Title: IEEE 10-Generator 39-Bus System

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Abstract:

This report summarizes a study of an IEEE 10-generator, 39-bus system. Two types of analysis were performed: load flow, small disturbance analysis by using the OpenIPSL library. Modelica implementation of the IEEE 10 Generator 39 bus system using the OpenIPSL library is shown in Figure 1. The power system model consists of 10 generators,12 transformers, 19 loads, 39 transmission lines. A three winding transformers are replaced by their equivalent connections by two winding transformers. A single line diagram (SLD) is shown in figure 2. A three-phase balanced fault is simulated at Bus 3 for the duration of 0.4 seconds (5 seconds to 5.4 seconds). The purpose of this power system simulation is to study the voltage stability at multiple buses.

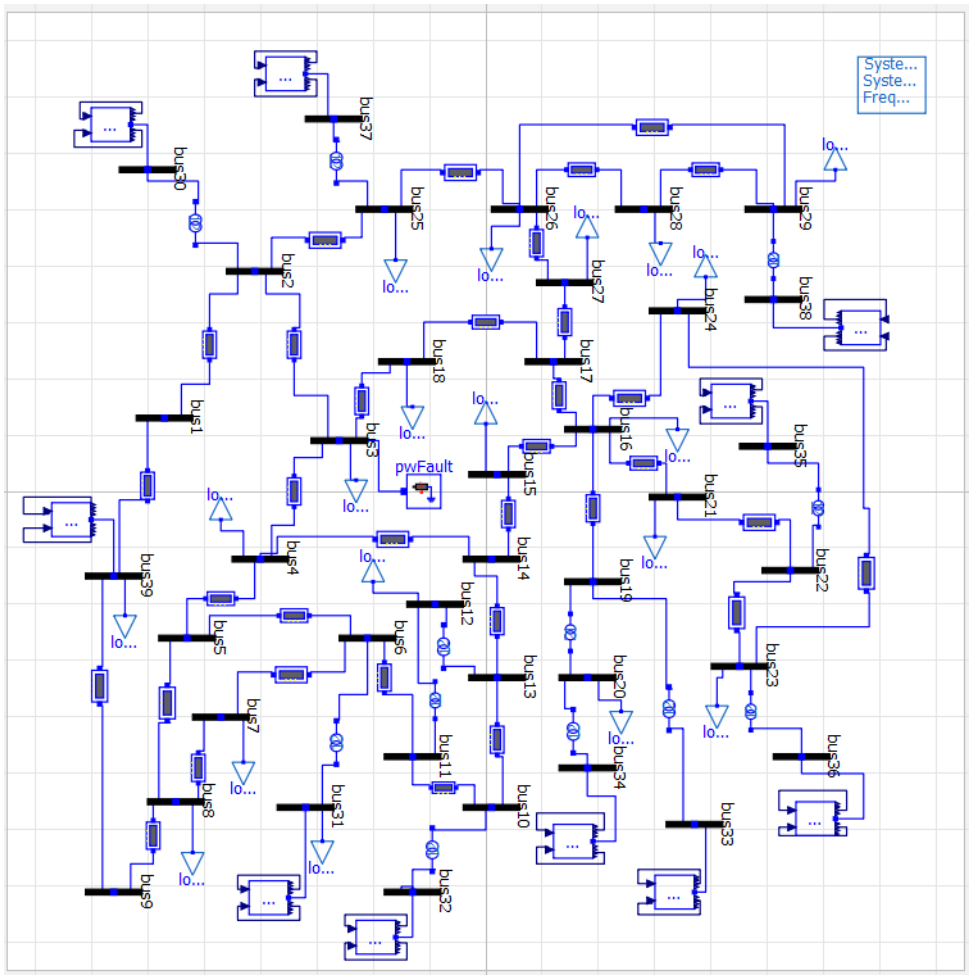

Figure 1. Implementation of IEEE 10-generator, 39-bus system

