AEDT Automation Development with PyAEDT

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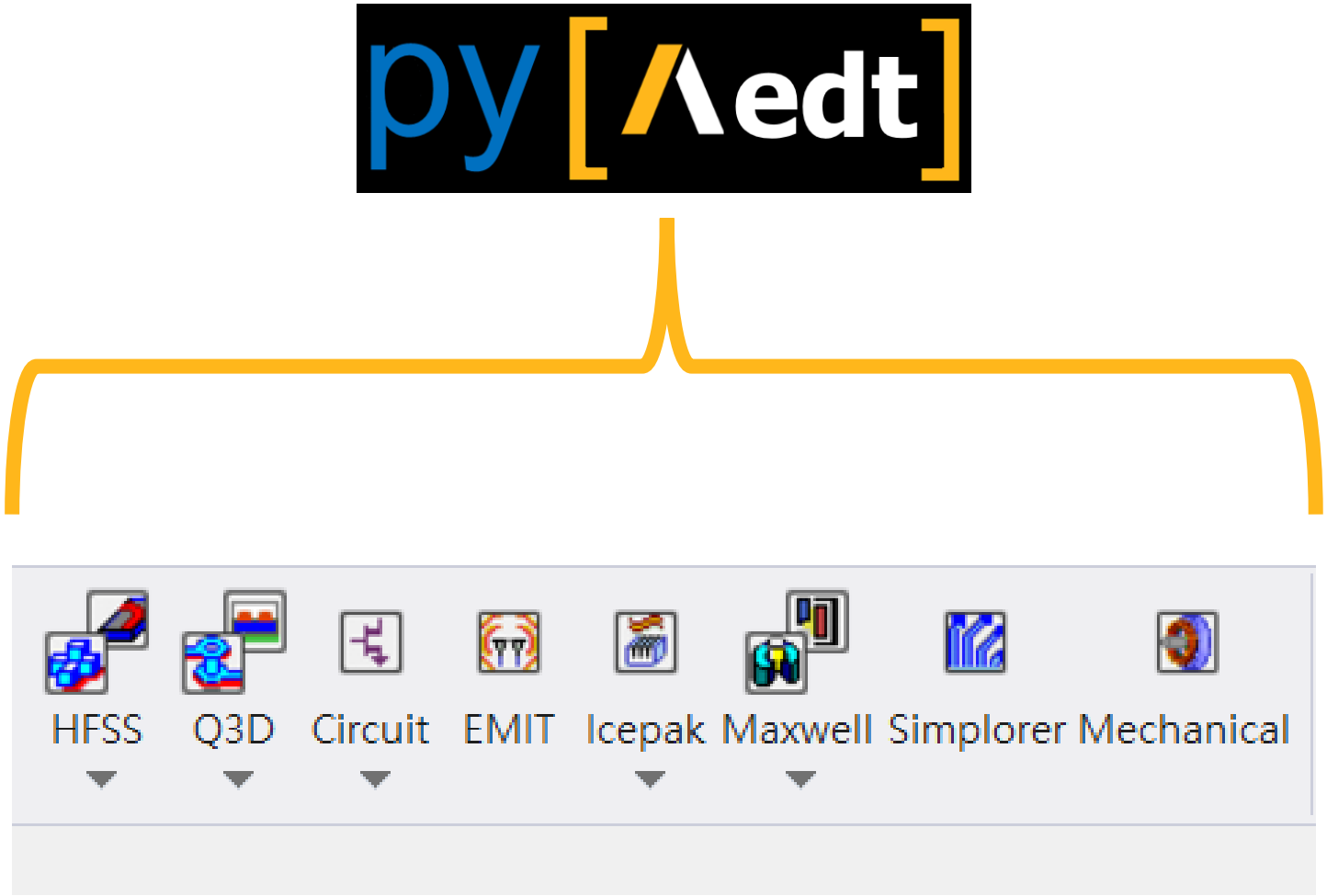
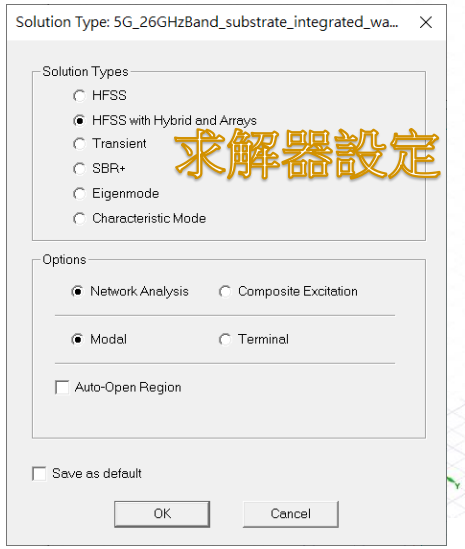
Ansys

Agenda

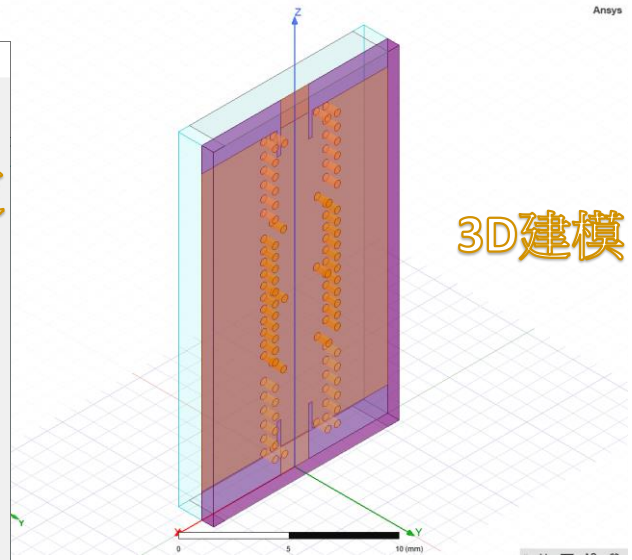
- PyAEDT Overview
- Examples Demo
- Installation
- IDE Introduction
- Scripting Demo



