

Title: Modelling of IEEE modified 30 bus system using Modelica and OpenIPSL

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Abstract:

Modelica implementation of the IEEE modified 30 bus system using the OpenIPSL library is shown in Figure 1. The power system model consists of 4 generators, 2 Synchronous Condensers, 4 transformers, 20 loads, 37 transmission lines. A three winding transformers are replaced by their equivalent connections by a two winding transformers. A single line diagram (SLD) is shown in figure 2. A three-phase balanced fault is simulated at 18th Bus for the duration of 0.4 seconds (4.6 seconds to 5 seconds). The purpose of this power system simulation is to study the voltage stability at multiple buses.

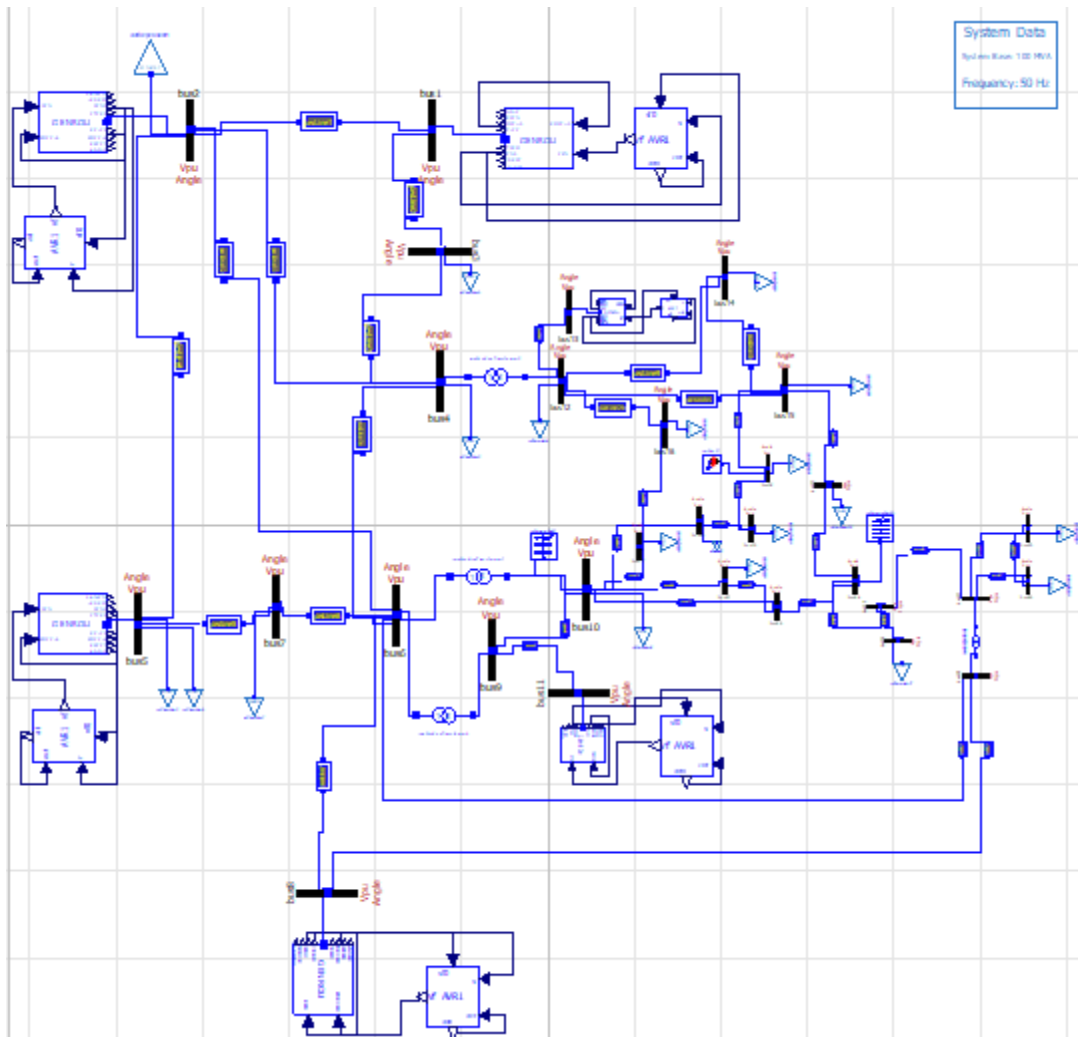


