Title: Modelling and simulation of radial distribution feeder using Openmodelica and OpenIPSL

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Abstract: The power system model will contain one generator (infinite bus) to meet power demand from the various loads. The model includes seven buses, one two-winding transformer, nine constant PQ loads, and five transmission lines (PwLine). System base is 10 MVA. A three-phase balanced fault simulated in one of the buses (seventh bus) at a duration of 0.08 seconds (from 7.01 seconds to 7.09 seconds). The purpose of this power system model is to study the voltage stability at multiple buses. Simulation obtained shows profiles at generators, buses and various constant PQ loads. Waveforms obtained is observed.
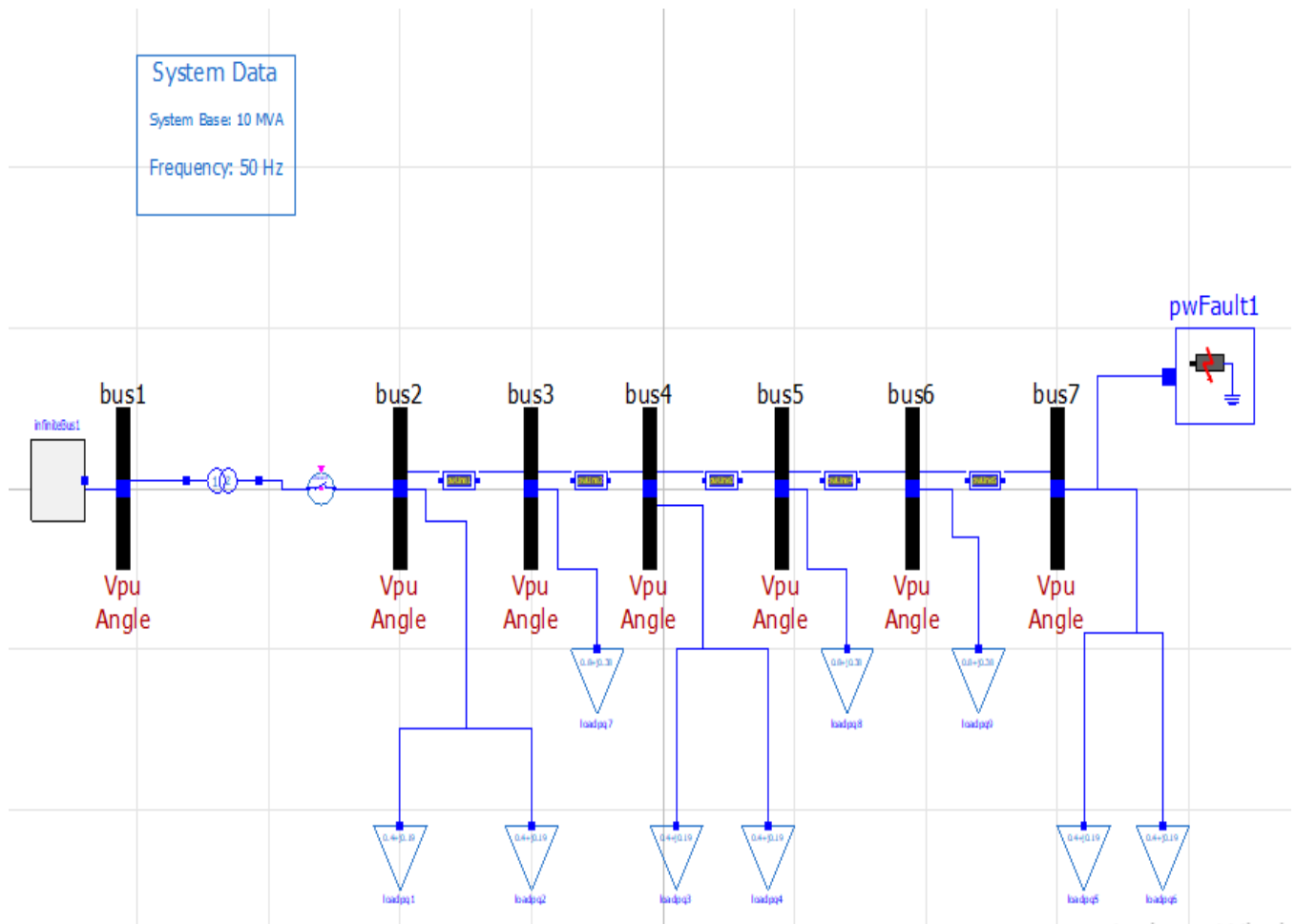