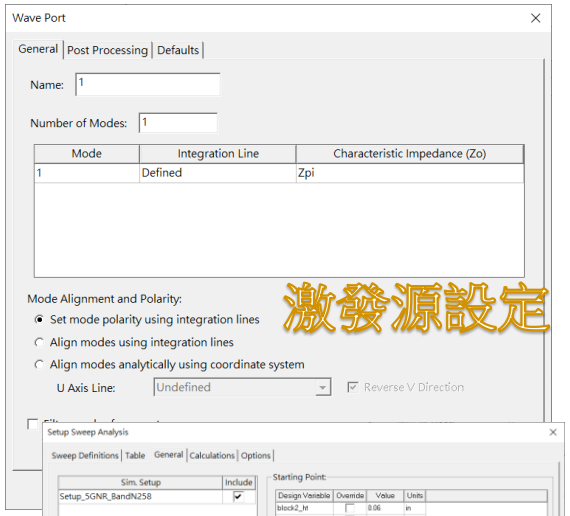
PreSim Setting in AEDT HFSS



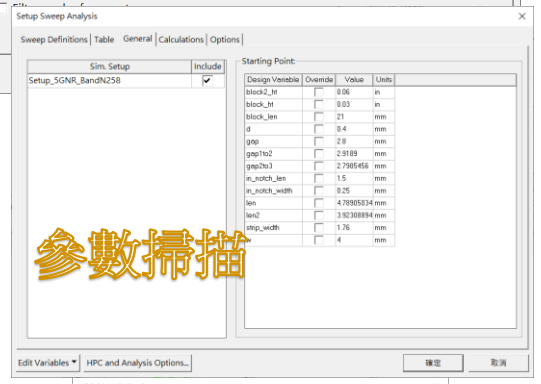
求解器設定



3D建模

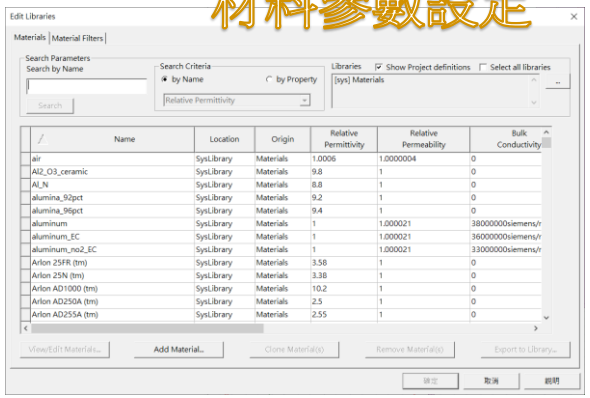


激發源設定



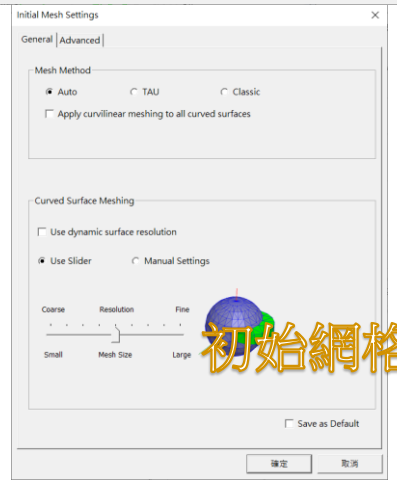
參數掃描

邊界設定

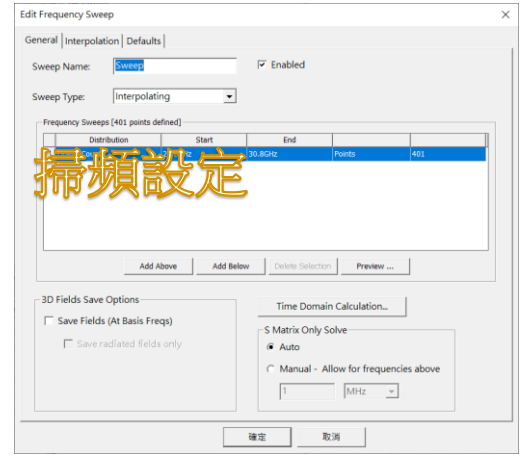


材料參數設定

收斂設定

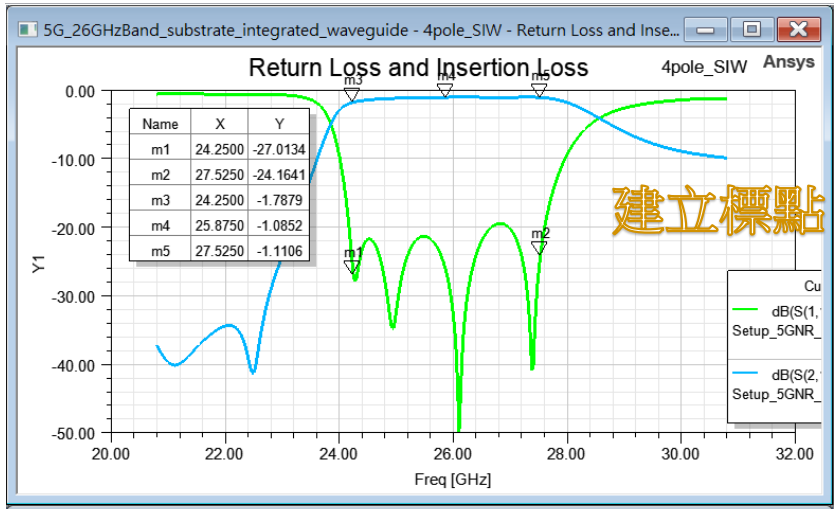


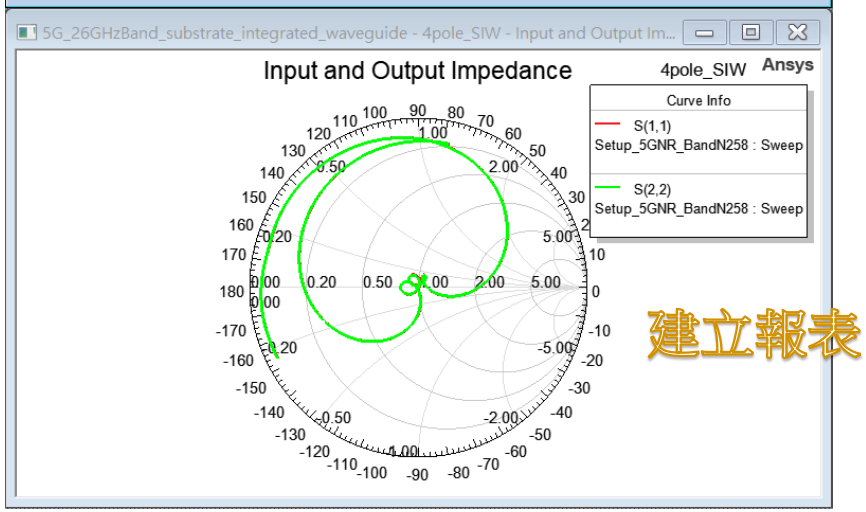
初始網格設定

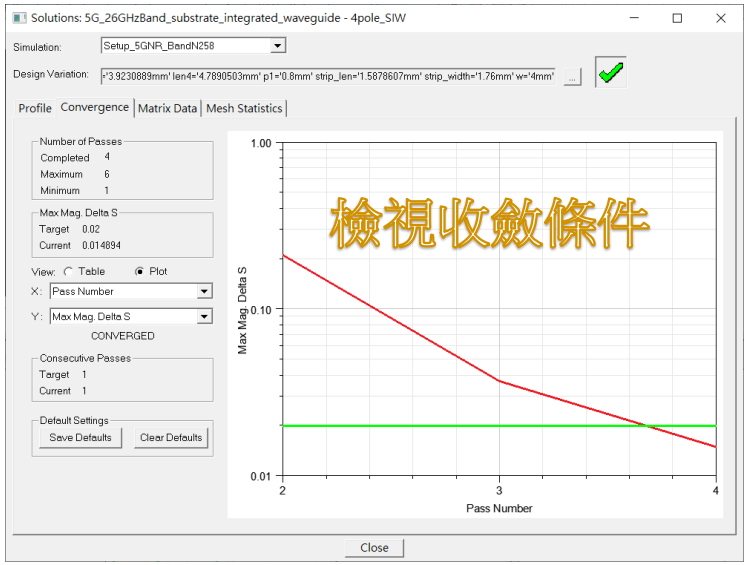


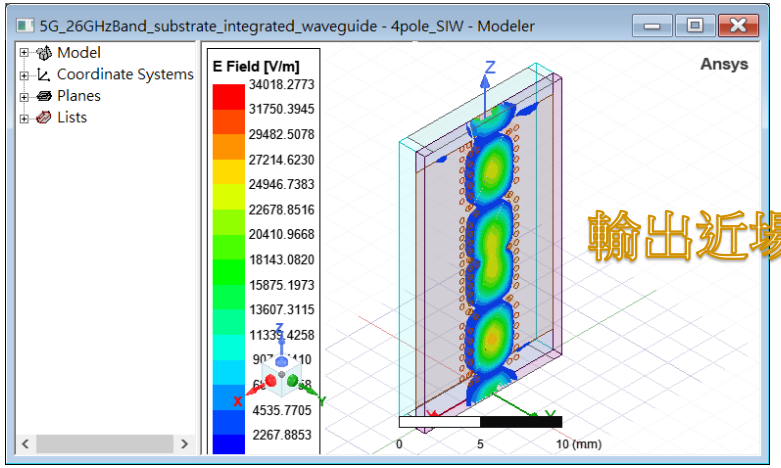
掃頻設定

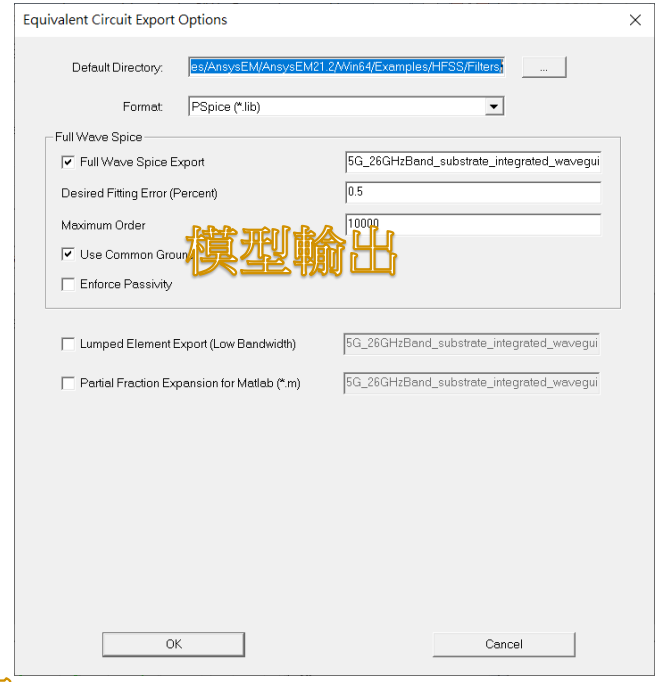
PostSim Setting in AEDT HFSS











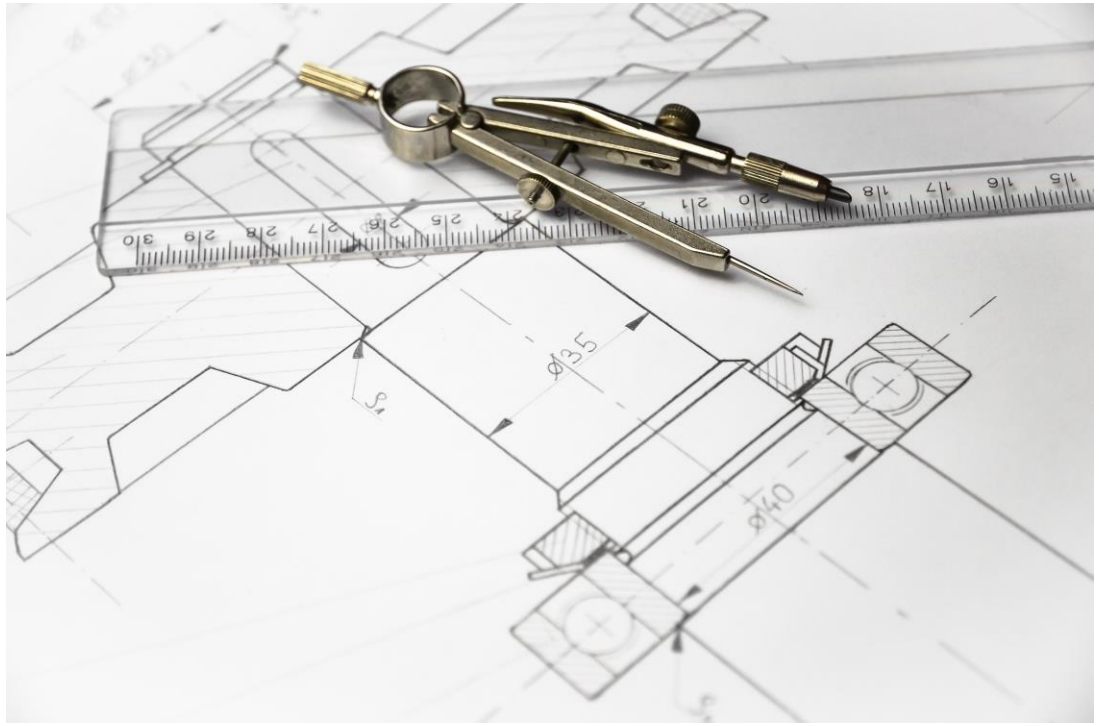
Typical GUI-Based Setting Flow

GUI is the native operation mode but there exist drawbacks:

- GUI license is long time occupied.
- Setting mistakes is easy to happen.
- Settings are distributed in dozes of windows, difficult to inspect.
- Comments of the settings are not supported.
- Hard to compare setting and data between projects and designs.
- Takes time to organize report and simulation data
- Advanced data processing is limited(e.g. Machine Learning)

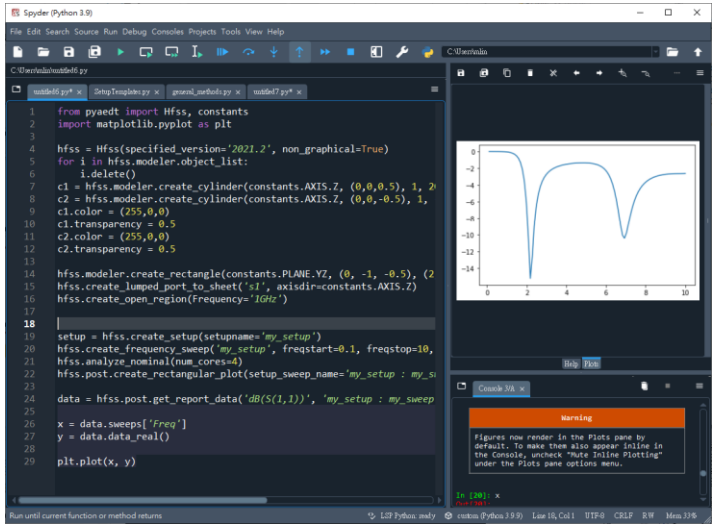