Figure 1: IEEE modified 30 bus system using Modelica and OpenIPSL

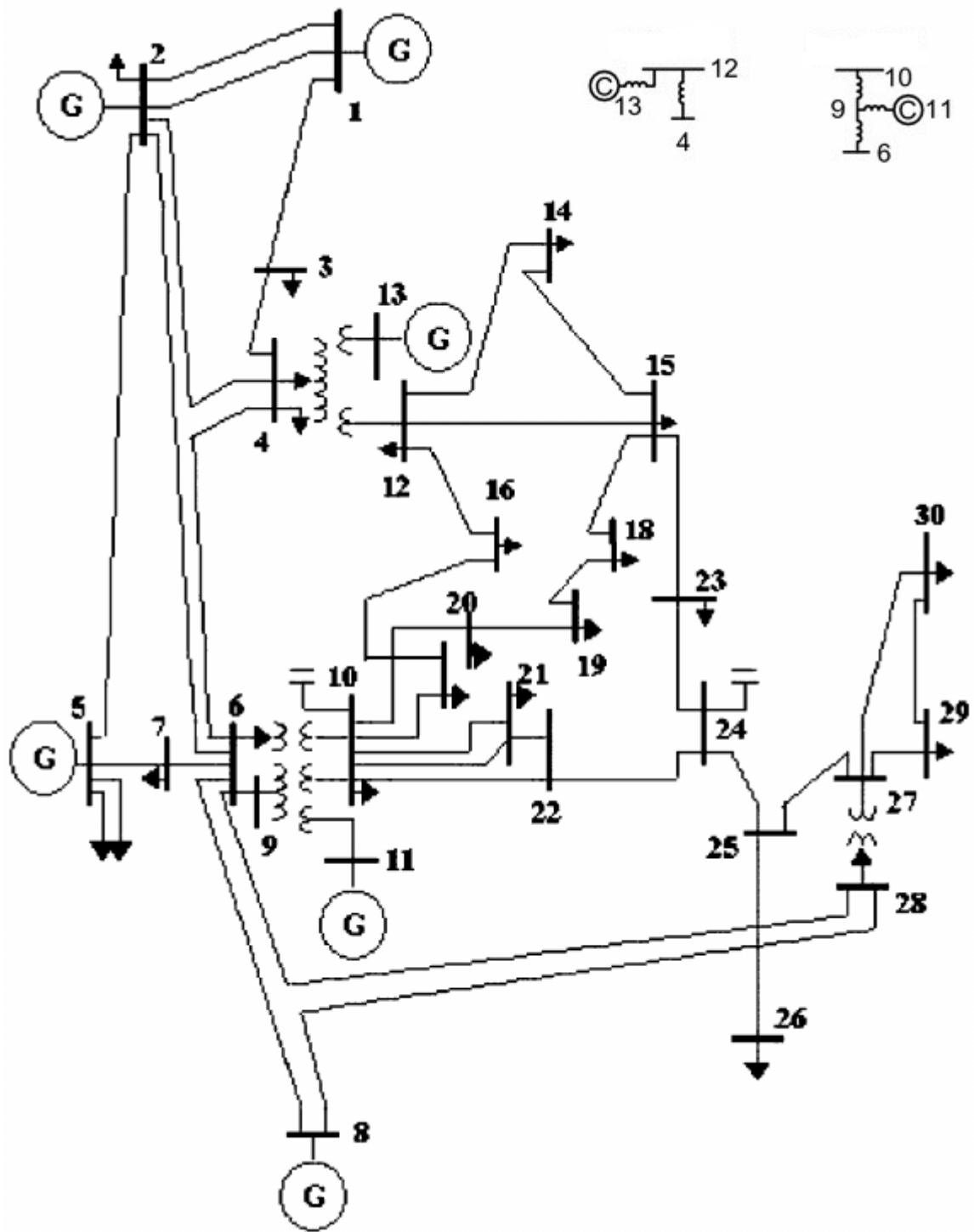


Figure 2: Single line diagram (SLD) of IEEE modified 30 bus system

Explanation:

This model uses the following components:

Component Name	Class Path	Number
Two Winding Transformer	OpenIPSL.Electrical.Branches.PSAT.TwoWindingTransformer	4
Three phase fault	OpenIPSL.Electrical.Events.PwFault	1
Voltage Dependent Load	OpenIPSL.Electrical.Loads.PSAT.VoltDependant	20
Generators (including synchronous condensers)	OpenIPSL.Electrical.Machines.PSSE.GENROU	6
Automatic Voltage Regulators (AVR)	OpenIPSL.Electrical.Controls.PSAT.AVR.AVRType1	6
Buses	OpenIPSL.Electrical.Buses.Bus	30
PwLine	OpenIPSL.Electrical.Branches.PwLine	37
Sysdata block	OpenIPSL.Electrical.SystemBase	1

