

# Modelling SMIB system using OpenIPSL

**Spoken Tutorial Project**  
**<https://spoken-tutorial.org>**

**National Mission on Education through ICT**  
**<http://sakshat.ac.in>**

**Samboju Sai Kiran**  
**FOSSEE, IIT Bombay**  
**20 January 2019**

# Learning Objectives

**In this tutorial, we will learn:**

# Learning Objectives

**In this tutorial, we will learn:**

- ▶ **What is a controlled SMIB system**

# Learning Objectives

**In this tutorial, we will learn:**

- ▶ **What is a controlled SMIB system**
- ▶ **How to model a controlled SMIB system**

# Learning Objectives

**In this tutorial, we will learn:**

- ▶ **What is a controlled SMIB system**
- ▶ **How to model a controlled SMIB system**
- ▶ **How to connect the components**

# System Requirements

# System Requirements

- ▶ **OpenModelica version 1.12.0**

# System Requirements

- ▶ **OpenModelica version 1.12.0**
- ▶ **Ubuntu Linux OS 16.04**



# System Requirements

- ▶ **OpenModelica version 1.12.0**
- ▶ **Ubuntu Linux OS 16.04**
- ▶ **Windows, Mac OS X or FOSSEE OS on ARM**

# Prerequisites

**To follow this tutorial, you should have knowledge of :**

# Prerequisites

**To follow this tutorial, you should have knowledge of :**

- ▶ **Power systems**

# Prerequisites

**To follow this tutorial, you should have knowledge of :**

- ▶ **Power systems**
- ▶ **Modeling using OpenModelica**

# Prerequisites

To follow this tutorial, you should have knowledge of :

- ▶ Power systems
- ▶ Modeling using OpenModelica

Prerequisite tutorials are available on  
<https://spoken-tutorial.org>

# Prerequisites

**In earlier tutorials we have already seen**

# Prerequisites

In earlier tutorials we have already seen

- ▶ how to simulate a SMIB system and

# Prerequisites

**In earlier tutorials we have already seen**

- ▶ how to simulate a SMIB system and**
- ▶ how to interpret its results**



# What is a controlled SMIB system?



# What is a controlled SMIB system?

- ▶ **The SMIB system which we are going to model is a controlled one**

# What is a controlled SMIB system?

- ▶ **The SMIB system which we are going to model is a controlled one**
- ▶ **The generator is controlled with the help of Automatic Voltage Regulator(AVR) and Power System Stabilizer(PSS).**

# What is a controlled SMIB system?

## Automatic Voltage Regulator (AVR)

- ▶ AVR regulates the generator terminal voltage

# What is a controlled SMIB system?

## Automatic Voltage Regulator (AVR)

- ▶ AVR regulates the generator terminal voltage
- ▶ This is done by controlling the amount of current supplied to the generator field winding by the exciter.

# What is a controlled SMIB system?

## Automatic Voltage Regulator (AVR)

- ▶ AVR regulates the generator terminal voltage
- ▶ This is done by controlling the amount of current supplied to the generator field winding by the exciter.
- ▶ AVR improves the voltage regulation of the system

# What is a controlled SMIB system?

## Power System Stabilizer(PSS)

- ▶ PSS is installed with AVR to damp the low frequency oscillations in power system

# What is a controlled SMIB system?

## Power System Stabilizer(PSS)

- ▶ PSS is installed with AVR to damp the low frequency oscillations in power system
- ▶ This is done by providing a supplementary signal to the excitation system



# What is a controlled SMIB system?

## Power System Stabilizer(PSS)

- ▶ PSS is installed with AVR to damp the low frequency oscillations in power system
- ▶ This is done by providing a supplementary signal to the excitation system
- ▶ PSS improves the damping of the system

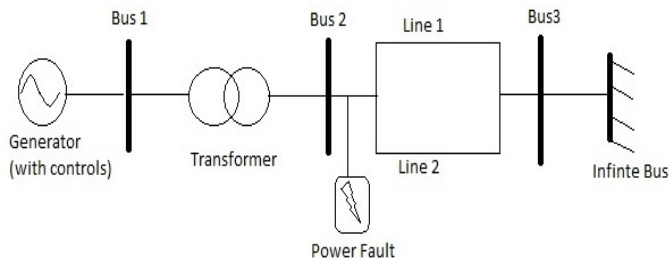
# What is a controlled SMIB system?