Python + PyAEDT + Jupyter Notebook/Streamlit

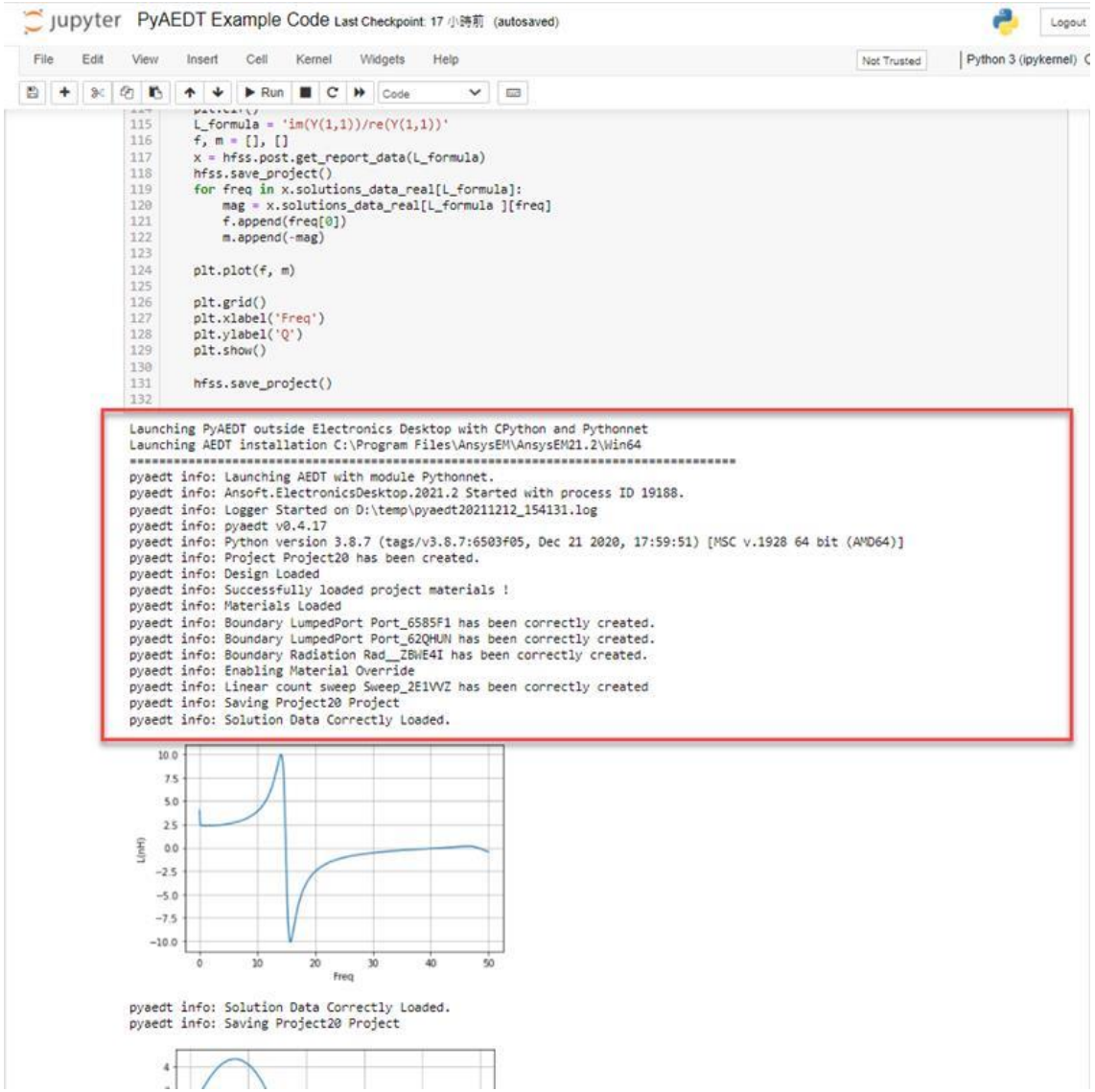
- Research and Design Optimization, like:
  - Design of Experiment
  - Variation and Yield Analysis
  - Data Processing
- Multi-Physics
  - Electrical-Thermal-Mechanical
  - Electrical-Optical
  - …
- Automate Routine Jobs, like:
  - Model Extraction
  - Signal Process
- Interactive Training Material, like:
  - Mode Theory
  - Array Antenna Mechanism



Examples

- Dipole Antenna Sweep
- Spiral Inductor Simulation
- PCB Model Extraction
- Package 3D Modeling





PyAEDT Overview

What is PyAEDT

- PyAEDT is a Python library that interacts directly with the AEDT API to make scripting simpler for the end user. It uses an architecture that can be reused for all AEDT 3D products (HFSS, Icepak, Maxwell 3D, Q3D and Mechanical) as well as 2D tools and circuit tools like Nexxim and Simplorer.
- Finally, it provides scripting capabilities in Ansys layout tools like HFSS 3D Layout and EDB. Its class and method structures simplify operation for the end user while reusing information as much as possible across the API.