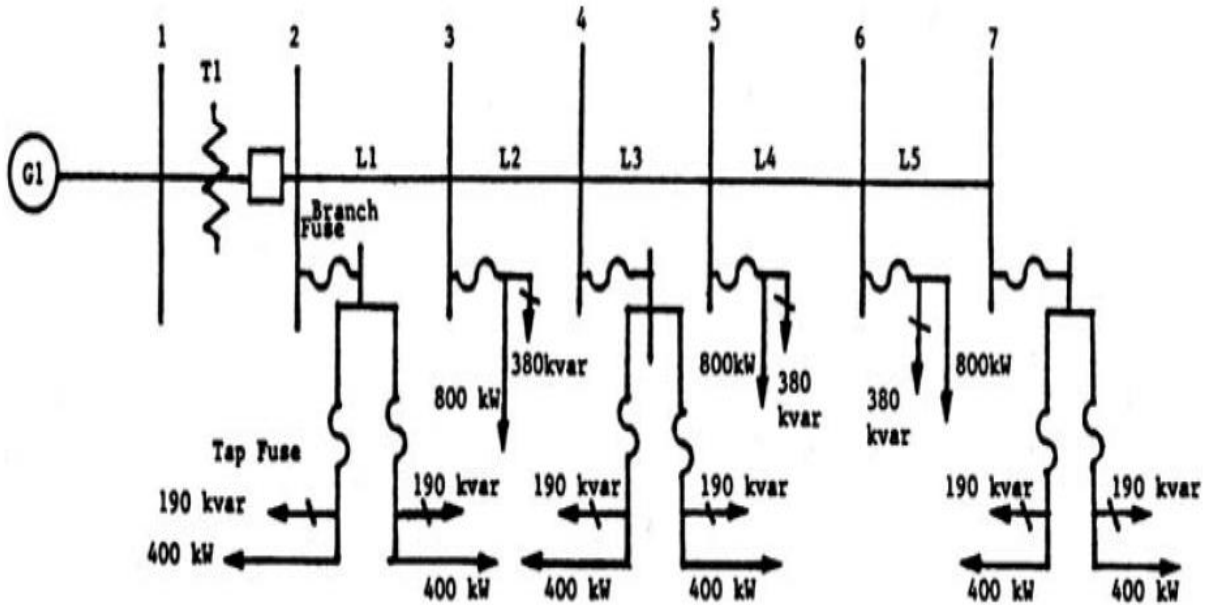Figure 1. Implementation of a radial distribution network

Figure 2. Single-line diagram of radial distribution network

Description of the simulation:

Table 1: model components:

Component Name	Path	Number
Two Winding Transformer	OpenIPSL.Electrical.Branches.PSAT.TwoWindingTransformer	1
Three phase fault	OpenIPSL.Electrical.Events.PwFault	1
Constant PQ Load	OpenIPSL.Electrical.Loads.PSAT.LOADPQ	4
Generators (infinite bus)	OpenIPSL.Electrical.Buses.InfiniteBus	1
Buses	OpenIPSL.Electrical.Buses.Bus	7
PwLine	OpenIPSL.Electrical.Branches.PwLine	5
Sysdata block	OpenIPSL.Electrical.SystemBase	1

