Title: Modeling of single machine infinite bus (SMIB) using Modelica and the OpenIPSL

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Abstract:

Modelica implementation of the single machine infinite bus (SMIB) using the OpenIPSL library is shown in Figure1. The generator model uses a PSAT synchronous machine of order VI, an AVR of type III along with a PSS of type II. A three phase balanced fault is simulated in the Bus 2 from 0.5 to 0.57 seconds. The simulation result shown in Figure 2, represents the voltage at Bus 2 before and after the fault occurs.

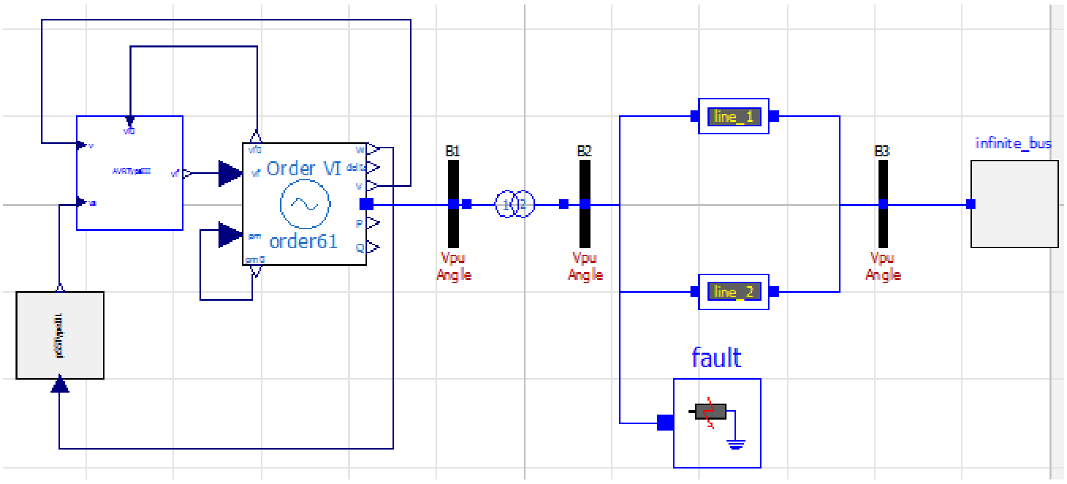

Figure 1: Implementation of SMIB using OpenIPSL

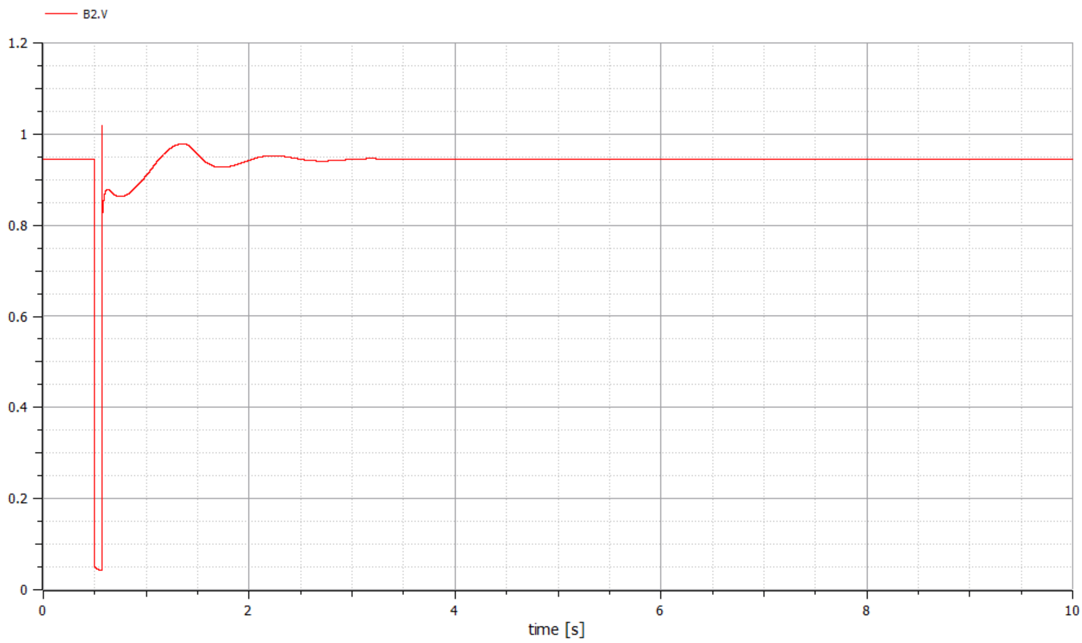

Figure 2: Voltage profile at the fault bus

Explanation:

This model is modelled using following components:

Component Name	Path	Number
AVR typeIII	OpenIPSL.Electrical.Controls.PSAT.AVR.AVRtypeIII	1
Two Winding Transformer	OpenIPSL.Electrical.Branches.PSAT.TwoWindingTransformer	1
Three phase fault	OpenIPSL.Electrical.Events.PwFault	1
Infinite Bus	OpenIPSL.Electrical.Buses.InfiniteBus	1
Generator (Order VI)	OpenIPSL.Electrical.Machines.PSAT.Order6	1
PSS TypeII	OpenIPSL.Electrical.Controls.PSAT.PSS.PSSTypeII	1
Bus	OpenIPSL.Electrical.Buses.Bus	3
PwLine	OpenIPSL.Electrical.Branches.PwLine	2
Sysdata block	OpenIPSL.Electrical.SystemBase	1

In this model the stability of a single generator connected to an infinite bus is analyzed. Here we use a classic case of a single synchronous machine connected to an infinite bus. The machine is modelled in OpenModelica as a 6th-order machine and has a simple AVR and PSS (type II) connected. The AVR controls the field voltage of the generator by taking initial field voltage and the terminal voltage of the generator as feedback. The Power System Stabilizer (PSS type III) takes the feedback of rotor speed and gives the required voltage to the AVR as input. The AVR and PSS parameters are set and the model is simulated. At t=0.5s, a three-phase fault is applied to the Bus 2 and at t=0.57s, the fault is cleared. From the voltage profile of bus 2 (fault bus), during the fault we can see there is huge dip in the voltage profile but the voltage doesn't drop to zero as there is fault reactance involved. The fault is cleared and the system becomes stable. These two, AVR and PSS together dampen the oscillations in voltage and bring back the system to stability. This can also be observed from the delta curve of the generator.

Conclusion:

The model represents the behavior of the system both before and after the fault has occurred. The generator (order VI) is a controlled one with AVR of type III along with a PSS of type II. Hence the system becomes stable about 3.5 secs after the fault is being cleared. This can be clearly seen from the voltage profile at the fault bus. The system is brought back to stable condition by adding AVR of type III along with a PSS of type II which are properly calibrated.