Classical API

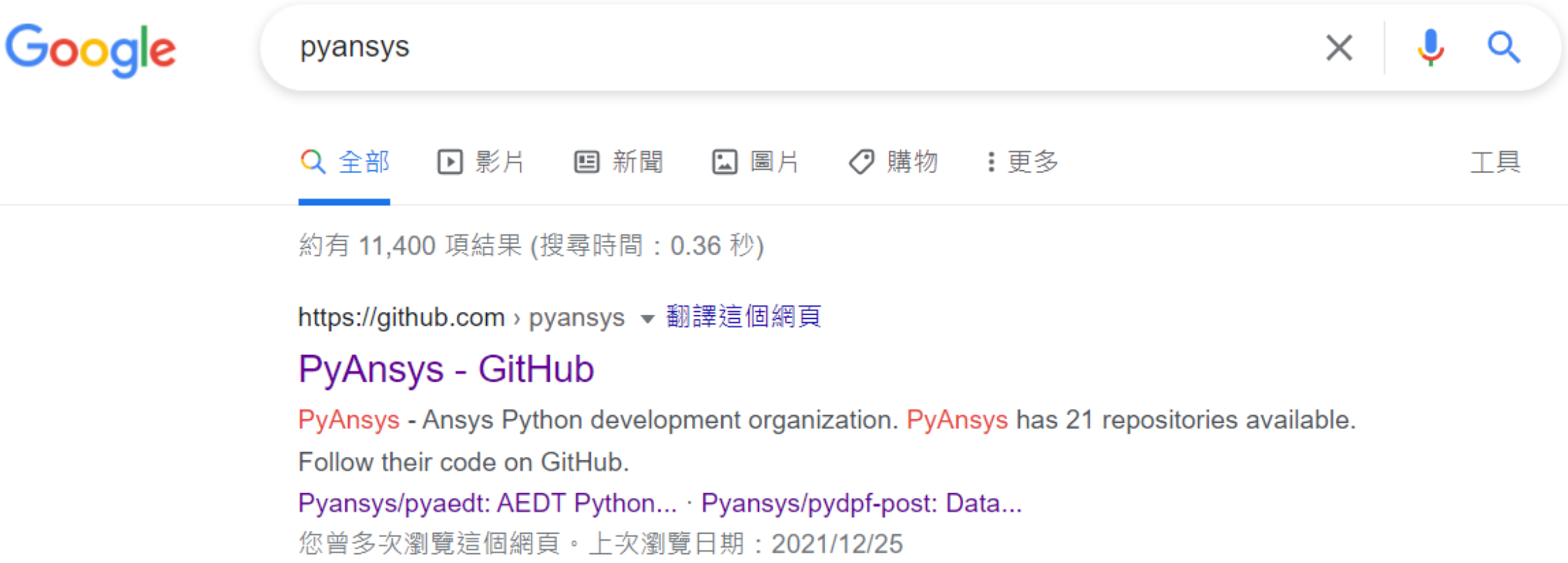
A quick and easy approach for automating a simple operation in the AEDT UI is to record and reuse a scripts. However, disadvantages of this approach are:

- Recorded code is dirty and difficult to read and understand.
- Recorded scripts are difficult to reuse and adapt.
- Complex coding is required by many global users of AEDT.
- No IDE can be used for code development.
- C-python modules can’t be integrated.

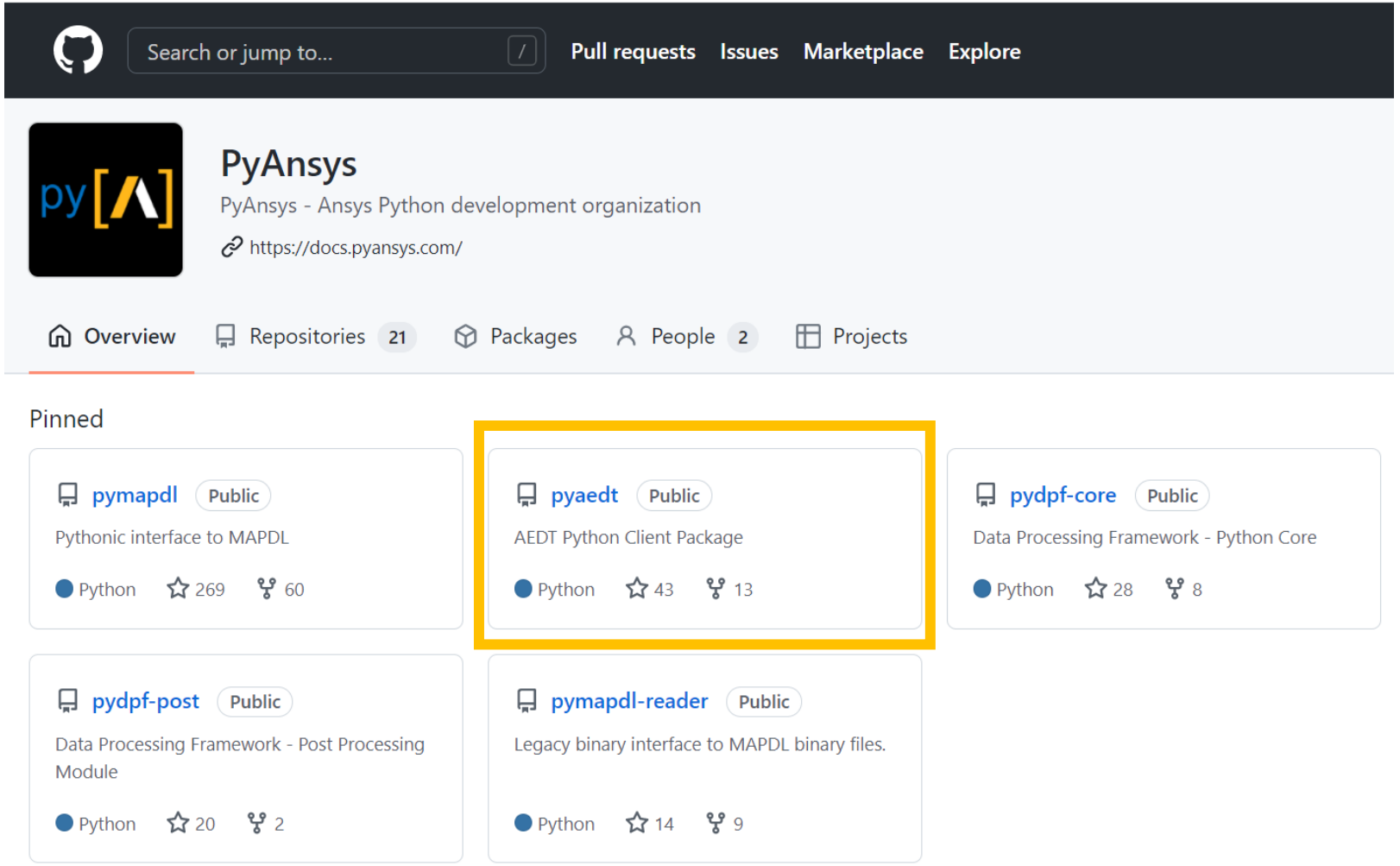
The Main Advantages of PyAEDT API

- Automatic initialization of all AEDT objects, such as desktop objects like the editor, boundaries, and so on
- Error management
- Log management
- Variable management
- Compatibility with IronPython and CPython
- Simplification of complex API syntax using data objects while maintaining PEP8 compliance.
- Code reusability across different solvers
- Clear documentation on functions and API
- Unit tests of code to increase quality across different AEDT versions

