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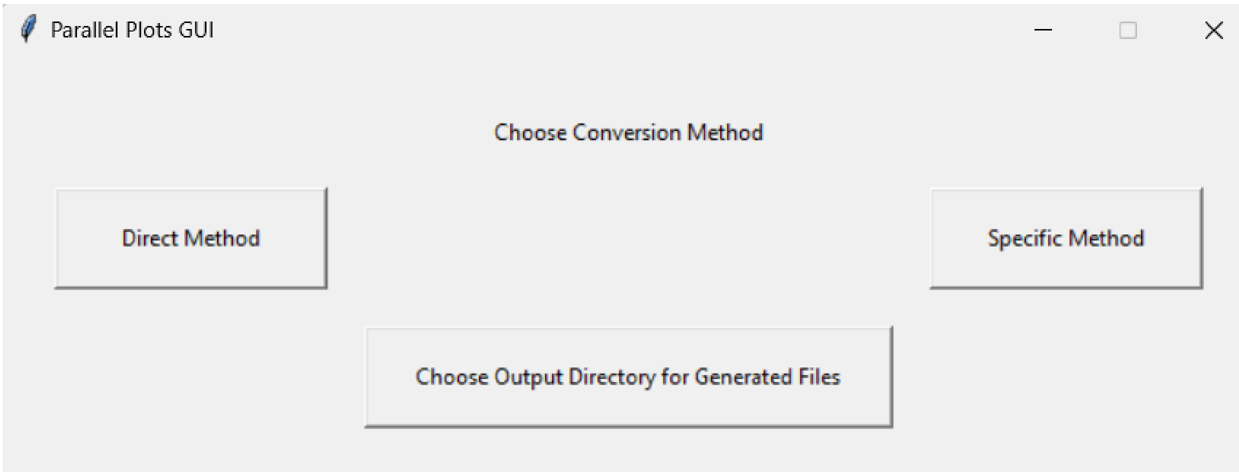
1. MAIN MENU

Upon launching the GUI, the first screen you should encounter is as follows:



From here, you can choose between the direct and specific methods for generating tabular data for parallel plots. Additionally, here one can select the output directory for all generated/exported tabular files in .txt format. If an output directory is not selected, all generated files will appear in the same directory as the Python file for the GUI.

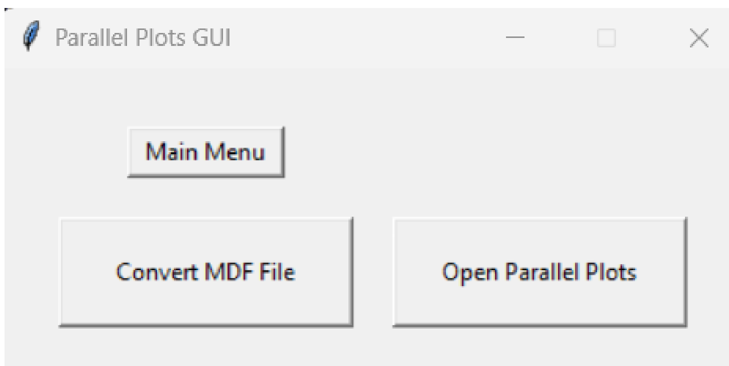
Any main menu button seen at any other point in the GUI will take you back to this screen.

2. DIRECT METHOD

The direct method is intended for generating tabular data directly from a .MDF file created via Load Pull simulation in AWR. This expedites the process of being able to go from Load Pull to Parallel Plots without having to create and export tabular files from AWR manually. The drawback is that not all measurement types are supported, as they each have to be calculated manually from A/B waves. The currently supported measurement types are:

