

# Mixed Signal Simulation using NGHDL

Spoken Tutorial Project

<https://spoken-tutorial.org>

National Mission on Education through ICT

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# Learning Objectives

**In this tutorial, we will learn**



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- Basics of the NGHDL feature



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- ▶ Creation of a NGHDL digital model



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In this tutorial, we will learn

- ▶ Basics of the NGHDL feature
- ▶ Creation of a NGHDL digital model
- ▶ Simulation of a mixed signal circuit



# System Requirements

To record this tutorial, I am using



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► **Ubuntu OS v20.04**



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- ▶ Ubuntu OS v20.04

- ▶ eSim v2.2





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**The process demonstrated in this tutorial is similar in Windows OS also**



# Pre-requisites

**To follow this tutorial,**



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To follow this tutorial,

- ▶ The learner should have basic knowledge of eSim



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To follow this tutorial,

- ▶ The learner should have basic knowledge of eSim
- ▶ For pre-requisite eSim tutorials, please visit <https://spoken-tutorial.org>



# Code Files

- The files used in this tutorial are provided in the Code files link



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- ▶ The files used in this tutorial are provided in the Code files link
- ▶ Please download and extract the files



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- ▶ The files used in this tutorial are provided in the Code files link
- ▶ Please download and extract the files
- ▶ Make a copy and then use them while practicing





# What is Mixed Signal Simulation?

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  - ▶ Digital Circuits



# What is NGHDL?

- The NGHDL feature converts a VHDL code file to its respective NGHDL digital model



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- ▶ The NGHDL feature converts a VHDL code file to its respective NGHDL digital model
- ▶ The created models are used for mixed signal circuit simulation in eSim



# File Type

- To create an NGHDL digital model, the input file should be in **.vhdl** format



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- ▶ To create an NGHDL digital model, the input file should be in **.vhdl** format
- ▶ VHDL is a Hardware Description Language to model digital circuits





# Checks to be done

- ▶ Refer to the Appendix of the eSim user manual

[https://static.fossee.in/  
esim/manuals/eSim\\_Manual\\_2.2.pdf](https://static.fossee.in/esim/manuals/eSim_Manual_2.2.pdf)



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- ▶ It has instructions on writing VHDL models in case of any errors



# Checks to be done

- It also mentions the Checks to be done before Simulation in NGHDL



# NGHDL Simulator

- For details on the NGHDL simulator and its implementation, please refer:

[https://doi.org/10.1109/  
/iccss51193.2021.9464198](https://doi.org/10.1109/iccss51193.2021.9464198)



# Microcontroller Simulation

- ▶ The Microcontroller Simulations can also be incorporated through NGHDL
- ▶ For more details, please visit:  
<https://github.com/FOSSEE/nghdl/tree/attiny-alpha>



# Summary

In this tutorial, we have

- ▶ Learned the basics of NGHDL feature
- ▶ Uploaded VHDL file in the Ngspice Digital Model Creator window
- ▶ Simulated a mixed Signal circuit



# Assignment

- ▶ Locate the **counter** folder which is available in **eSim-2.2/nghdl/Example/combinational-logic**
- ▶ Upload the **up\_counter.vhdl** file on the **Ngspice Digital Model Creator**



# Assignment

- ▶ Create a schematic representation of the **up\_counter**
- ▶ Annotate the **schematic**
- ▶ Generate and Save the **Netlist** file
- ▶ Simulate the circuit to see the output





# 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 summarizes 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)



# Answers to THIS spoken tutorial

- ▶ Questions in THIS Spoken Tutorial
- ▶ Visit <https://forums.spoken-tutorial.org>
- ▶ Choose the minute and second where you have the question
- ▶ Explain your question briefly
- ▶ The Spoken Tutorial project will ensure an answer
- ▶ You will have to register to ask questions



# FOSSEE Forum

- For any general or technical questions on eSim, visit the FOSSEE forum and post your question

<https://forums.fossee.in/>



# Circuit Simulation Project

- ▶ The FOSSEE team coordinates the Circuit Simulation project
- ▶ For more details visit:  
<https://esim.fossee.in/circuit-simulation-project>



# TextBook Companion Project

- ▶ The FOSSEE team coordinates the TextBook Companion project
- ▶ For more details visit:  
<https://esim.fossee.in/textbook-companion-project>



# Lab Migration

- ▶ The FOSSEE team coordinates the Lab migration project
- ▶ For more details visit:  
<https://esim.fossee.in/lab-migration-project>



# Acknowledgements

- ▶ **Spoken Tutorial project is funded by Ministry of Education, Govt. of India**





# Thank you!

- ▶ This is Harisankar, a FOSSEE Summer fellow 2022, IIT Bombay signing off
- ▶ Thanks for joining

