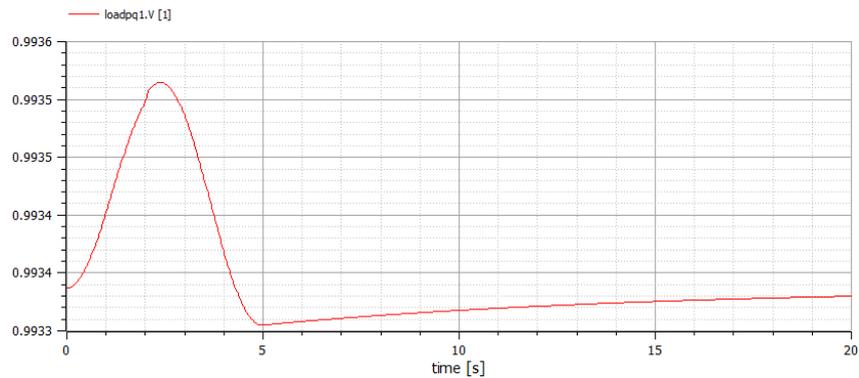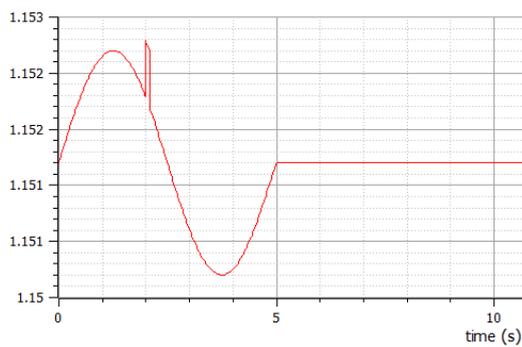**Figure 1: Modelica Implementation of the PQ load test set-up**

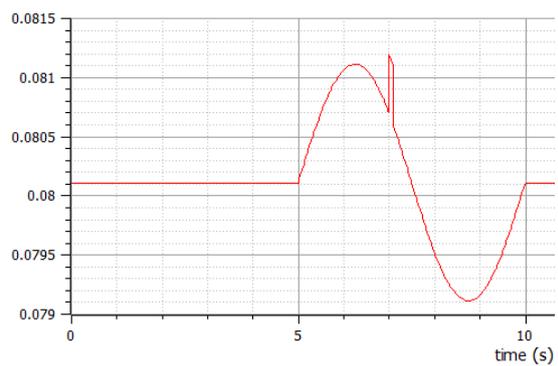
Figure 2: Plot of the PQ load voltage

Explanation:

This test setup uses following components

Component Name	Path	Number
Addition block(Two inputs)	Modelica.Blocks.Math.Add	4
Addition block(Two inputs)	Modelica.Blocks.Math.Add3	2
Sine input	Modelica.Blocks.Sources.Sine	4
Step input	Modelica.Blocks.Sources.Step	4
Generator (Order III)	OpenIPSL.Electrical.Machines.PSAT.Order3	1
Bus	OpenIPSL.Electrical.Buses.Bus	3
Load PQ	OpenIPSL.Electrical.Loads.PSAT.LOADPQ	1
PwLine	OpenIPSL.Electrical.Branches.PwLine	4
Sysdata block	OpenIPSL.Electrical.SystemBase	1

The generator is connected with bus 1 and the load at bus 3. The buses 1 & 3 are connected to bus 2 with the help of power lines as shown. The Sine and Step inputs together with the addition blocks are used to generate perturbation which is injected into the generator. The perturbation is added up with both initial field voltage (Vf0) and initial mechanical power (Pm0) signal of the generator. The resultant signal is feed back to the generators The perturbations injected are shown below in Fig3 and Fig4.

Fig3. Field voltage (Vf)

Fig4. Mechanical power (Pm)

Here, the constant PQ load voltage output increases due to the perturbation in field voltage (Vf) of the generator. The same setup is simulated using PSAT and the graphs of load voltages are compared in order to validate the constant PQ Load in OpenModelica.

Conclusion:

The above model is built to validate the constant PQ load. The perturbation is introduced both for the Vf (Field Voltage) and Pm(Mechanical power). From the plot obtained we can observe there is an increase in PQ load voltage for the duration 0-5 seconds when there is a perturbation injected into the generator Vf signal. The load voltage plot is compared with that of the plot obtained from psat to validate the PQ load.