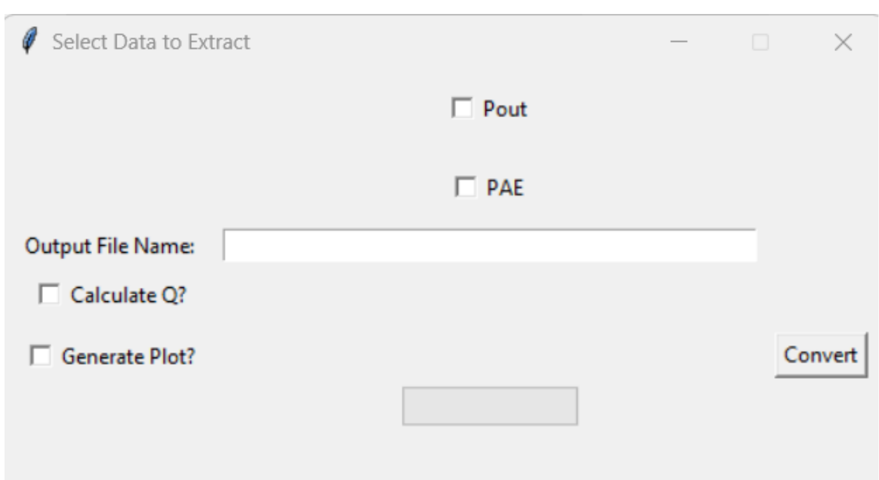
- PAE (Power Added Efficiency)
- Output Power

Choosing this method from the main menu will yield the following screen:



From here, one can launch the Parallel Plots application in a new browser window by clicking "Open Parallel Plots" or begin an MDF conversion by clicking "Convert MDF File". This will open a file explorer prompting for the selection of an MDF to convert.

After selecting an MDF file, the following menu will appear:



From this menu, the desired measurement types can be selected and deselected at the user's discretion. One tabular file will be generated for each measurement selected, and will be in the directory specified by the user in the main menu, if applicable.

An output file name can be optionally provided to dictate the naming convention of the tabular files. If only one measurement is selected, the tabular file's name will be identical to what is specified in the entry box. If multiple measurements are selected, the tabular files will contain the name followed by the measurement type, separated by an underscore. If no file name is provided, the tabular files will be named identically to the source MDF followed by the word "Converted" and the measurement name, if relevant.

If "Calculate Q" is selected, a notation will be made in the tabular file that indicates to the Parallel Plots application to calculate Q-factor for both the source and load. Note that the tabular file will remain virtually identical and Q-factor data will NOT be present in the tabular file, as this is calculated when uploading to the Parallel Plots application.

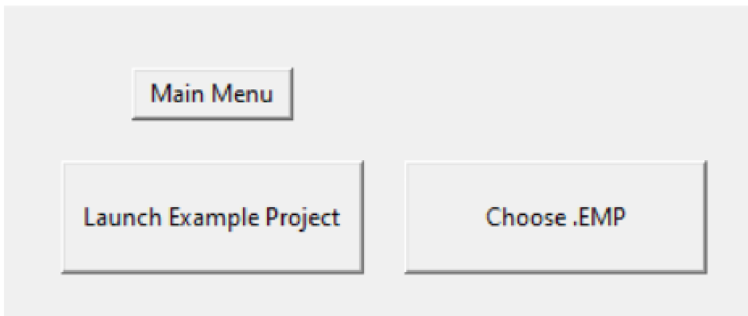
If "Generate Plot" is selected, a preliminary version of the parallel plots will be generated using Python's paxplot library for the last measurement selected. While this does not allow for the solution checking and intractability of the primary application, this can be used to verify that the correct MDF was selected and the tabular data was generated correctly as a sanity check.

For larger MDF files, the progress bar will be a useful indicator of how much of the file has been converted to tabular. Additionally, an estimate for the time remaining for the conversion will display for exceptionally large MDF files. Note that the progress bar and time remaining is an indicator for the current file being worked on, which corresponds to a single measurement type. If multiple measurement types are selected, there will be one full iteration of the progress bar per measurement and it will reset for the next one.

3. SPECIFIC METHOD

The specific method is intended for simulations in circumstances where a normal Load Pull will not be applicable in AWR. This can include simulations on schematics with multi-stage designs, sensitivity analysis, and more. Additional measurement types as well as PAE and Output Power can also be simulated as the parallel plot code will separate out the individual column types (PGain, Itime, Vharm, etc). Specifically, the GUI provides an easy interface for simulating sweeps for different schematics in an AWR project.

