Title: Modelling of IEEE 62 bus system using Modelica and OpenIPSL

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Abstract:

The IEEE 62 bus system shall be used to study the voltage stability at different buses. The power system model consists of 19 round rotor generators, 13 transformers, 32 loads, 77 transmission lines. The system is on 100 MVA base. A fault is simulated at Bus 60 for duration of 0.4 seconds (4.6 seconds to 5 seconds), the simulated voltage profiles of IEEE 62 bus system at various buses shown in Figure 3. The submitted model will be implemented in Modelica language using OpenIPSL package shown in Figure 1, shall present simulation scenario of fault at one of the buses. For all analysis of this system, the lower voltage magnitude limits at all buses are 0.9 p.u and upper limits are 1.1 p.u. A single line diagram (SLD) is shown in figure 2. Waveforms obtained will be observed.

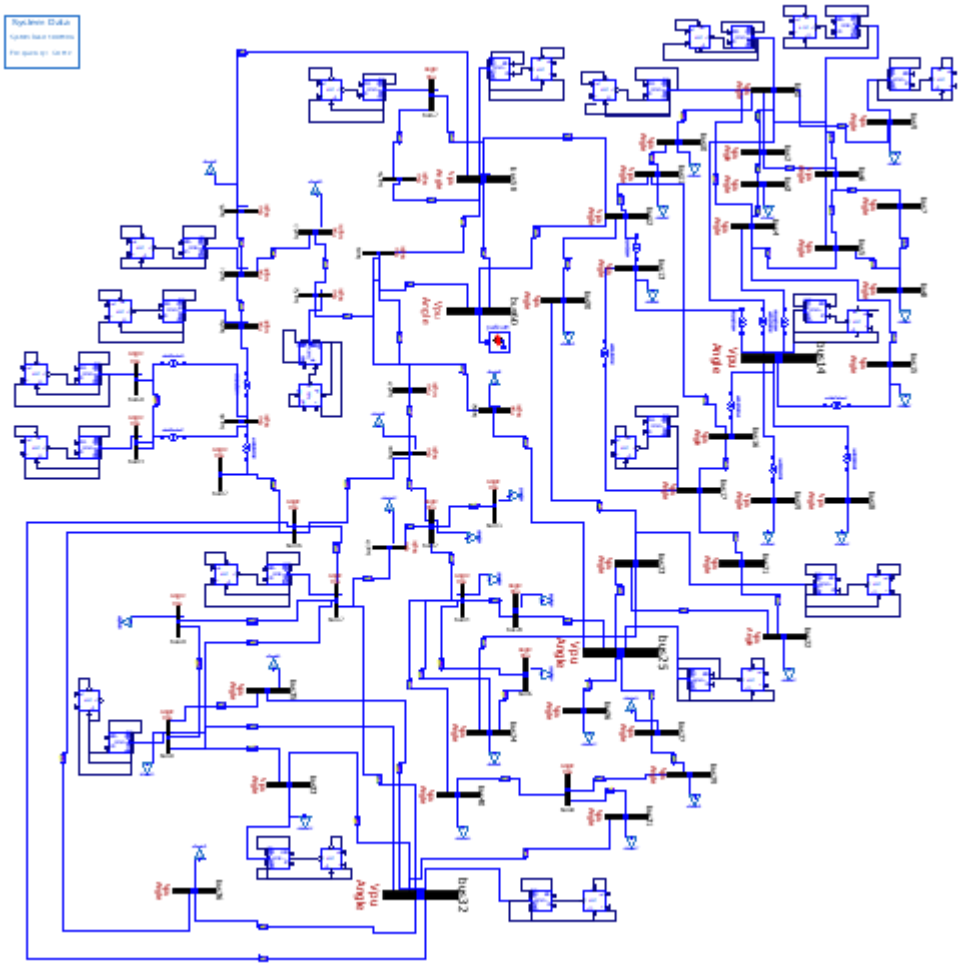

Figure 1: Implementation of IEEE 62 bus system using Modelica and OpenIPSL.

