



Tutorial Read Me

Design a dipole antenna and its matching network using PyAEDT

Developed and curated by the Ansys Academic Development Team

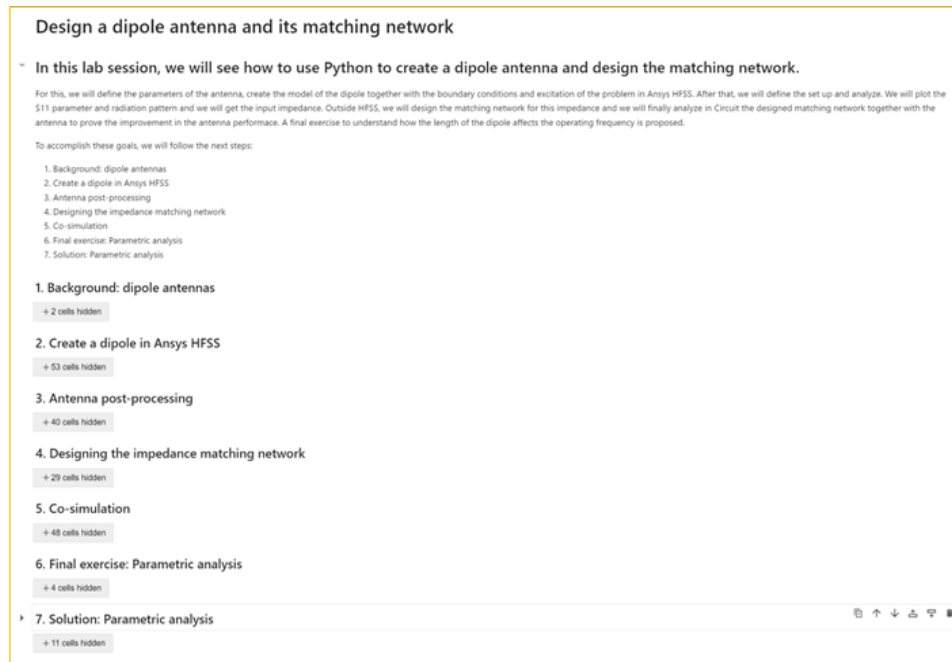
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1. Overview

This virtual lab experiment simulates the dipole antenna performance using Ansys HFSS™, a high-frequency simulation software, via Python coding in JupyterLab. The design of the impedance matching network at the operating frequency is also addressed and validated using a co-simulation with Ansys Circuit. A final exercise to explore how the length of dipole affects the antenna performance is proposed.

When you open the Jupyter file, you will see these exercises structured in the notebook, so students can work through them in order:



2. Learning Objectives

1. Grasp fundamental principles of dipole antenna design and matching networks.
2. Analyze communication components using Python scripting in Ansys HFSS.
3. Develop workflows for designing, analyzing, and optimizing antenna performance.
4. Understand the impact of a matching network and how the dipole length influences the antenna performance.
5. Gain experience in simulation using Ansys Electronics Desktop (AEDT)™, an electronics systems design platform.
6. Enhance Python programming proficiency.

3. Student Knowledge Prerequisites

This lab is written assuming that students have already been introduced to antennas theory but have not yet had a chance to design and visualize their performance. Beginner level of Python programming is also advised as a pre-requisite for this lab.

4. System/Library Requirements

In order to run, the following software and libraries must be installed on the computer. (The version numbers listed below in brackets are those which were used to create this resource: while it may run successfully with other versions, this has not been tested).

1. Ansys Electronics Desktop (release 2024 R2)
2. JupyterLab (version 4.2.4)
3. PyAEDT libraries (version 0.10.0): `pip install pyaedt[installer]`

If you are unfamiliar with installing Python packages, guidance can be found on the Python website or elsewhere online.

5. Steps for opening the Jupyter Lab

There are two alternatives to open this virtual lab. The first one is directly through the console and the second one is by means of AEDT. The steps for the first approach are:

1. Open the zip file and extract its contents to a single location. The virtual lab is contained within the Jupyter Notebook file *Dipole_LabTutorial.ipynb*, and it uses the other files (such as images) within this folder.
2. Go to your virtual environment folder.
3. Open a command console by typing `cmd` in the explorer bar.
4. Activate the virtual environment by typing in the console: `Scripts\activate`
5. Open the folder where the Jupyter file is contained by typing: `cd <virtual_lab_folder>`
6. Finally, type: `jupyter lab`

The alternative is via Ansys Electronics Desktop. For that, follow the next steps:

1. Open AEDT.
2. In *Automation* Tab, click on *Jupyter Notebook* or *Jupyter Lab*.
3. Navigate to the virtual lab folder, where you have previously extracted the downloaded zip file.

6. Steps for using the Lab

1. Before giving the lab to students, we suggest running the simulation to understand its functionality and how long it will take on the computers where you have it installed.

2. Once you are happy that the lab runs successfully, it may then be used with students. All the instructions and information which they should need are contained within the *.ipynb file. It is recommended to run the code visualizing AEDT to better understand the effects of each line.

3. Depending on how much you want students to engage with the Python code, you may wish to hide the code cells (in Jupyter, do this by selecting a cell and then clicking the blue vertical bar that appears to the left of it).

4. There is a final exercise for students to explore Python commands for parametric analysis. It is advisable to suggest them visit PyAEDT website: <https://aedt.docs.pyansys.com/version/stable/index.html>, to check the functionality of the proposed hint commands.

7. Optional Extensions

There is an optional exercise to propose to the students towards the end of the lab for changing the operating frequency of the antenna by doing a parametric sweep analysis of the length of the dipole. The solution to this exercise is given at the end of the lab (which can be hidden from students in advance). However, it is possible to extend this lab in multiple different ways: since the behavior is controlled by the Python code, you are free to change variables or functionality as best suits your specific learning objectives– the possibilities are endless!

8. Documentation and more information

Documentation for Jupyter can be easily found online. Documentation for PyAEDT– and other PyAnsys libraries – can be found on the [Ansys Developer Portal](#), along with examples, support articles and a user community.

9. Acknowledgments

This resource would not have been created without the assistance of many people. Within Ansys, acknowledgment is extended to Susannah Cooke and Dimitris Tzagkas for their valuable inputs and contributions.

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