Upon choosing Specific Method, the user is presented with the following menu:



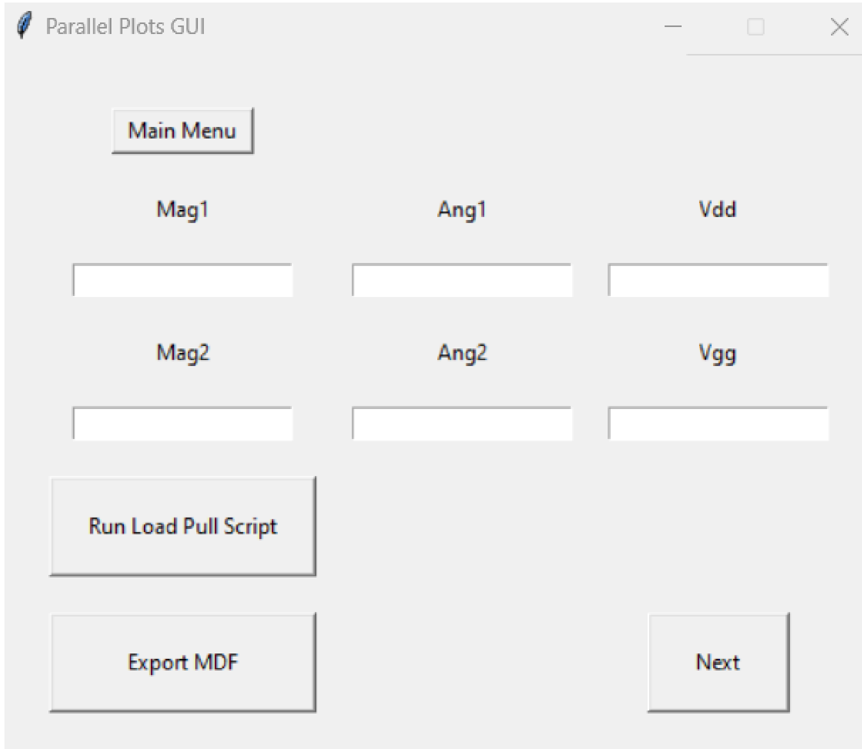
Clicking "Launch Example Project" will attempt to open "Parallel_Plot_Example_File.emp" in AWR. If this file does not exist, the operation will fail.

Alternatively, the user can click "Choose .EMP" to select an AWR project file to launch AWR with, and the GUI will bring the user directly to the sweeps interface.

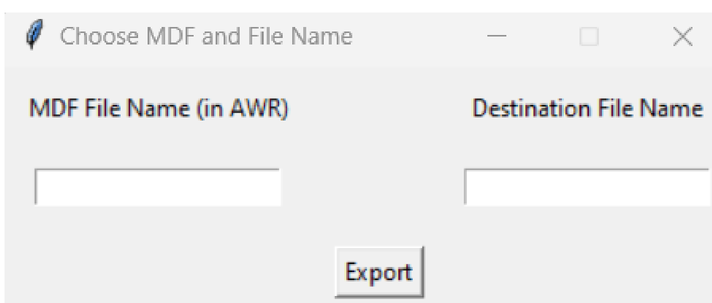
Note that this step needs to be done for all GUI interactions with AWR. There is no way for the GUI to detect an instance of AWR that is already open with a desired project.

3a. EXAMPLE PROJECT

If launching the example project, the user will be presented with the following screen:

