Week 7-圖表生成及HTML報告輸出

5G Power Density(PD)
分析範例解說

Ansys

Power Density Simulation Report

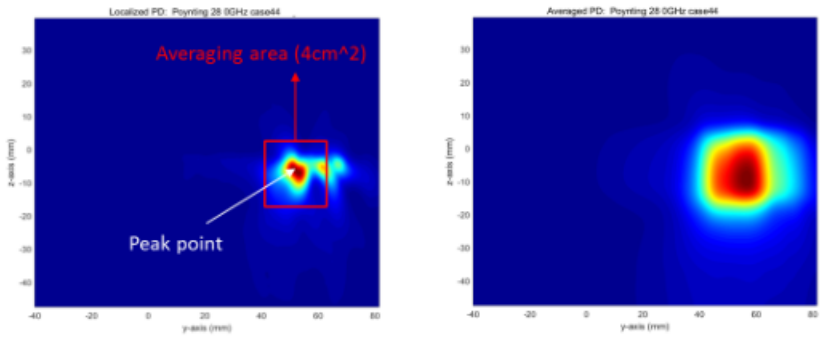
FCC ID: A3LSMN976V

Power Density Simulation Report

Revision A

July 3, 2019

SAMSUNG ELECTRONICS



(a) Localized power density

(b) Averaged power density

Table 2. PD of Ant J – dipole / patch antenna (28GHz)

- J–dipole Low CH

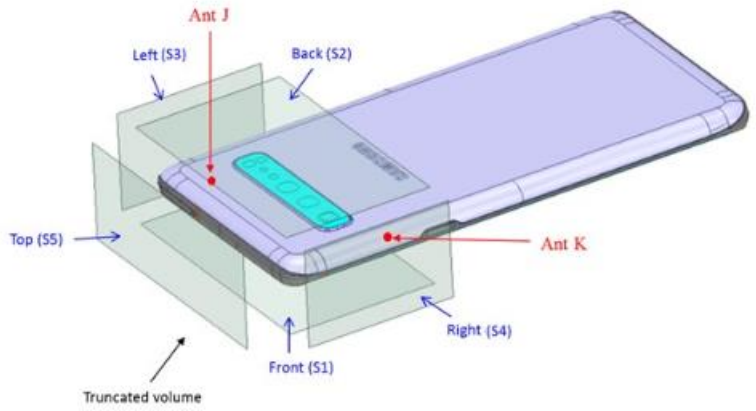
Module	Type(P or D)	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)					
					S4(Right)	S3(Left)	S5(Top)	S6(Bottom)	S1(Front)	S2(Rear)
J	DIPOLE	0		1	0.04	1.83	0.48		0.20	8.83
		4		2	0.19	2.98	0.51		0.38	29.52
		5		2	0.09	2.90	0.53		0.18	26.69
		6		2	0.07	2.34	1.05		0.16	20.59
		16		2	0.15	3.10	0.43		0.36	31.04
		17		2	0.08	2.79	0.84		0.16	22.81
		128		1	0.05	2.01	0.16		0.01	9.92
		132		2	0.09	3.57	0.29		0.05	16.09
		133		2	0.07	3.15	0.20		0.05	23.56
		134		2	0.06	2.02	0.26		0.04	17.63
		144		2	0.07	3.71	0.20		0.05	22.73
		145		2	0.04	2.21	0.24		0.04	19.14
		0	128	2	0.21	2.64	0.29		0.12	7.63
		4	133	4	0.20	4.53	0.64		0.32	24.62
		5	132	4	0.08	2.85	1.07		0.17	22.16
		6	134	4	0.07	2.12	1.13		0.19	22.85
		16	144	4	0.19	4.62	0.51		0.30	23.72
		17	145	4	0.14	2.04	0.97		0.17	23.94