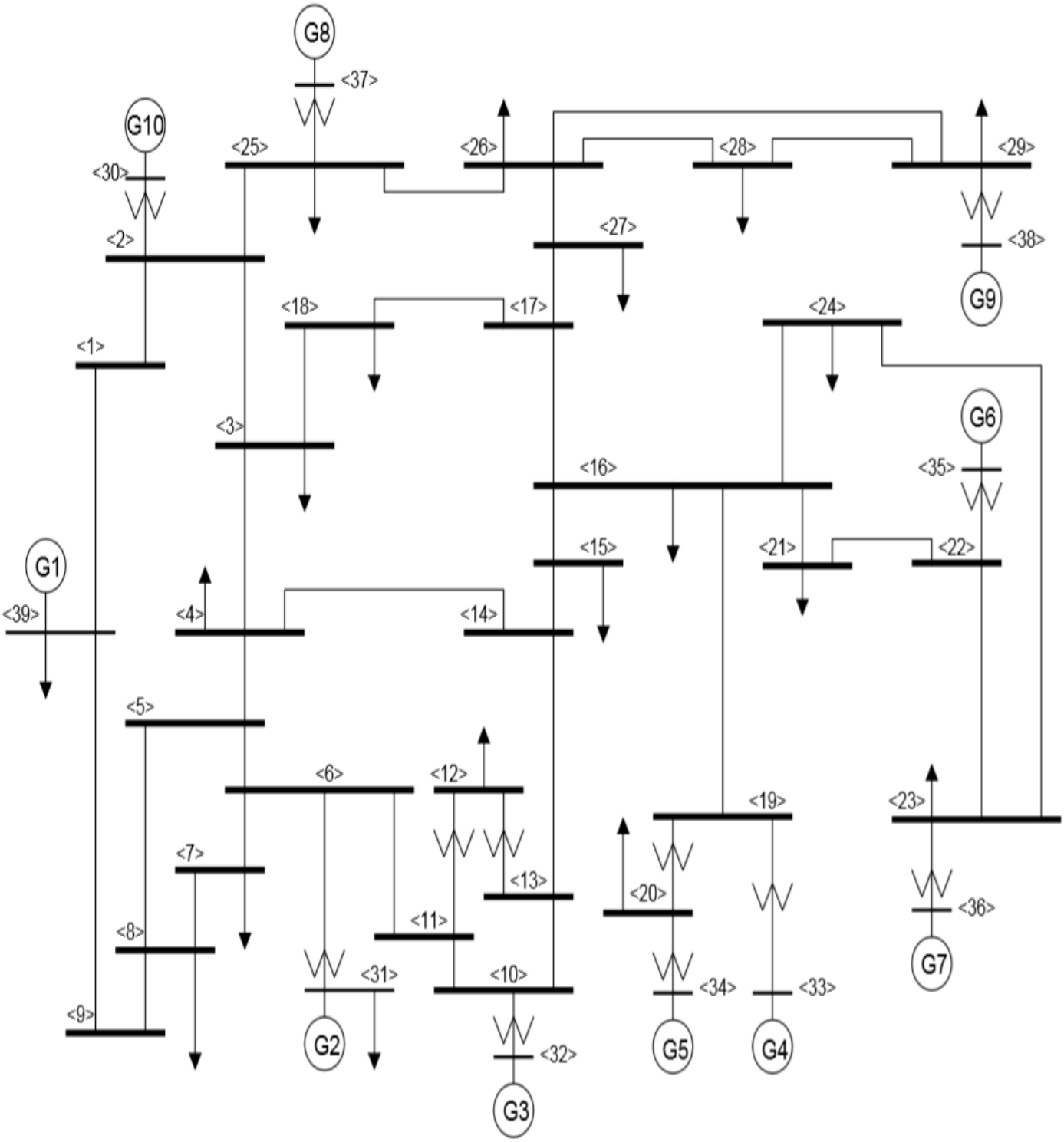

Figure 2. Single-line diagram of IEEE 10-generator, 39-bus system

Description of the simulation:

Table 1: Model components:

Componet Name	Path	Number
Buses	OpenIPSL.Electrical.Buses.Bus	39
Power Line	OpenIPSL.Electrical.Branches.PwLine	34
Generator	OpenIPSL.Electrical.Machines.PSE.GENROU	10
Transformer	OpenIPSL.Electrical.Branches.PSAT.TwoWindingTransformer	12
Constant PQ Load	OpenIPSL.Electrical.Loads.PSAT.LOADPQ	19
System Data Block	OpenIPSL.Electrical.SystemBase	1
Three phase fault	OpenIPSL.Electrical.Events.PwFault	1

The IEEE 10-generator, 39-bus system network model is implemented in OpenModelica language using OpenIPSL package is to study the voltage stability at different buses. The model is taken from a published paper "IEEE PES Task Force on Benchmark Systems for Stability Controls". The system is on a 100 MVA base, the system voltage level is 132-140KV, and Load Demand is 6149.5MW.