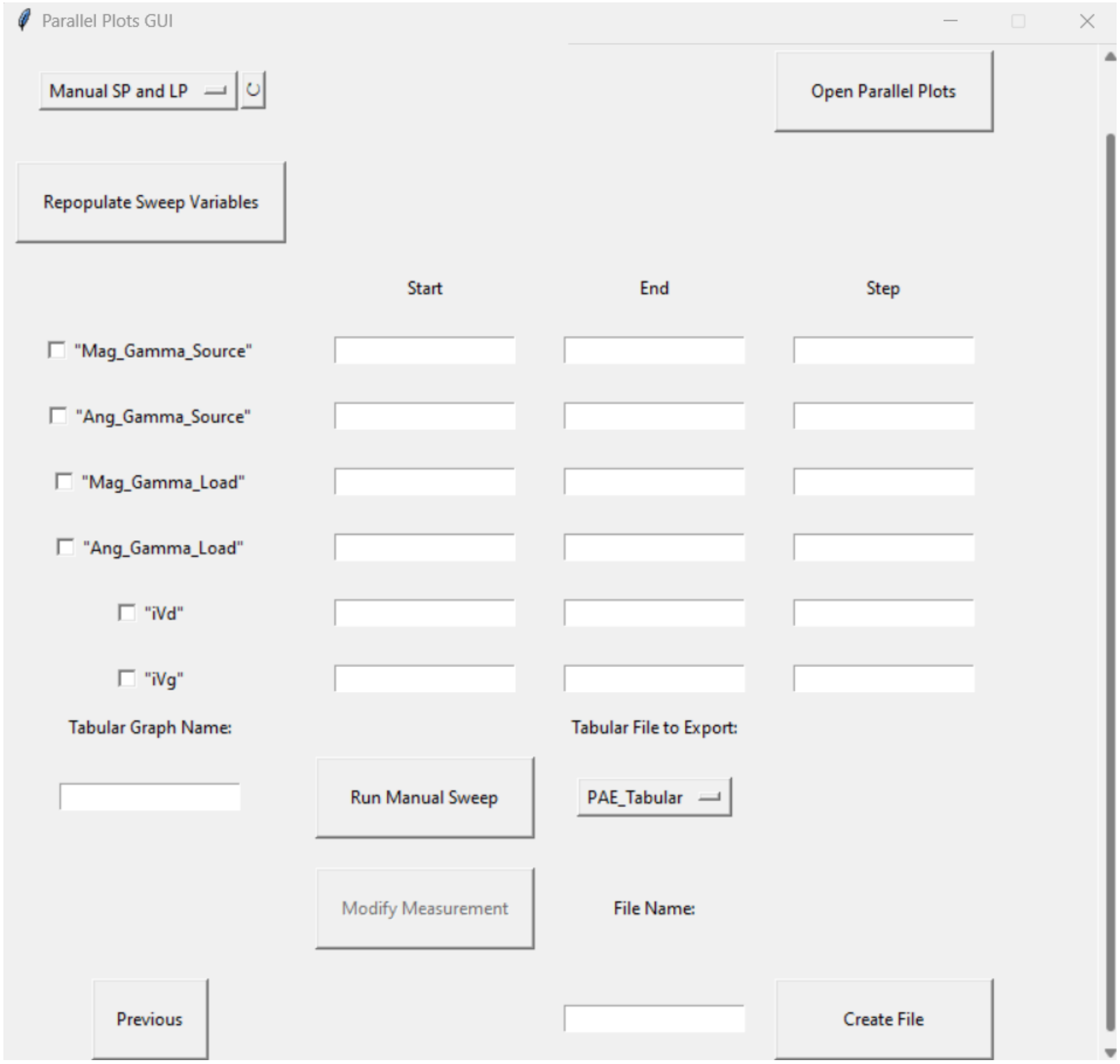


This menu allows the user to specify values for the relevant variables in the "Load_Pull_Template" schematic, and run a Load Pull simulation by clicking "Run Load Pull Script". Clicking this button will populate the specified values from the GUI into the schematic and then launch AWR's Load Pull tool. Once the desired Load Pull has been simulated, the user can export the corresponding MDF, which is helpful if the user wants to use the results of this simulation in the direct method provided by the GUI:



Clicking the "Next" button will bring the user to the sweeps interface, which is where the user is originally brought if selecting their own project in the specific method.