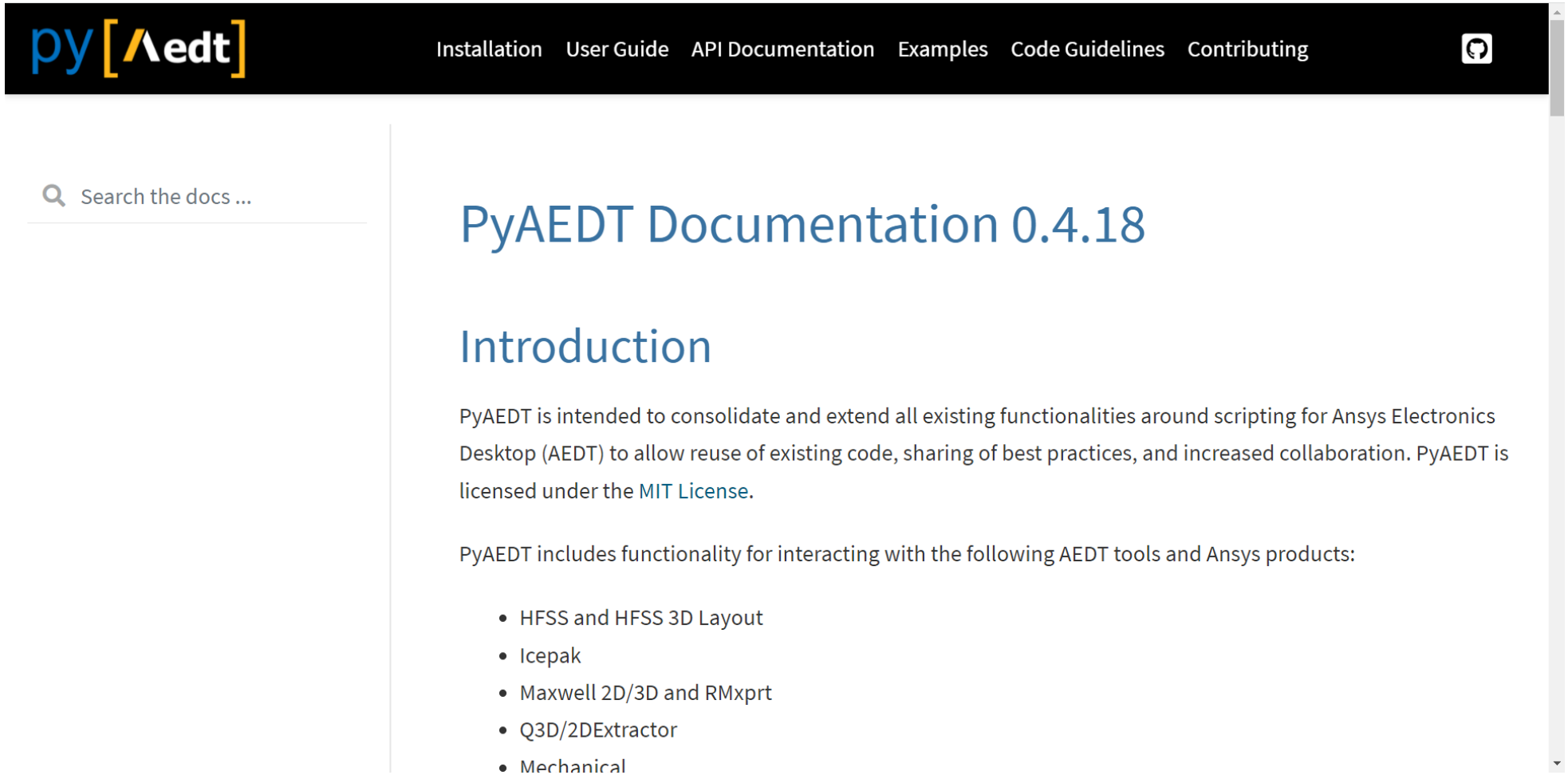
Google PyAnsys



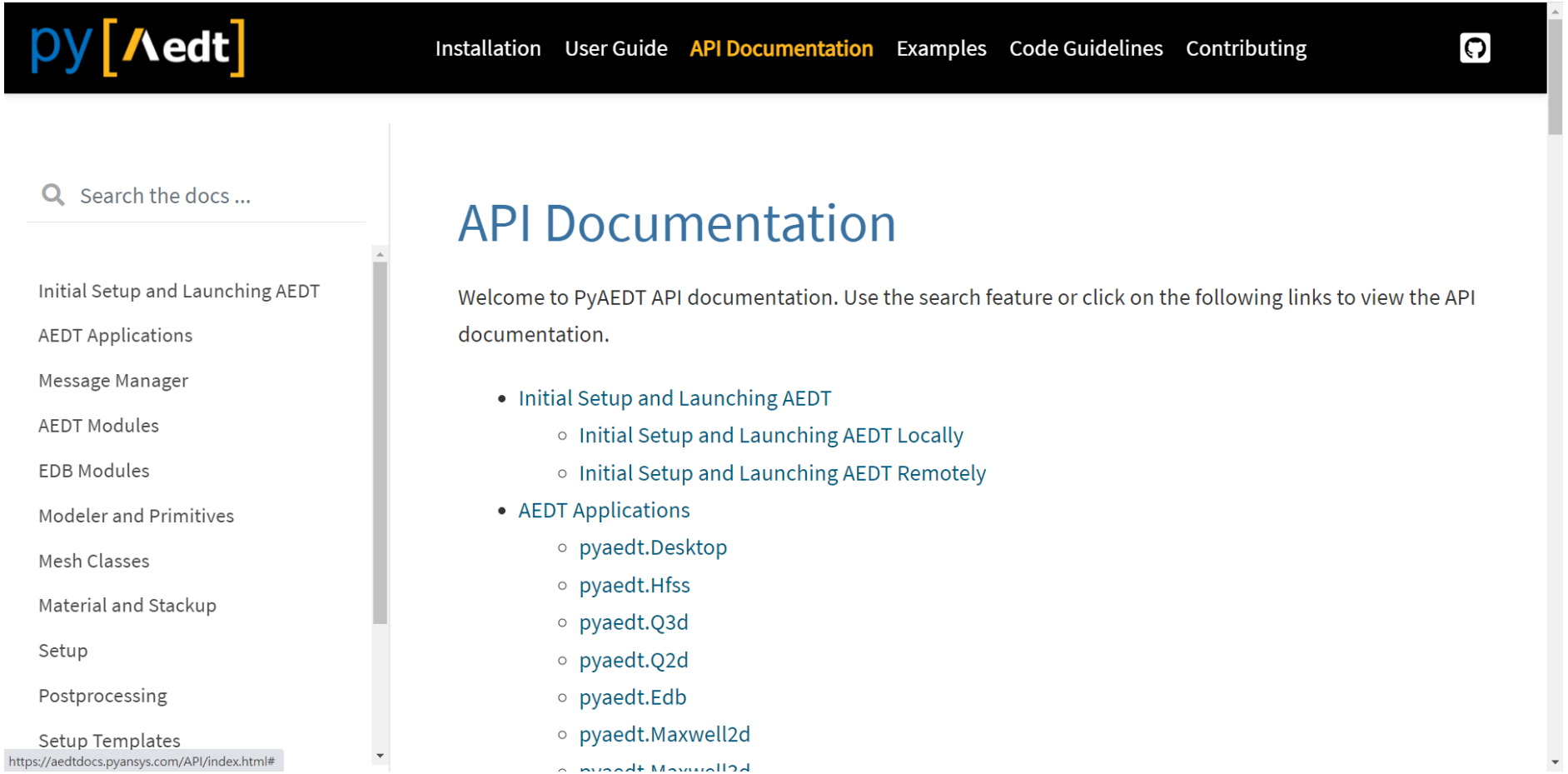
Source Code in Github



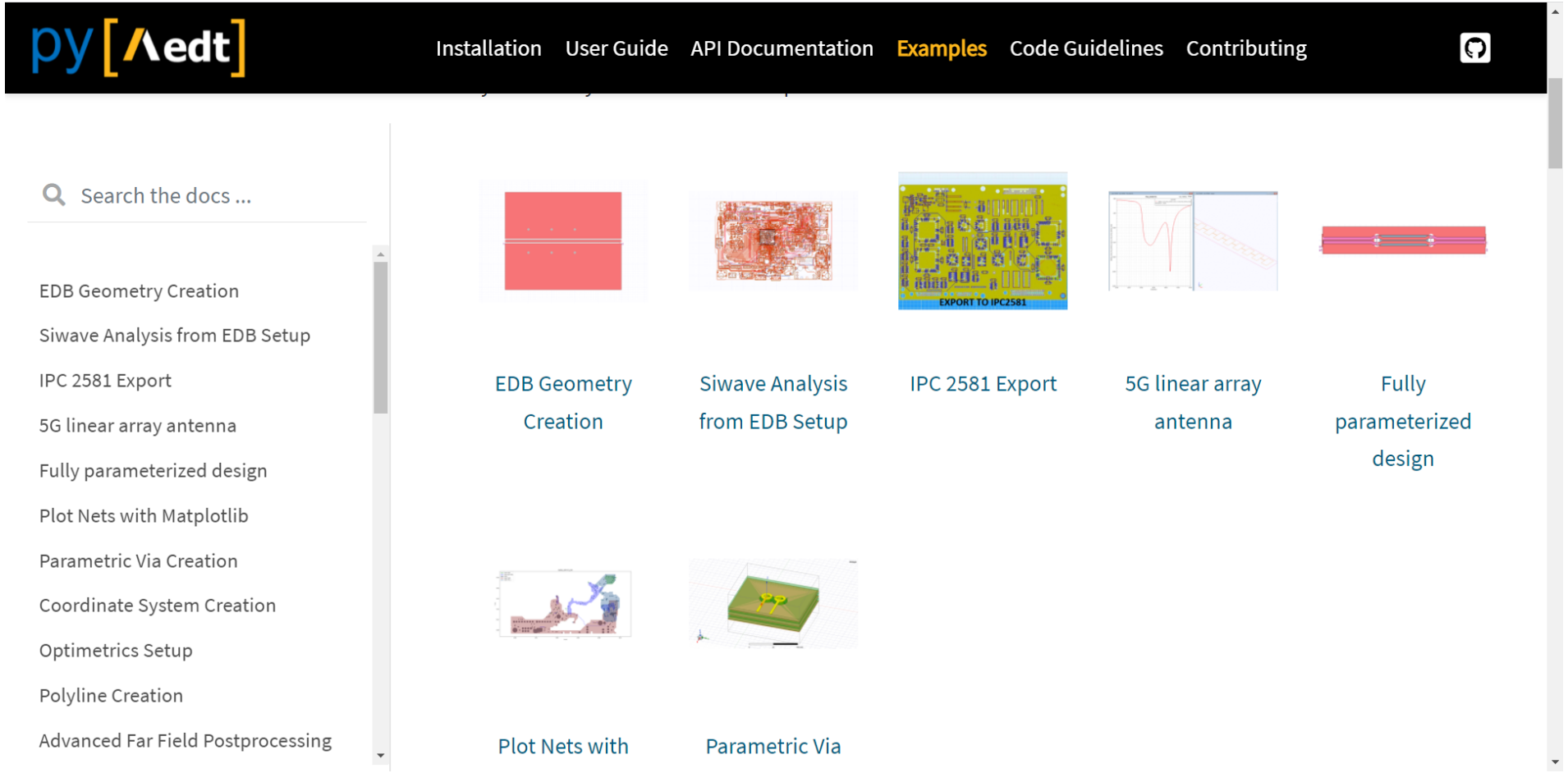
https://aedtdocs.pyansys.com/



API Documentation



API Example