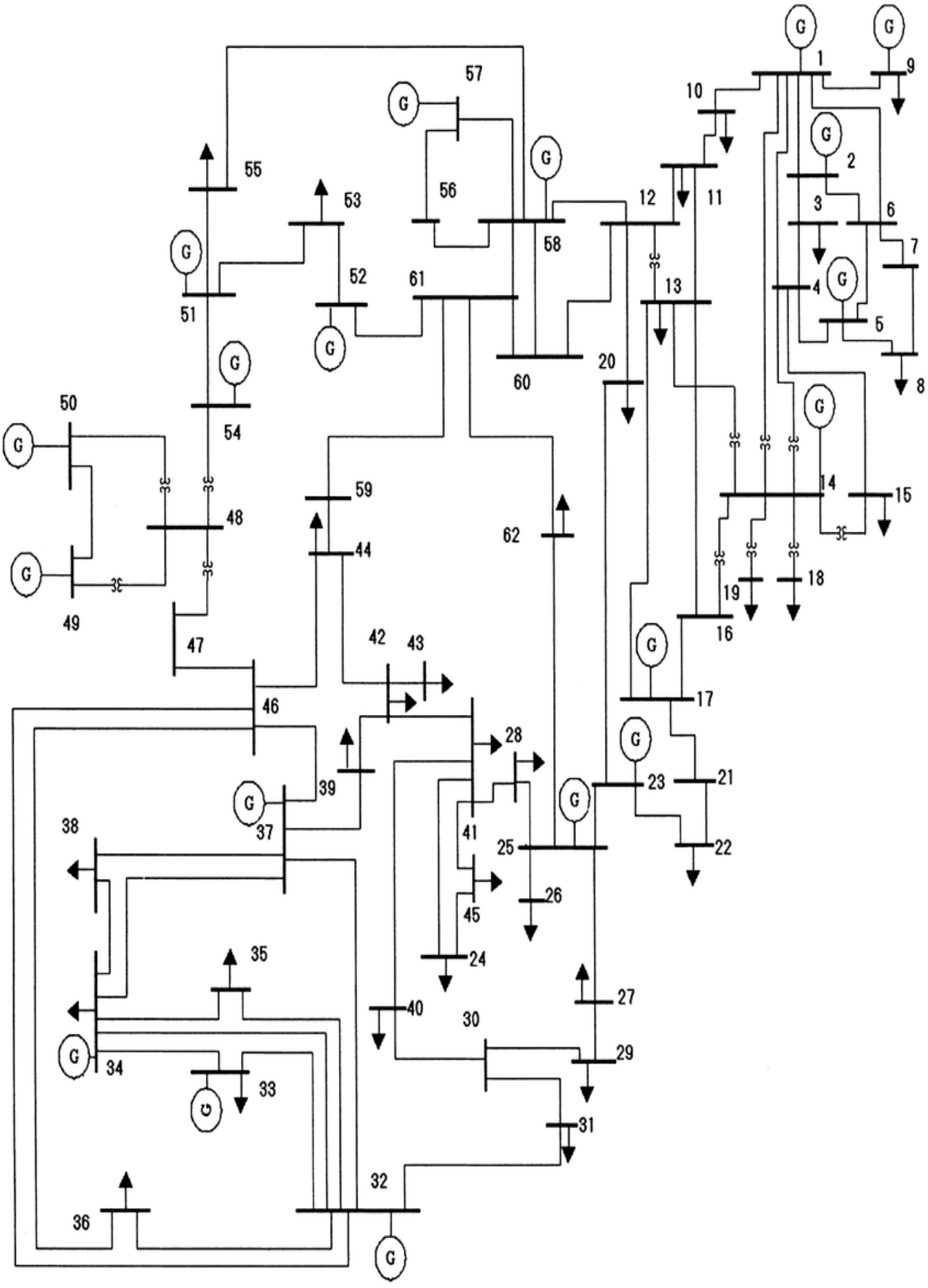

Figure 2: Single line diagram (SLD) of IEEE 62 bus system.

Explanation:

This model uses the following components:

Component Name	Class Path	Number
Two Winding Transformer	OpenIPSL.Electrical.Branches.PSAT.TwoWindingTransformer	13
Three phase fault	OpenIPSL.Electrical.Events.PwFault	1
Voltage Dependent Load	OpenIPSL.Electrical.Loads.PSAT.VoltDependant	32
Generator	OpenIPSL.Electrical.Machines.PSSE.GENROU	19
Automatic Voltage Regulators (AVR)	OpenIPSL.Electrical.Controls.PSAT.AVR.AVRTypeI	19
Bus	OpenIPSL.Electrical.Buses.Bus	62
PwLine	OpenIPSL.Electrical.Branches.PwLine	77
Sysdata block	OpenIPSL.Electrical.SystemBase	1

Table 1: Components used in system.

The IEEE 62 bus model implemented in Modelica language using OpenIPSL package, is used to study the voltage stability at different buses. The system is on 100 MVA base. For all analysis of this system, the lower voltage magnitude limits at all buses are 0.9 p.u. and upper limits are 1.1 p.u. An extra transformer is used in a line between buses 13 to 17, as both buses are at different voltage levels. 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. The type of generator used is round rotor machine (GENROU). A fault is simulated for the duration of 4.6 to 5 seconds at the 60th bus. During the fault, we can observe from the bus voltage profiles, that the voltage dip is more for the 60th 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 waveforms obtained are observed.