3b. SWEEPS INTERFACE

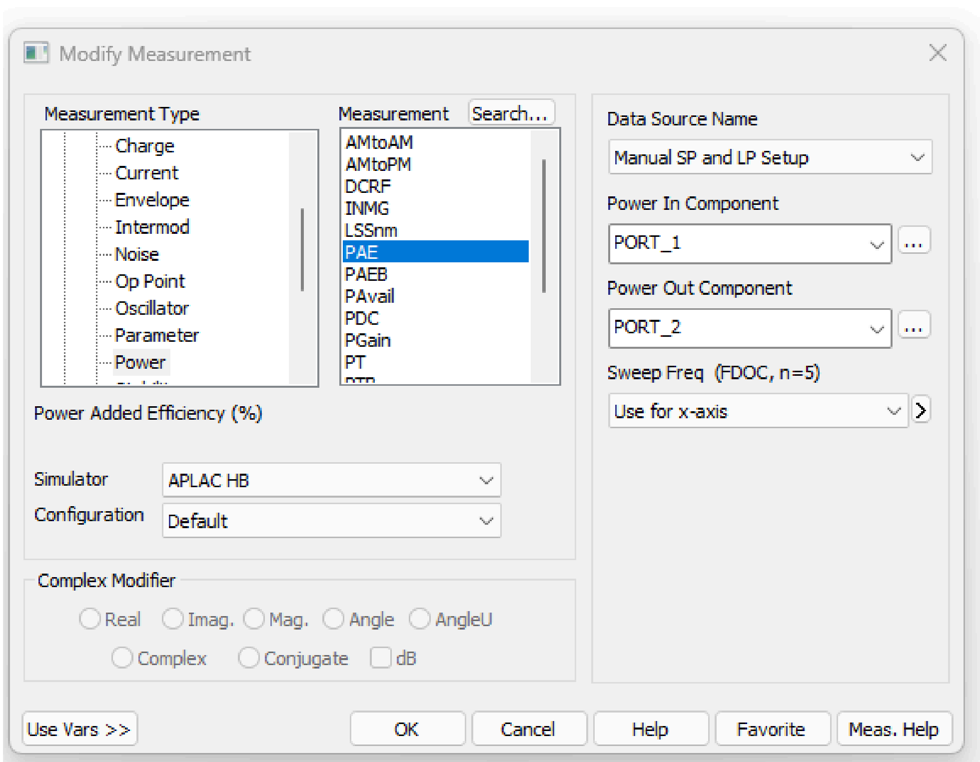


The sweeps interface allows the user to choose between any of the schematics in their currently open AWR project and create sweeps for the relevant variables in each schematic. Note that these entries are currently determined by retrieving all the “SWPVAR” elements from each schematic. If the user wants to create another variable to sweep, the user needs to add another SWPVAR element to their AWR schematic and then click “Repopulate Sweep Variables” in the GUI to see the new corresponding row.

If the user wants to create a new schematic in their project and have it be visible in the GUI, one simply needs to click the refresh icon next to the schematic dropdown list after the schematic is created and the new schematic will be inserted into the list.

The checkboxes will allow the user to dynamically enable and disable SWPVARs in the currently selected schematic, which allows the user to quickly specify a variety of different sweeps to simulate in AWR. Once the user is satisfied with their chosen values, clicking "Run Manual Sweep" will perform the simulation in AWR. This is the direct equivalent of clicking the "Simulate" button in AWR.

A new tabular file will be generated at the completion of the simulation. If the user optionally provided a name, the tabular file will be named exactly as specified by the user. Otherwise, by default it will be named "Tabular 1" and all subsequently created tabular files will follow this same naming convention ("Tabular 2", "Tabular 3", etc.) By default, the measurement type will be PAE for the first created tabular file, and this can be subsequently changed by clicking on the "Modify Measurement" button. Depending on the new measurement, this may cause the program to run a new simulation.



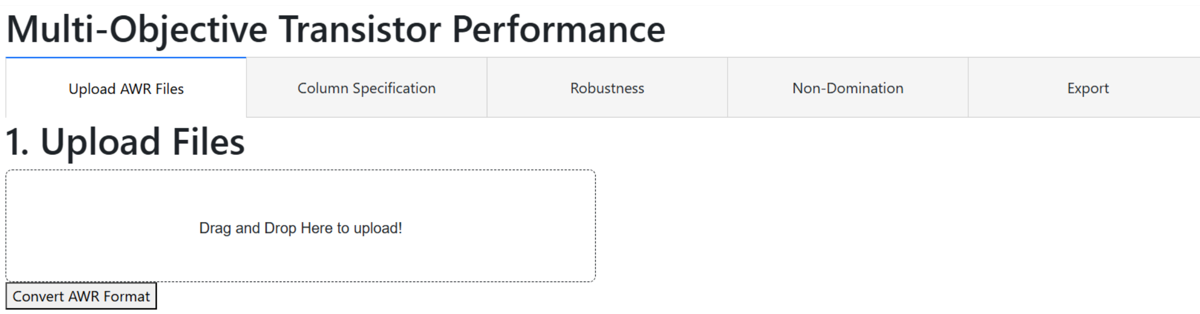
After any new simulation performed by the GUI, the corresponding tabular file should appear in the dropdown in the bottom right of the menu. From here, it can be selected and directly exported to a .txt file with an optionally specified name. If a name is not specified, it will retain the same name as displayed in AWR.