The radial distribution network model implemented in OpenModelica language using OpenIPSL package is used to study the voltage stability at different buses. The model is taken from "J. D. Glover, M. S. Sarma, and T. J. Overbye, Power System Analysis and Design" page no.376. The system is on a 10 MVA base. The generator models in the implemented network is an infinite bus. The infinite bus voltage and frequency remain constant even after the variation of load. A fault simulated for the duration of 7.1 to 7.2 seconds at the 7th bus. During the fault, we can observe from the bus voltage profiles, that the voltage dip is more for the 7th bus as it is the fault bus and the severity of the fault reduced 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 Bus voltages of radial distribution network shown below:
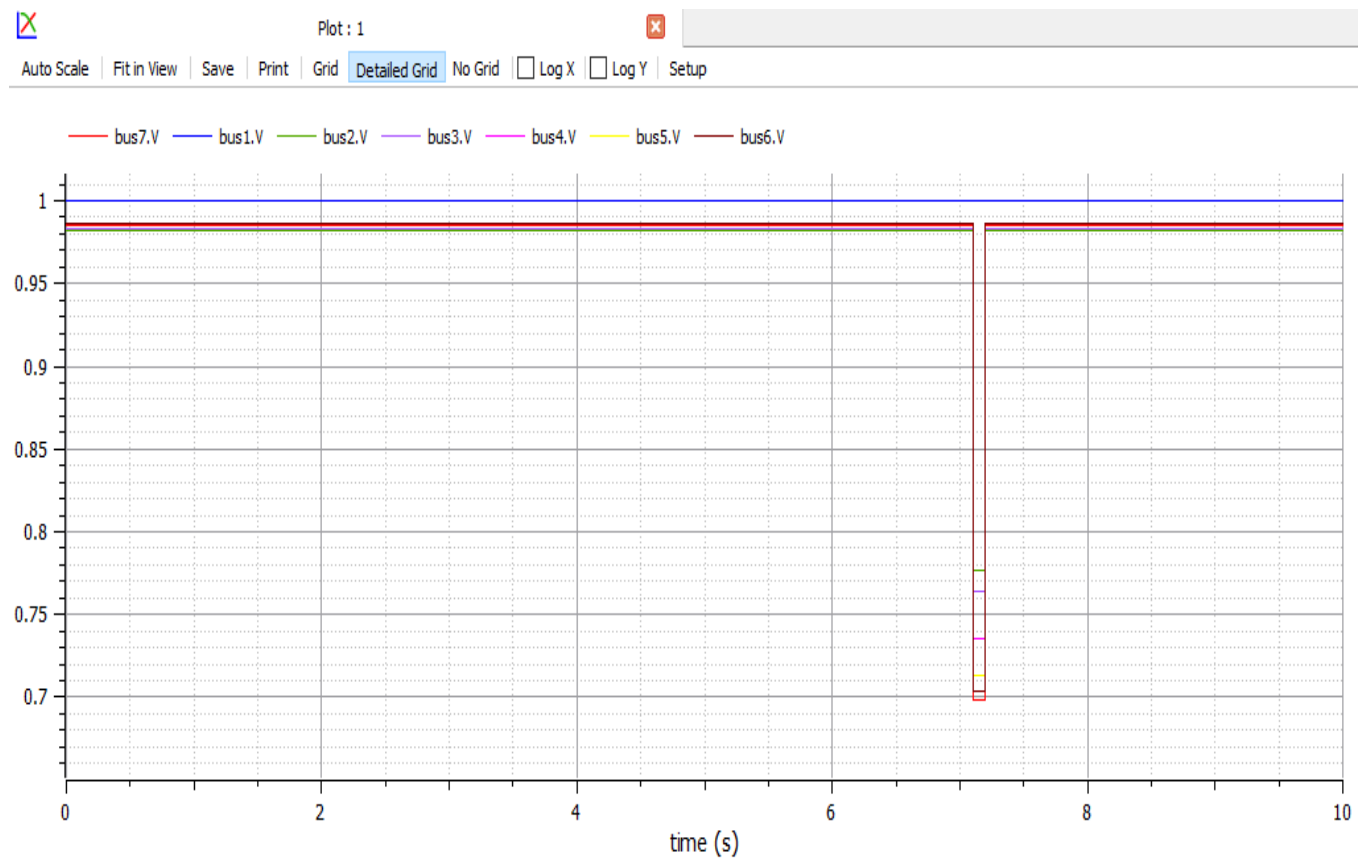

Figure 3. Voltage profiles of buses of radial distribution network

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

Bus no.	Bus Voltage magnitude (p.u.)
1	1
2	0.981717
3	0.98293
4	0.986183
5	0.986465
6	0.985903
7	0.985701

Conclusion:
The implemented radial distribution network in Modelica represents the system behavior before and after the fault occurs at the bus 7. Bus voltage magnitude (p.u.) of all buses are obtained. The relation between line impedance and fault severity observed. The voltage profiles indicate that even after a fault in the system, the voltage at slack bus remains constant.