Title: Modelling of a six bus power system under variable load using OpenIPSL

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Abstract:

The model is a six bus power system with 3 constant Photo Voltaic (PV) generators at bus 2, bus 3 and bus 6. Bus 1 is considered as a slack bus. PQ load is connected at bus 2, bus 4 and bus 5.

The system is subjected to the following condition: Disturbance of 15MW and 10MVar in load at bus 5 starting from 4 sec for duration of 1 sec is introduced.

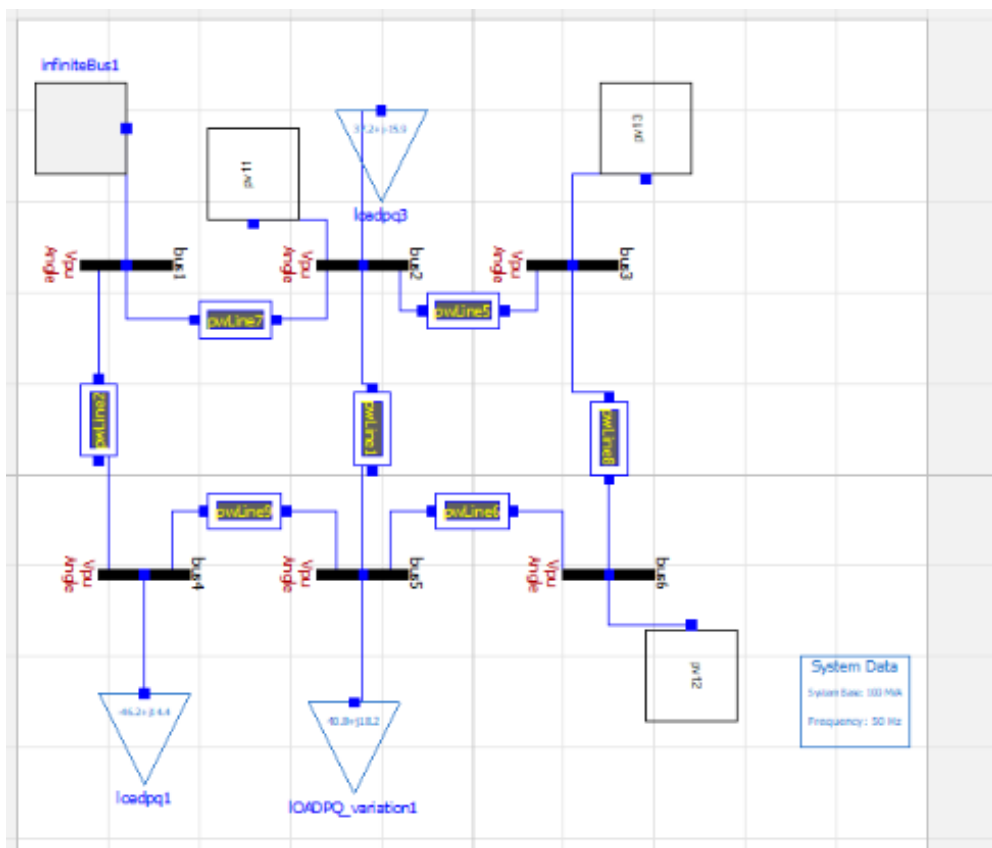The output under the above condition is observed and explained

Fig 1. Modelling of a 6 bus power system for a variable load

Explanation:

The model uses the following components

| Component name	Path	Quantity
Constant PV Generator	OpenIPSL.Electrical.Solar.PSAT.ConstantPQPV.PV1	3
Bus	OpenIPSL.Electrical.Buses.Bus	6
Transmission Line	OpenIPSL.Electrical.Branches.PwLine	7
Load	OpenIPSL.Electrical.Loads.PSAT.LOADPQ	2
Load variation	OpenIPSL.Electrical.Loads.PSAT.LOADPQ_variation	1
System block	OpenIPSL.Electrical.SystemBase	1
Infinite bus	OpenIPSL.Electrical.Buses.InfiniteBus	1

Results
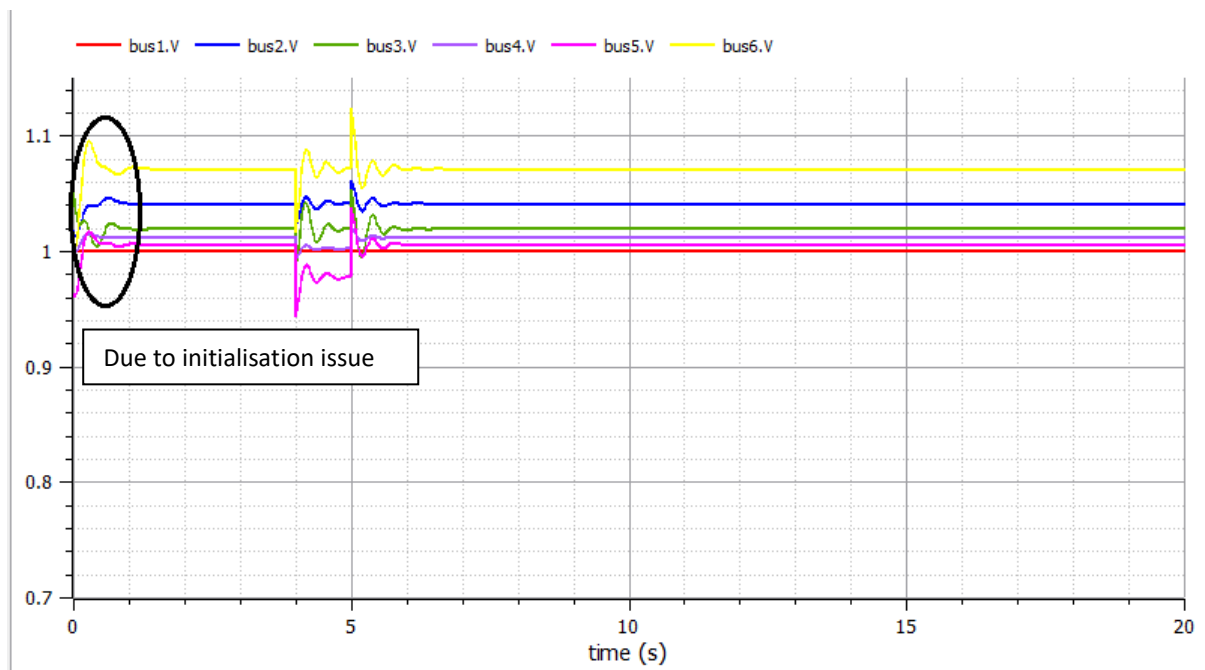
Fig 2. Voltage profile of the buses during the load disturbance

In this model, a PQ Load variation is simulated at bus 5 for duration of 1 secs starting from 4 sec. The voltage profiles are plotted (refer to figure 2). The severity of disturbance is observed maximum at the bus five and zero at the slack bus (due to the initialisation issue as circled in the Fig 2) and minimum at the bus 4. We can observe that the voltage is stabilised after the disturbance is settled down. .We can also observe that even after the fault is cleared the system consists of persistent oscillations in its voltage profile. Voltage stability is concerned with the ability of a power system to maintain acceptable voltages at all buses of the system under normal conditions and after the occurrence of a disturbance. A system enters a state of voltage instability when a disturbance, increase in load demand or change in system conditions

Conclusion:

The implemented 6 bus model in Modelica represents the system behaviour before and after the load disturbance is created. The voltage profile at the bus indicates that the system can be brought back to stable operating condition even faster by adding additional controls such as Power System Stabilizers (PSS) and FACTS devices.