- J–dipole Mid CH

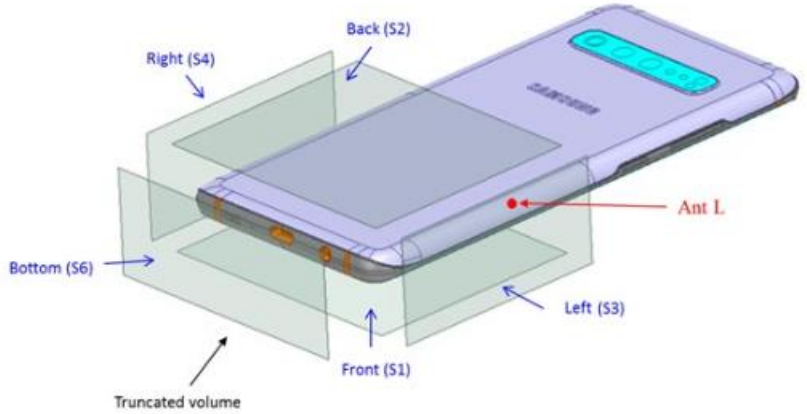
Module	Type(P or D)	Beam ID_1	Beam ID_2	Feed no.	4cm2 PD(W/m2)					
					S4(Right)	S3(Left)	S5(Top)	S6(Bottom)	S1(Front)	S2(Rear)
J	DIPOLE	0		1	0.08	1.99	0.31		0.20	9.00
		4		2	0.23	2.88	0.45		0.38	28.85
		5		2	0.10	3.44	0.88		0.15	26.13
		6		2	0.09	3.45	1.70		0.19	20.16
		16		2	0.18	2.94	0.36		0.40	30.35
		17		2	0.08	3.52	1.38		0.20	22.45
		128		1	0.05	2.12	0.17		0.02	9.77
		132		2	0.09	3.57	0.76		0.11	18.14
		133		2	0.04	3.24	0.23		0.05	21.90
		134		2	0.08	2.42	0.80		0.08	20.40
		144		2	0.04	3.70	0.20		0.04	21.32
		145		2	0.04	2.45	0.68		0.07	21.28
		0	128	2	0.16	2.69	0.38		0.12	7.98
		4	133	4	0.17	3.81	0.62		0.29	23.73
		5	132	4	0.14	3.62	1.06		0.15	24.78
		6	134	4	0.14	1.83	1.14		0.22	26.09
		16	144	4	0.16	3.93	0.49		0.29	23.04
		17	145	4	0.13	2.28	0.83		0.19	23.65

5G系統廠天線工程師所碰到的PD分析需求

- 系統上有3個5G毫米波天線模組
- 每個模組支援多個頻帶
- 每個模組上有30多個beam
- 每個beam需要再多個面上分析PD
- PD需要做平均分析並擷取平均過後之最大值
- 需要輸出上萬組PD圖做處理
- 模擬結果須與量測交互驗證
- 報告須送交FCC(聯邦通信委員會)備案

