

PART B: Antenna Design with FEKO

In this section, we will design the antenna using FEKO, a popular electromagnetic solver.

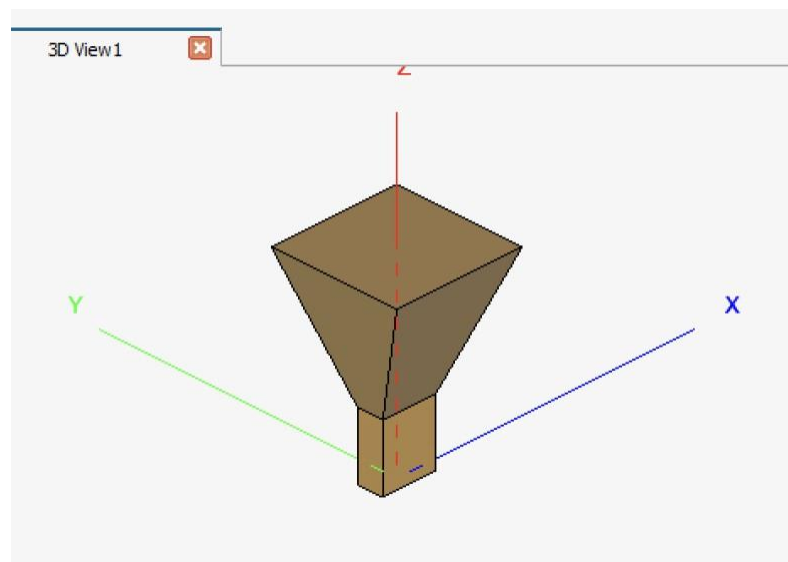
- 1) Use the appendix in this document to access the software through the College of Engineering (COE) Virtual Labs (VLABs).
- 2) The first step to design an antenna is to draw its geometry. For this, launch CADFEKO:



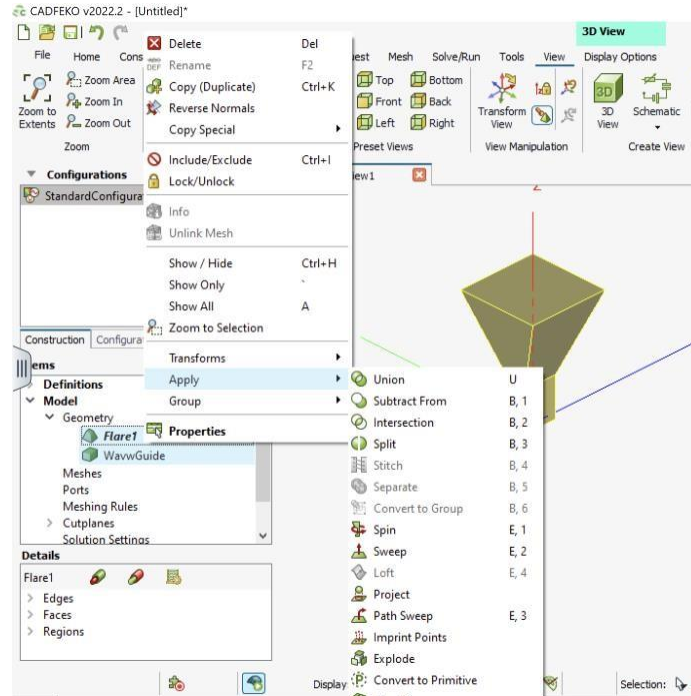
- a. Create a new project.
- b. Using the construct tab,



- i. Draw the parts of the antenna. There will be two separate parts:
 1. The waveguide, which can be represented by a cuboid. *Hint:* The dimensions of a waveguide determine the frequencies that can propagate through it. For a 300 GHz antenna, define a standard rectangular waveguide WR3 (which can cover the range from 220 GHz to 330 GHz).
 2. The flare. *Hint:* On one end, the flare is connected to the waveguide, so you know its dimensions. On the other end, the flare needs to have the effective area that you have calculated in Question 2e.



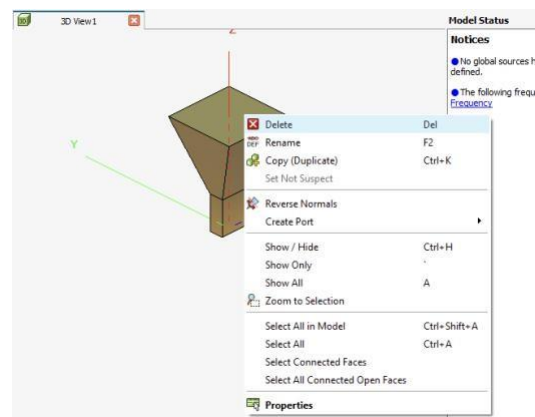
- ii. Use the union feature to merge the waveguide and the flare.



- iii. Make sure to modify the model units.



- iv. Make sure to delete the face of the flare and the face at the interface between the waveguide and the flare as to not block the flow of the signal. You can simply right click each face individually and click the delete button.