The simulation result of the all 62 Bus voltages shown below.

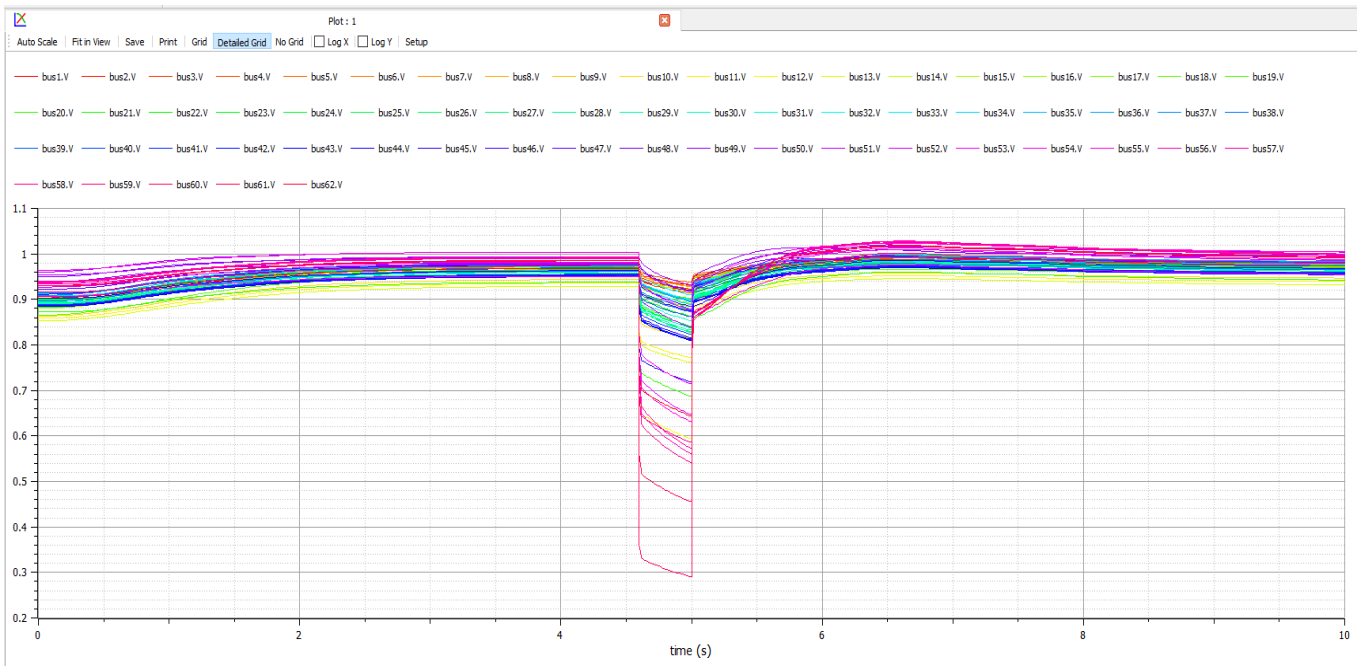

Figure 3: The voltage profiles of simulated IEEE 62 bus.

Bus no.	Bus Voltage magnitude (p.u.)	Bus no.	Bus Voltage magnitude (p.u.)
1	0.972572	32	0.983539
2	0.979065	33	0.982099
3	0.975507	34	0.976528
4	0.973811	35	0.982336
5	0.981896	36	0.983190
6	0.976402	37	0.979230
7	0.975727	38	0.965318
8	0.974779	39	0.972998
9	0.972412	40	0.959312
10	0.946940	41	0.955405
11	0.939132	42	0.956936
12	0.976372	43	0.954392
13	0.932257	44	0.967879
14	0.972419	45	0.957906
15	0.983215	46	0.980027
16	0.968831	47	0.980006
17	0.982251	48	0.993298
18	0.956154	49	0.981983
19	0.975190	50	1.004250
20	0.942578	51	0.995747
21	0.979441	52	0.985672
22	0.970067	53	0.954671
23	0.977323	54	1.004580
24	0.967590	55	0.987767
25	0.981388	56	0.999301
26	0.965933	57	1.000090
27	0.962095	58	0.997726
28	0.968453	59	0.979264
29	0.965316	60	0.992868
30	0.965206	61	0.991589
31	0.964532	62	0.973877

Table 2: Bus voltage magnitude (p.u.) of all 62 buses obtained.

Conclusion:

The implemented IEEE 62 bus model in Modelica represents the system behaviour before and after the fault occurs at the bus 60. Bus voltage magnitude (p.u.) of all 62 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.