Note that the tabular data will be for the most recent measurement simulated for that given file in AWR. The most efficient method for generating multiple tabular text files is probably to run a simulation, export the file, modify the measurement and repeat, recycling the same tabular file in AWR for each measurement. Alternatively, a new AWR tabular file can be created for each different measurement type by clicking “Run Manual Sweep” and then modifying the measurement for each one. This is most useful if wanting to preserve the tabular data for each measurement in AWR for future use.

As in the direct method, a button is also present at the top right to allow the user to launch the Parallel Plots application in a new browser window.

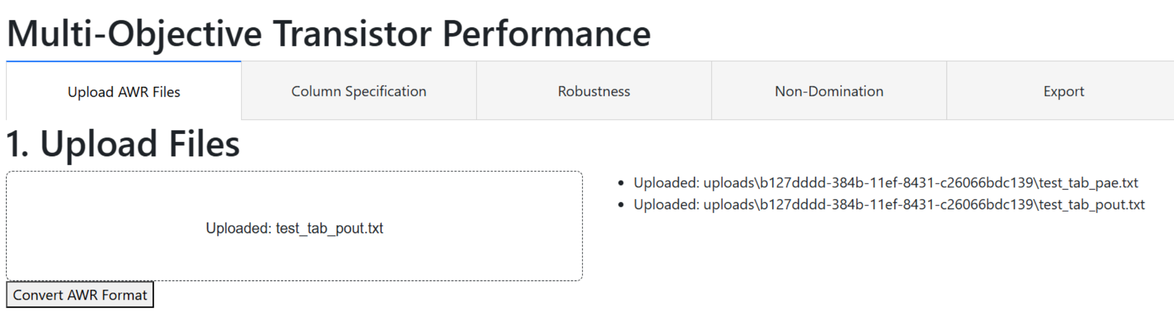
4. PARALLEL PLOTS

The user should see the following upon attempting to launch the Parallel Plots application:

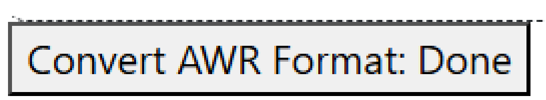


The user can either drag and drop files from an existing window to upload them, or click directly on the upload box to open a file explorer, prompting for the selection of the tabular text files. Up to 5 files can be selected for inclusion in the generated parallel plots.