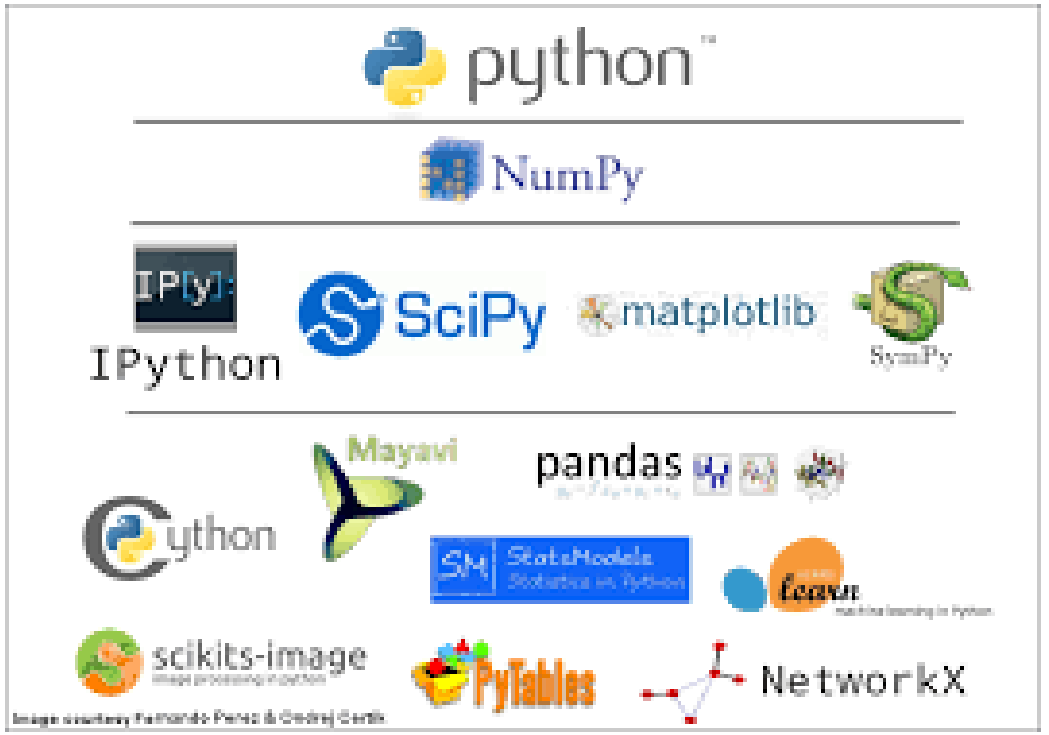


Installation of PyAEDT Module

Python安装: https://www.python.org/downloads/windows/

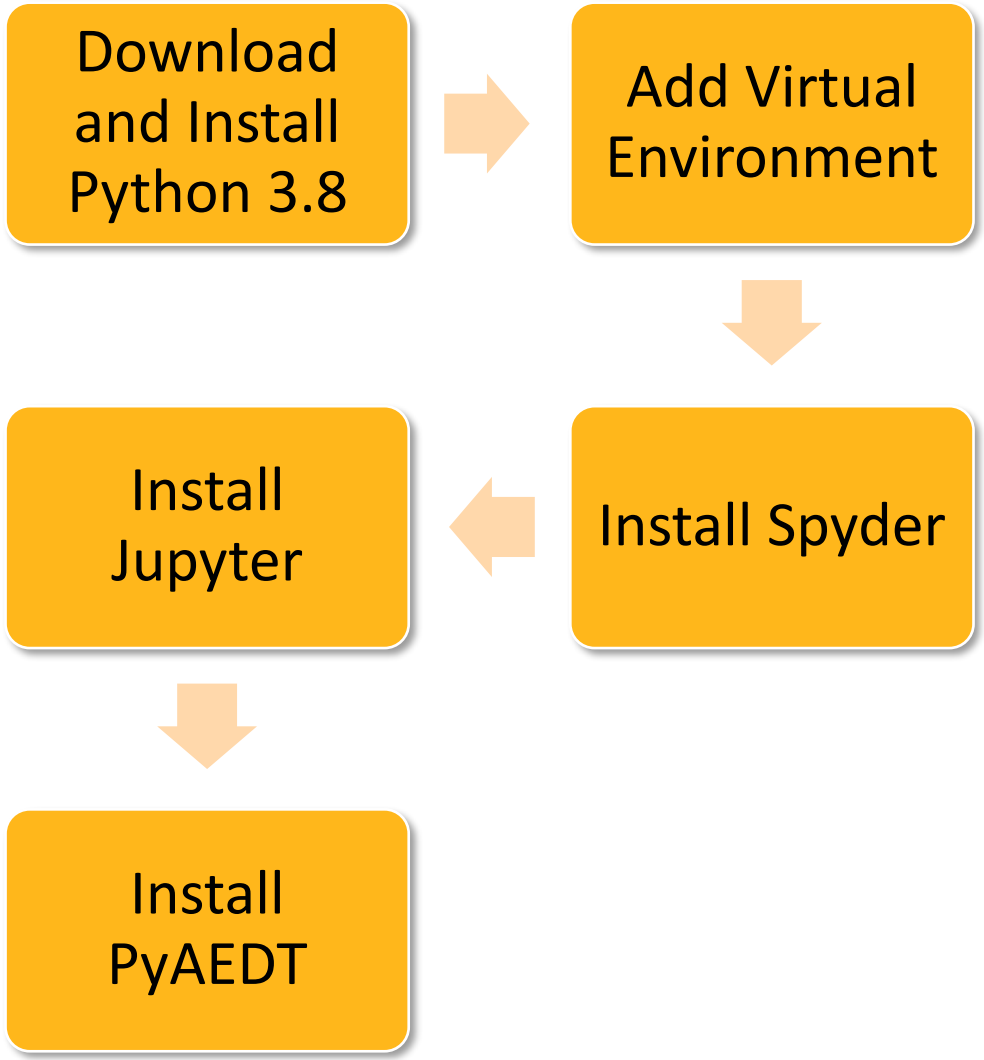
Note that Python 3.8.9 *cannot* be used on Windows XP or earlier.