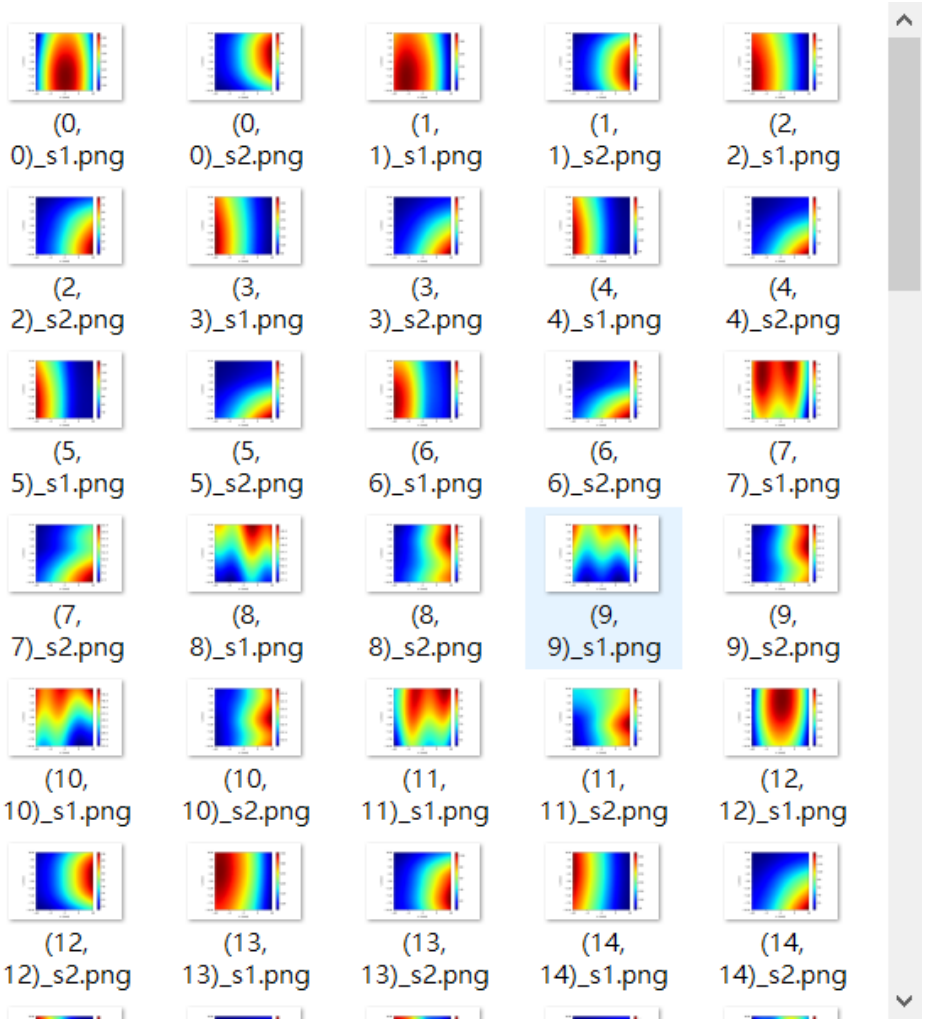


(a) Ant J and Ant K



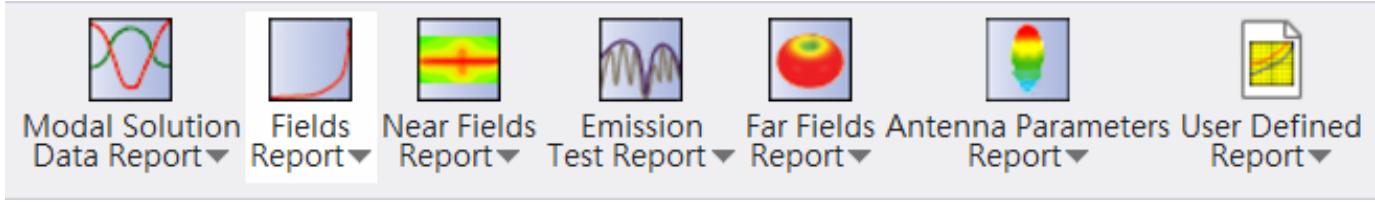
PD分析遇到的困難及解決方案+流程展示

- 在HFSS當中修改beam並匯出不同面的PD圖時間過久5min/image, 人工操作也需要五個月以上。且必須占用HFSS license。
- 加上每張圖需要做完平均處理並擷取最大值，其工作量可想而知
- 此時就可以透過自動化來加速其工作：
  - **在HFSS當中將E/H資料匯出**
  - 在Python讀取Code Book的beam相位設定
  - 做數學運算產生PD
  - 做平均處理
  - 匯出PD圖及表格
- 時間縮短到一天~兩天可以完成10000張PD的計算。