Table 1: Components used in system

The IEEE modified 30 bus model implemented in Modelica language using OpenIPSL package, is used to study the voltage stability at different buses. The system base is 100 MVA base. For all analysis on this system, the lower voltage magnitude limits at all buses are 0.9 p.u and upper limits are 1.1 p.u. A three winding transformers are replaced by their equivalent connections by a single two winding transformer. The generator models in the implemented network use Automatic Voltage Regulators (AVR) type 1. The purpose of using the AVR is to control the generator field voltage to stabilize this oscillation of the bus voltage after the fault clearing time. Type of generator used is round rotor machine (GENROU). A fault is simulated for the duration of 4.6 to 5 seconds at the 18th bus. During the fault, we can observe from the bus voltage profiles, that the voltage dip is more for 18th bus as it is the fault bus and the severity of the fault is decreased as we move away from the fault bus. Simulation obtained shows profiles at various buses and wave forms obtained are observed

The simulation result of the all 30 Bus voltages shown below.

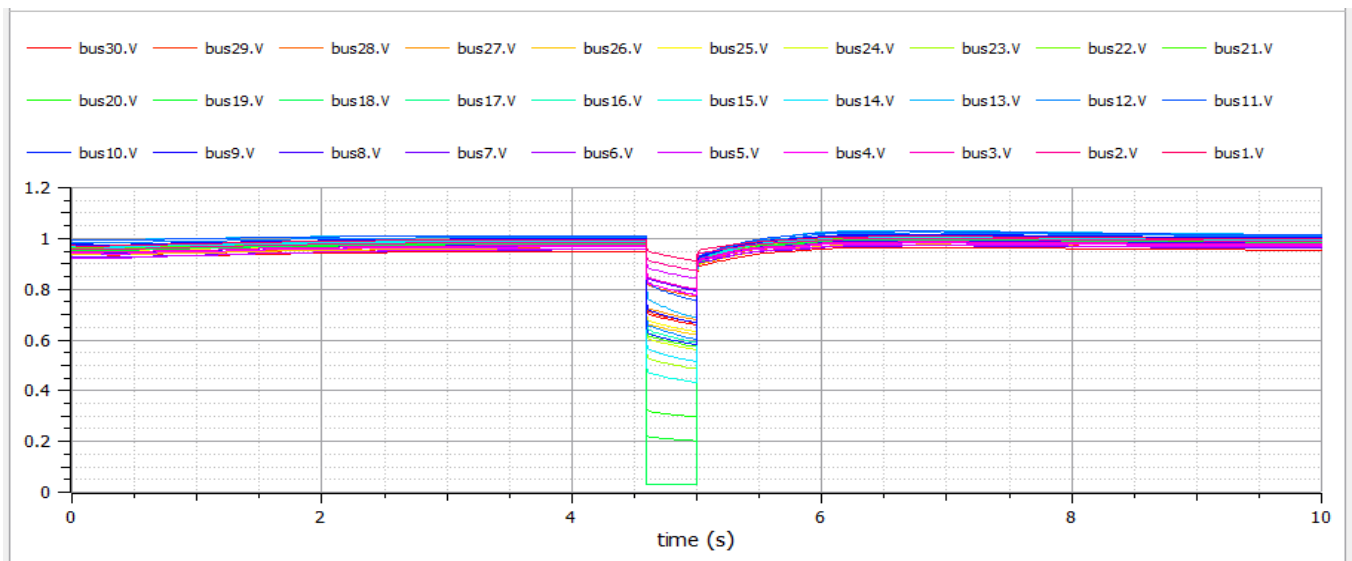


Figure 3: Voltage profiles of 30 buses

Bus no.	Bus Voltage magnitude (p.u.)	Bus no.	Bus Voltage magnitude (p.u.)
1	0.998269	16.	0.997579
2	0.989513	17.	0.993916
3	0.976927	18.	0.982853
4	0.971627	19.	0.980417
5	0.965849	20.	0.984568
6	0.973281	21.	0.990190
7	0.962490	22.	0.991590
8	0.979940	23.	0.988315
9	1.002450	24.	0.991481
10	1.000190	25.	0.981621
11	1.013270	26.	0.964576
12	1.008540	27.	0.983845
13	1.015280	28.	0.971979
14	0.994907	29.	0.964934
15	0.992308	30.	0.954136

Table 2: Bus voltage magnitude (p.u.) of all 30 buses obtained.

Conclusion:

The implemented IEEE modified 30 bus model in Modelica represents the system behaviour before and after the fault occurs at the 18th bus. Bus voltage magnitude (p.u.) of all modified 30 buses obtained are found to be between 0.9 p.u and 1.1 p.u. The relation between line impedance and fault severity is also observed.