- ▶ **Optimal tuning of AVR controller and PSS parameters is necessary**
- ▶ **This is to obtain better voltage regulation and oscillation damping in the system.**

# How to model a SMIB system?

**Before launching OMEdit let us look at the Single Line Diagram of the SMIB system**

# How to model a SMIB system?



Single Line Diagram(SLD) of SMIB system

# How to model a SMIB system?

**The following are the components required to model SMIB system**

# How to model a SMIB system?

**The following are the components required to model SMIB system**

- ▶ **Generator Order VI**

# How to model a SMIB system?

**The following are the components required to model SMIB system**

- ▶ **Generator Order VI**
- ▶ **Buses**

# How to model a SMIB system?

**The following are the components required to model SMIB system**

- ▶ **Generator Order VI**
- ▶ **Buses**
- ▶ **Two winding transformer**



# How to model a SMIB system?

**The following are the components required to model SMIB system**

- ▶ **Generator Order VI**
- ▶ **Buses**
- ▶ **Two winding transformer**
- ▶ **Power System Stabilizer (Order II)**

# How to model a SMIB system?



# How to model a SMIB system?

- ▶ **Automatic Voltage Regulator (Order III)**

# How to model a SMIB system?

- ▶ **Automatic Voltage Regulator (Order III)**
- ▶ **Power Line**

# How to model a SMIB system?

- ▶ **Automatic Voltage Regulator (Order III)**
- ▶ **Power Line**
- ▶ **Infinite Bus**

# How to model a SMIB system?

- ▶ **Automatic Voltage Regulator (Order III)**
- ▶ **Power Line**
- ▶ **Infinite Bus**
- ▶ **Power Pin**

# How to model a SMIB system?

- ▶ **Automatic Voltage Regulator (Order III)**
- ▶ **Power Line**
- ▶ **Infinite Bus**
- ▶ **Power Pin**
- ▶ **Fault Block**

# How to model a SMIB system?

- ▶ **Automatic Voltage Regulator (Order III)**
- ▶ **Power Line**
- ▶ **Infinite Bus**
- ▶ **Power Pin**
- ▶ **Fault Block**
- ▶ **System Data**



# Summary

Let's summarize:

- ▶ What is a controlled SMIB system
- ▶ How to model a SMIB system
- ▶ How to connect the components

# Assignment

- ▶ We recommend that you take an example network from any textbook or publications.
- ▶ Using the OpenIPSL library components, connect and model the network.

# Power System Simulation Project

## The FOSSEE team

- ▶ Invites contributions to develop power system networks using OpenIPSL library
- ▶ Gives honararium and certificates to those who do this
- ▶ For more details, please visit this site  
<https://om.fossee.in/powersystems>

# About the Spoken Tutorial Project

- ▶ Watch the video available at [https://spoken-tutorial.org/What\\_is\\_a\\_Spoken\\_Tutorial](https://spoken-tutorial.org/What_is_a_Spoken_Tutorial)
- ▶ It summarises the Spoken Tutorial project
- ▶ If you do not have good bandwidth, you can download and watch it



# Spoken Tutorial Workshops

## The Spoken Tutorial Project Team

- ▶ Conducts workshops using spoken tutorials
- ▶ Gives certificates to those who pass an online test
- ▶ For more details, please write to [contact@spoken-tutorial.org](mailto:contact@spoken-tutorial.org)

# Forum to answer questions

- ▶ **Do you have questions in THIS Spoken Tutorial?**
- ▶ **Choose the minute and second where you have the question.**
- ▶ **Explain your question briefly.**
- ▶ **Someone from the FOSSEE team will answer them.**

Please visit <https://forums.spoken-tutorial.org/>



# Forum to answer questions

- ▶ Questions not related to Spoken Tutorial?
- ▶ Do you have general / technical questions on the software?
- ▶ Please visit the FOSSEE Forum  
<https://forums.fossee.in/>
- ▶ Choose the software and post your question

# Textbook Companion Project

- ▶ **The FOSSEE team coordinates coding of solved examples of popular books**
- ▶ **We give honorarium and certificate to those who do this**

**For more details, please visit this site:**

**<https://OM.fossee.in/Textbook-Companion-Project>**





# Lab Migration Project

- ▶ **The FOSSEE team helps migrate commercial simulator labs to OpenModelica**
- ▶ **We give honorarium and certificates to those who do this**

**For more details, please visit this site:**

**<https://OM.fossee.in/lab-migration-project>**



# Acknowledgements

- ▶ **Spoken Tutorial Project is a part of the Talk to a Teacher project**
- ▶ **It is supported by the National Mission on Education through ICT, MHRD, Government of India**
- ▶ **More information on this Mission is available at <https://spoken-tutorial.org/NMEICT-Intro>**

# Acknowledgements

- ▶ **We acknowledge the contributions made by Prof. Luigi Vanfretti and Biswarup for the models used in this series.**

# Thanks!

<https://openmodelica.org>