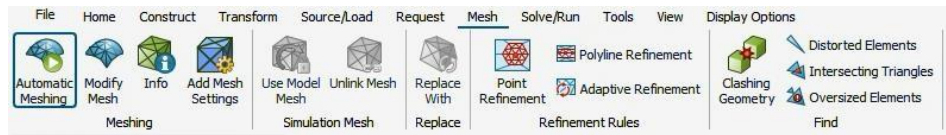
In your deliverables, attach a screenshot of the antenna CAD model, clearly indicating the final dimensions.

c. Using the source/load tab,

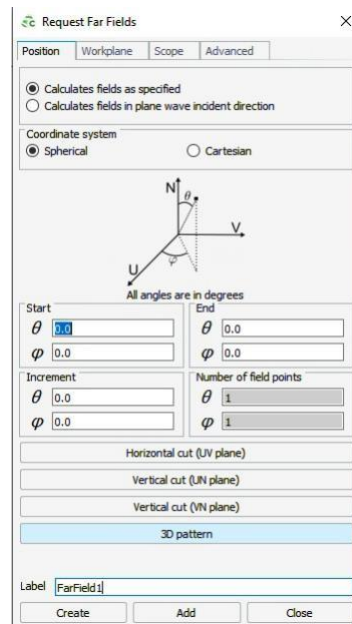
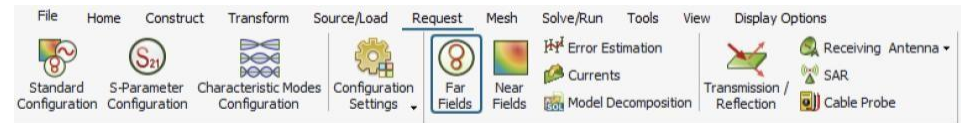


- i. Define the operational frequency of 300 GHz. Set the setting to single frequency.
- ii. Click the waveguide port button, choose the waveguide port face, and click create. This will tell FEKO where you would like your signal to begin.
- iii. Click waveguide source button and click create. This will provide the actual waveguide source for the simulation through the port previously defined.

d. Using the mesh tab, create a mesh for the antenna (just use automatic meshing)



e. Using the request tab, click the Far Field button and choose 3D pattern from the options at the bottom of the pop-up window. Then click create.



f. Save the antenna and give it an appropriate name.

- g. Using the Solve/run tab, click FEKO solver to run.



- 3) Using POSTFEKO,
- a. From the Home tab,
 - i. Click on the Far field button. This will allow you to see the 3D radiation diagram.
 - ii. Click on polar plot, then drag and drop the requested far field to generate the 2D radiation pattern. (hint: make sure to click on the dB checkbox in the Traces panel)

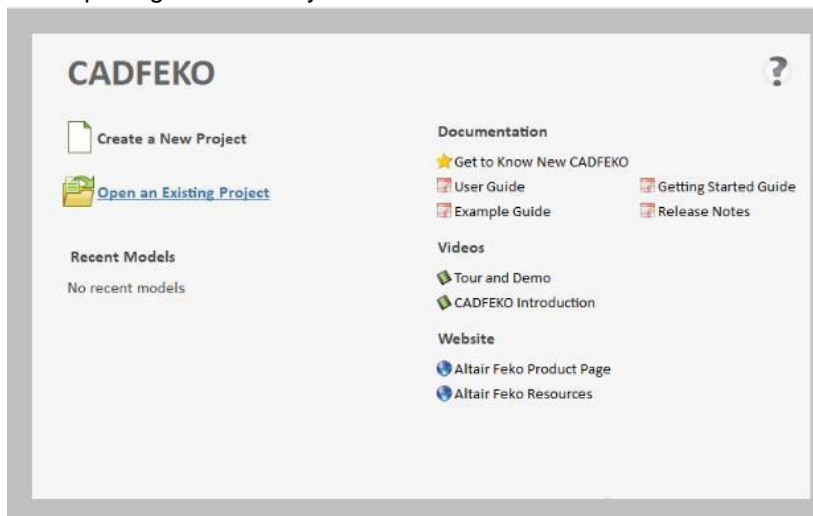


- iii. Select Theta (wrapped) from the independent axis (Angular) list to see the whole pattern.
- b. Do the results show the anticipated 15 dBi gain? If more gain is required, what modification needs to happen to the antenna?
 - c. For this type of antenna, increasing the effective area must be accompanied by increasing the length of the antenna as well. Could you explain why that is? How does this relate to the efficiency of the antenna?

Appendix: Accessing the VLAB and FEKO

FEKO is not a free software. For this course, we are going to leverage the license acquired by the UN Lab. In addition, FEKO is only compatible with Windows. To facilitate everyone's access to this tool, we are going to leverage the College of Engineering (COE) Virtual Labs:

1. Navigate to: <https://vlabduo.coe.neu.edu/>
2. Click the "VMware Horizon HTML Access" link (or feel free to install the client in your computer by Downloading the VMware Horizon Client to your PC/Mac).
3. Log in with your COE username and password. **This differs from your Husky username and password.** Your COE username is likely your first initial followed by your last name. For example: jmjornet for Josep Miquel Jornet or dbodet for Duschia Bodet
 - a. If you do not have a COE account, you can request one:
 - i. Make sure you are either connected to the university wi-fi (NUwave) or you are connected to the university's VPN
 1. See instructions for downloading GlobalProtect and connecting to the university VPN [here](#).
 - ii. Navigate to <https://www2.coe.neu.edu/account/register.cgi>
 - iii. Enter your information and click submit.
 - iv. You should receive an email with your account information/instructions.
 - b. If you do have a COE account but cannot remember the password you can request to change it [here](#).
4. Click the "COE Windows" desktop option
5. At this point, you should be logged into the virtual windows machine.
6. In the search bar type Feko to run the Feko 2022.3.2 app.
7. The tab that opens shows options for CADFEKO and POSTFEKO
8. After opening CADFEKO you should see this window.



9. If you are unfamiliar with Feko, we highly recommend watching the 7-minute "CADFEKO Introduction" video (circled) before starting the antenna design.

Submission Materials

Prepare a report that includes your answers, supported when needed with diagrams and/or screenshots of your design and results in FEKO, for both Parts A and B.

The report does not need to be a line-by-line answer, but more of a discussion. Just make sure that you answer all the questions.