- Download Windows embeddable package (32-bit)
- Download Windows embeddable package (64-bit)
- Download Windows help file
- Download Windows installer (32-bit)
- Download Windows installer (64-bit)



Installation Flow

- 下載並安裝Python套件
- 開啟Command視窗，建立虛擬環境
  - .\python -m venv D:\demo_env\myenv
- 啟動虛擬環境
  - .\activate
- 安裝Spyder IDE(Integrated Development Environment), Jupyter
  - pip install spyder
  - pip install jupyter
- 安裝pyaedt
  - pip install pyaedt



Installation and Initial Setup

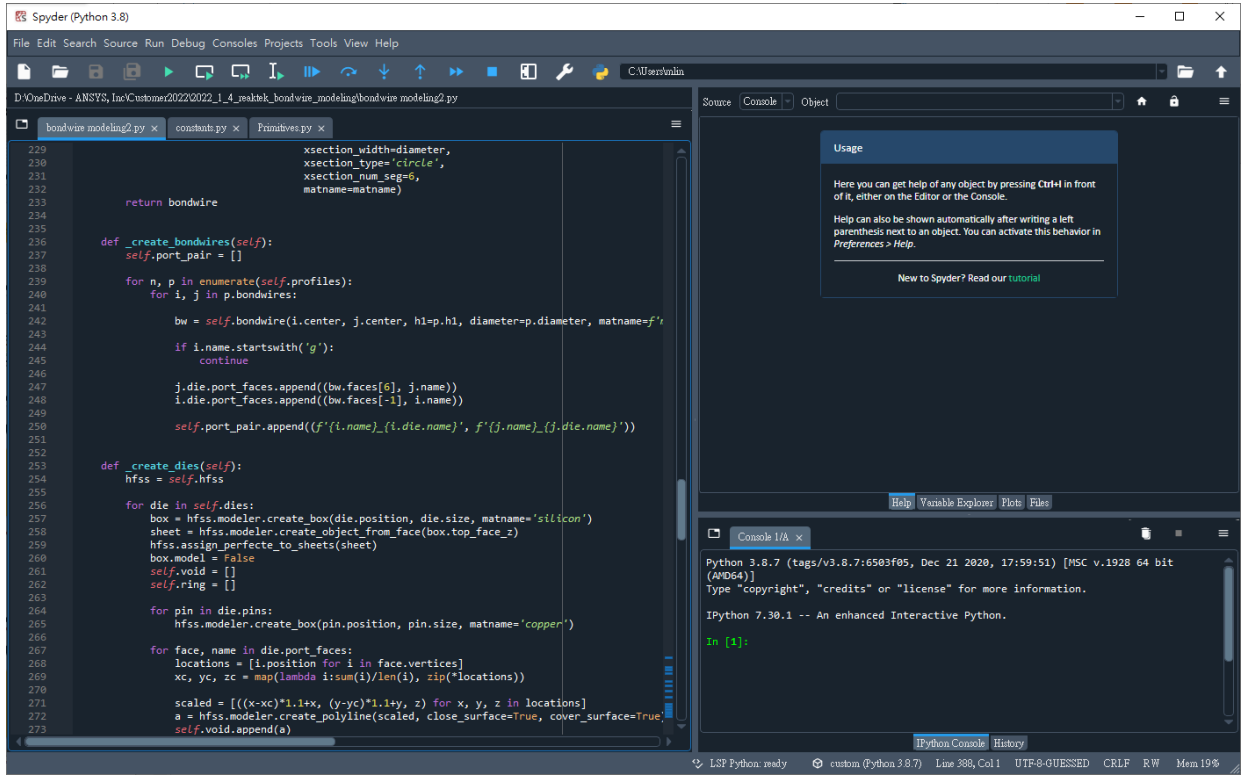
- PyAEDT consolidates and extends all existing capital around scripting for Ansys Electronics Desktop (AEDT), allowing re-use of existing code, sharing of best practices, and collaboration.
- This tool has been tested on HFSS, Icepak, and Maxwell 3D. It also provides basic support for EDB and Circuit (Nexxim).
- In addition to the runtime dependencies listed in the installation information, PyAEDT requires ANSYS EM Suite 2021 R1 or later.