The simulation result of the Bus voltages of IEEE 10-generator, 39-bus system network shown below:

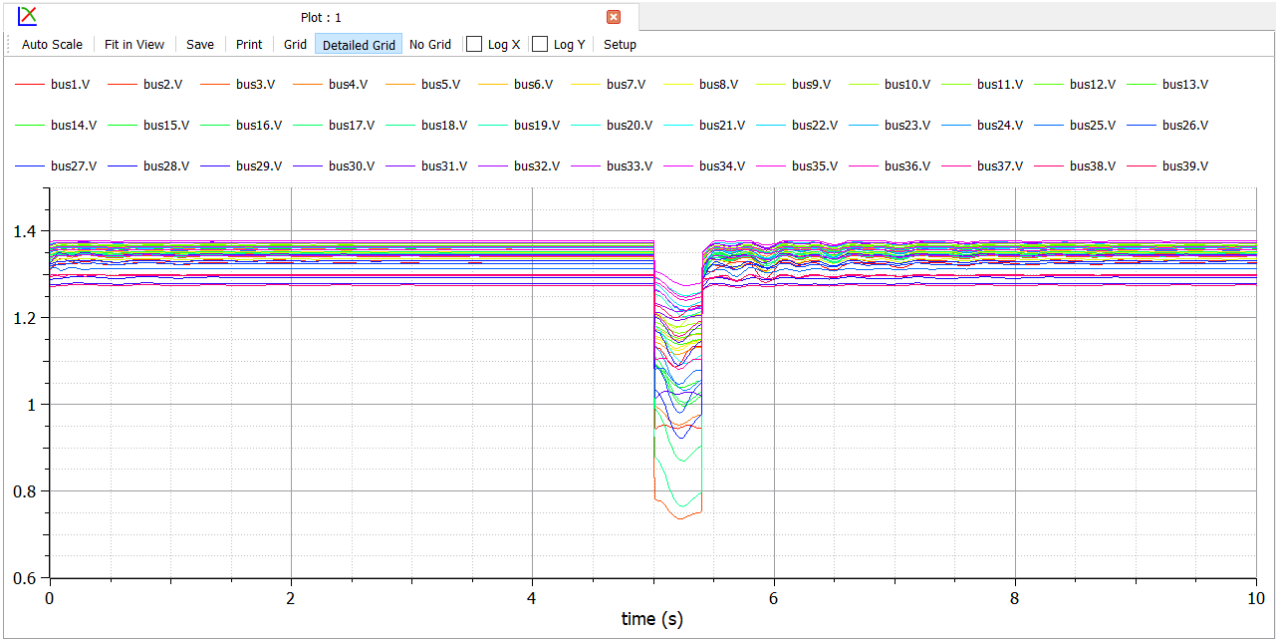

Figure 3. Voltage profiles of buses of IEEE 10-generator, 39-bus system

Table 2: Bus voltage magnitude (p.u.) of all buses obtained are tabulated below.

Bus Number	kV(p.u)	Bus Number	kV(p.u)
1	1.052	21	1.044
2	1.06	22	1.056
3	1.057	23	1.051
4	1.059	24	1.053
5	1.074	25	1.066
6	1.074	26	1.062
7	1.061	27	1.052
8	1.059	28	1.055
9	1.054	29	1.054
10	1.061	30	1.048
11	1.064	31	0.982
12	1.049	32	0.983
13	1.059	33	0.997
14	1.056	34	1.012
15	1.041	35	1.049
16	1.049	36	1.064
17	1.052	37	1.028
18	1.052	38	1.026
19	1.056	39	1.03
20	0.994		

Conclusion:

The implemented IEEE 10 Generator 39 bus model in Modelica represents the system behaviour before and after the fault occurs at the bus 3. Bus voltage magnitude (p.u.) of all 39 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.