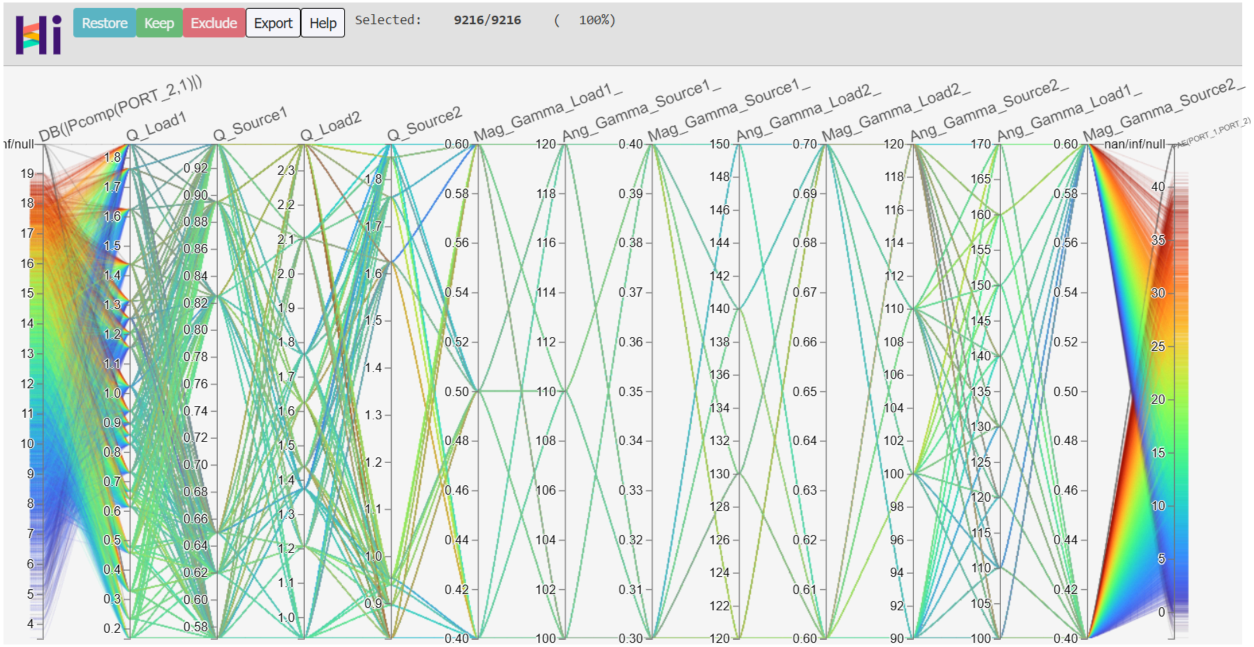
After selection, wait until the files appear as uploaded on the right side of the screen before continuing:



Once the files are uploaded, click on the "Convert AWR Format" button and wait until the word "Done" appears in the button. During this process, the browser tab should say "Updating…" while it is working, although there will be no other visual indication on the screen that the application hasn't crashed or thrown an error.



Once the conversion is done, the user can click on "Column Specification" to view the parallel plots and make selections for which columns will serve as the decisions, states, and objectives.



Once the user has selected their columns, the 3rd tab can be used to compute robustness, and the 4th tab can be used to compute all non-dominated solutions. Lastly, the user can export the computed data so it can be directly opened as an .HTML file later without having to upload the tabular data and make the column selections again.

MDIF Conversion Slides

.mdf file contains, a and b waves, Vgg, Vdd, igg, idd.

$$mag = \sqrt{Re^2 + Im^2}$$

$$P_{in} = \frac{mag(a_1)^2}{2}$$

$$P_{del} = \frac{mag(a_1)^2 - mag(b_1)^2}{2}$$

$$P_{out} = \frac{mag(b_2)^2 - mag(a_2)^2}{2}$$

$$P_{dc} = V_{dd} * I_{dd}$$

$$PAE = \frac{(P_{out}(Watts) - P_{in}(Watts)) * 100}{P_{dc}}$$

$$PAE(del) = \frac{(P_{out}(Watts) - P_{del}(Watts)) * 100}{P_{dc}}$$

$$Power_{dBm} = 10 * 10\log(Power_{Watts}) + 30$$

$$Power_{watts} = \frac{10^{\frac{power_{dBm}}{10}}}{1000}$$

$$Q = \frac{Imag(Z)}{Real(Z)}$$

$$Gamma = \frac{mag(a_i)}{mag(b_i)}$$

$$Gamma\ Load = \frac{mag(a_2)}{mag(b_2)}$$

$$Gamma\ Source = \frac{mag(a_1)}{mag(b_1)}$$

$$ang(a_i) = tan^{-1}\frac{im(a_i)}{re(a_i)}$$

$$angle = ang(a_i) - ang(b_i) + 360$$

Installation Instructions:

This application was tested on Python 3.9. If you experience any issues with packages on later versions of Python, consider downgrading to Python 3.9.

The following instructions assume you already have a valid Python installation, including pip.

1. Clone into the following Git repository: https://github.com/damc8609/parallel_plots_gui
2. In a terminal, navigate to the installed folder and run ***pip install -r requirements.txt,*** which will install all required packages.
    a. In the event that future package releases cause compatibility issues, ***validated_requirements.txt*** attempts to install known working versions of each package that were used for testing the application. Run the ***pip install*** command on this file if there are any issues with importing the packages.
3. Run ***python gui.py*** in the terminal window to run the Python application.