Spyder IDE & Jupyter Notebook

Ansys

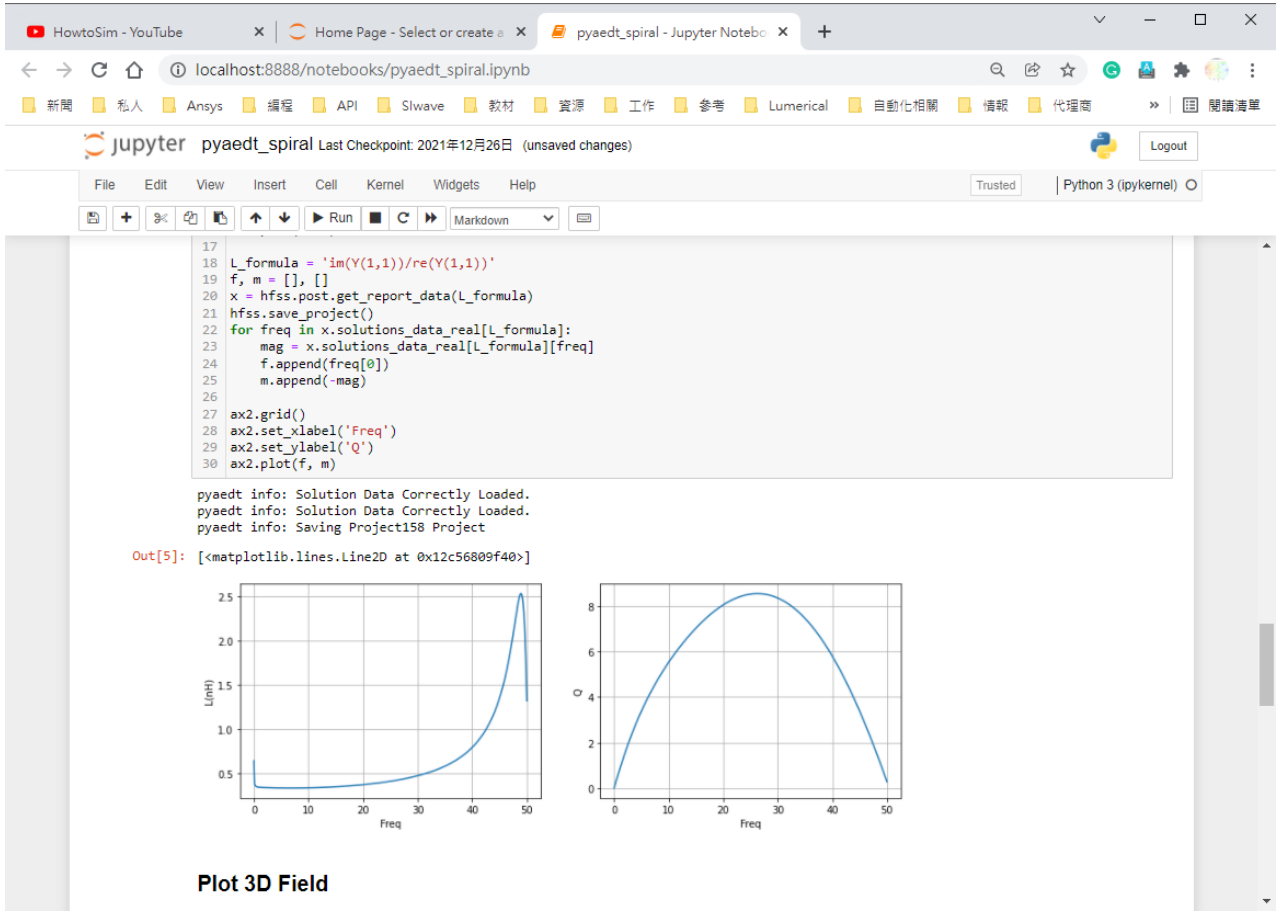
Spyder

- 編輯器：
  - 具有函式和類檢視器
  - 代碼分析特性
  - 代碼補全
  - 直接跳入定義
- 互動視窗：
  - Python或IPython埠都在工作區可以調整和使用。支援對編輯器里的代碼直接除錯。。
- 文件瀏覽器：
  - 在編輯器或埠中顯示任意類或函式呼叫的文件。
- 變數瀏覽視窗
- Matplotlib的圖表顯示視窗
- 歷史記錄



Jupyter Notebook

- HTML格式混和支援多種資料型態
  - 程式碼
  - 文字，Markdown語法
  - 圖表輸出
- 以Cell為單位
- 可讀性高



PyAEDT Classes

Class v.s Object

- Class
  - Define
    - Attributes/Properties
    - methods
- Object
  - Access
    - Attributes
    - methods

類別關係: Is-a v.s. Has-a

- Is-a
  - Inheritance(繼承)
  - Family
  - Module
  - One-way
- Has-a
  - Composition(組成)
  - Team
  - Application
  - Two-way

Design Operation

Validate and Solve

- validate_simple
  - Hfss.validate_simple(*logfile=None*)
- validate_full_design
  - Hfss.validate_full_design(*dname=None, outputdir=None, ports=None*)
- solve_in_batch
  - Hfss.solve_in_batch(*filename=None, machine='local', run_in_thread=False*)
- submit_job
  - Hfss.submit_job(*clustername, aedt_full_exe_path=None, numnodes=1, numcores=32, wait_for_license=True, setting_file=None*)
- analyze_nominal
  - Hfss.analyze_nominal(*num_cores=None, num_tasks=None, num_gpu=None, acf_file=None*)

初始化與退出

```
from pyaedt import Hfss, constants
hfss = Hfss(specified_version='2021.2’)
#%%
……..
```

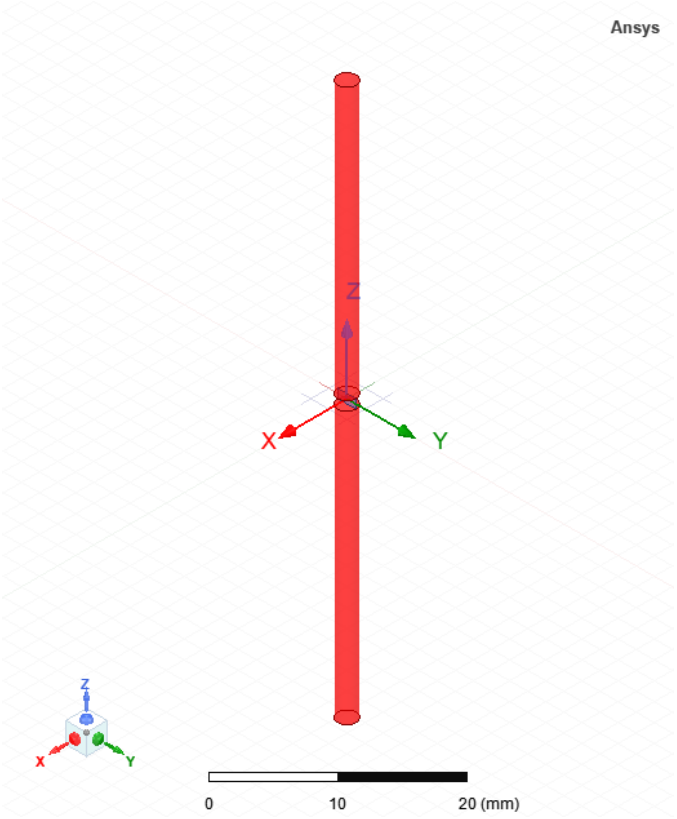
```
#%%
hfss.save_project()
hfss.release_desktop()
```

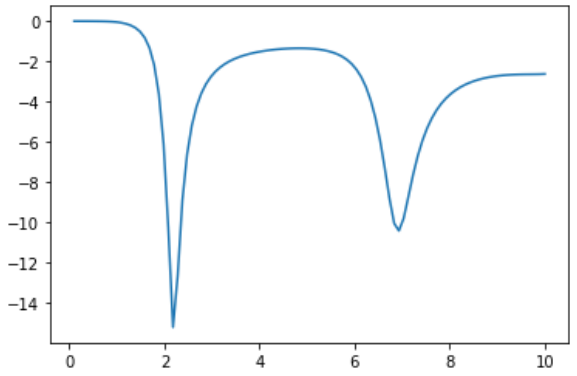
模擬流程常用函式

- 屬性
  - hfss['length'] = '3mm'
- 材料
  - hfss.materials.add_material()
- 物件
  - hfss.modeler.create_box()
- 激發元
  - hfss.create_lumped_port_to_sheet()
- 邊界條件
  - hfss.create_open_region()
- 網格
  - hfss.mesh.assign_initial_mesh_from_slider()
- 模擬設定
  - hfss.create_setup()
  - hfss.create_linear_count_sweep()
  - hfss.analyze_all()
- 生成報告
  - hfss.create_lumped_port_to_sheet()
- 輸出資料
  - hfss.post.get_report_data()
- 常數
  - constants.AXIS.X (Y, Z)
  - constants.PLANE.XY, (YZ, ZX)

Example Code

```
from pyaedt import Hfss, constants
import matplotlib.pyplot as plt

hfss = Hfss(specified_version='2021.2', non_graphical=True)

c1 = hfss.modeler.create_cylinder(constants.AXIS.Z, (0,0,0.5), 1, 20, matname='copper')
c2 = hfss.modeler.create_cylinder(constants.AXIS.Z, (0,0,-0.5), 1, -20, matname='copper')

hfss.modeler.create_rectangle(constants.PLANE.YZ, (0, -1, -0.5), (2,1), 's1')
hfss.create_lumped_port_to_sheet('s1', axisdir=constants.AXIS.Z)
hfss.create_open_region(Frequency='1GHz')

setup = hfss.create_setup(setupname='my_setup')
hfss.create_frequency_sweep('my_setup', freqstart=0.1, freqstop=10, num_of_freq_points=101,sweepname='my_sweep')
hfss.analyze_nominal(num_cores=4)
hfss.post.create_rectangular_plot(setup_sweep_name='my_setup : my_sweep')

data = hfss.post.get_report_data('dB(S(1,1))', 'my_setup : my_sweep')

x = data.sweeps['Freq']
y = data.data_real()

plt.plot(x, y)
hfss.release_desktop()
```





DDR Simulation

```
from pyaedt import Hfss3dLayout, Edb

edb = Edb()
edb.import_cadence_file("d:/demo/Galileo_G87173_204.brd")
edb.core_hfss.create_coax_port_on_component(['U1B5', 'U2A5'], ['M_DQ<0>', 'M_DQ<1>'])

edb.core_components.set_solder_ball('U1B5')
edb.core_components.set_solder_ball('U2A5')

edb.create_cutout(['M_DQ<0>', 'M_DQ<1>'],
                  ['GND'],
                  output_aedb_path='d:/demo/ddr.aedb',
                  open_cutout_at_end=False)
edb.close_edb()

h3d = Hfss3dLayout('d:/demo/ddr.aedb/edb.def')
setup1 = h3d.create_setup('setup1')
setup1.props['Frequency'] = '1GHz'
h3d.create_frequency_sweep('setup1', 'GHz', 0, 1, 11)
setup1.update()

h3d.analyze_all()
h3d.save_project()
```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