AEDT輸出資料

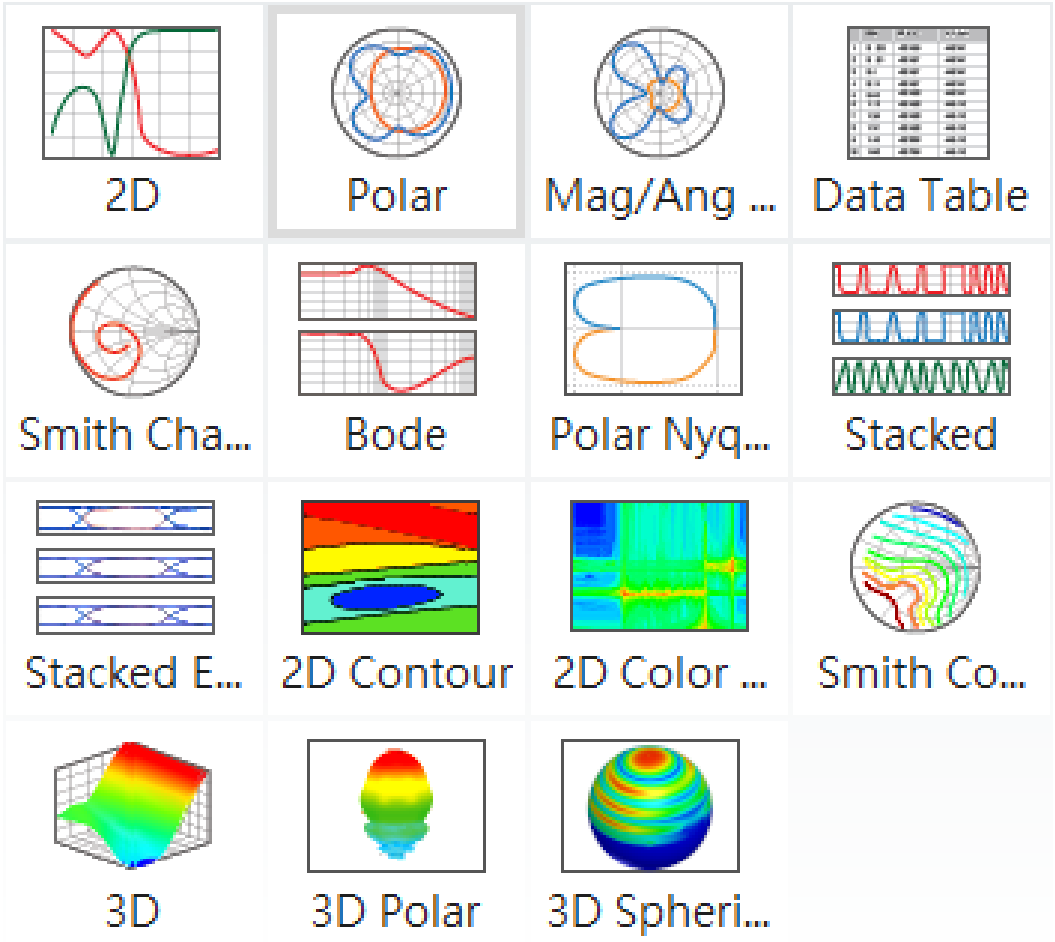
Report Types

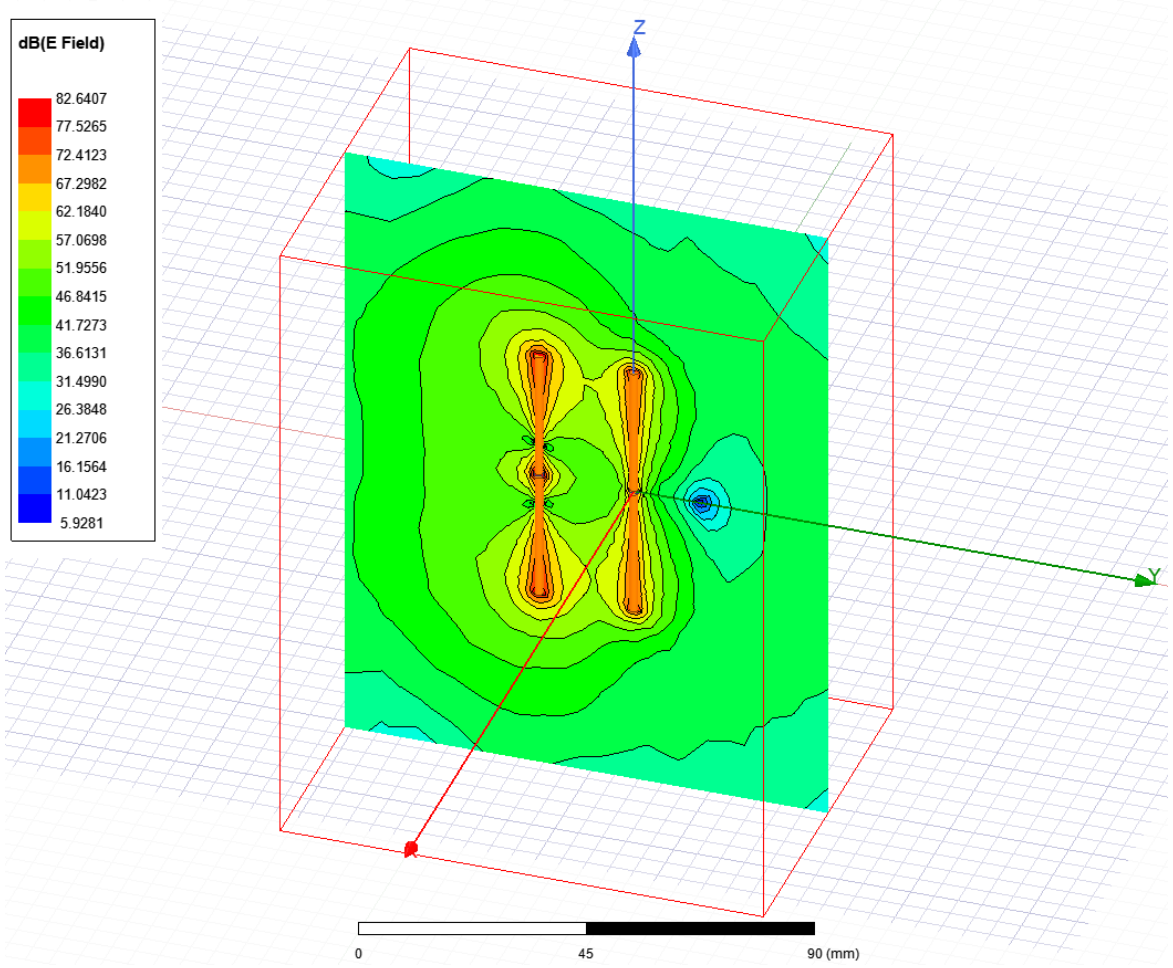


Modal Solution Data	S-, Y-, and Z-parameter data will be available to plot, as well as propagation constant, characteristic port impedance, reflection/transmission coefficients for HFSS designs, and voltage standing wave ratio (VSWR) data. **Note:** For HFSS calculations, phase is currently assigned zero value.
Terminal Solution Data	This solution type results in a terminal-based description in terms of voltages and currents. Some modal data is also available. The terminal-based S-, Y-, and Z parameters, voltage standing wave (VSWR), Port Zo, and Active S-, Y-, Z, and VSWR parameters are available to plot.
Eigenmode Parameters	The Eigen Modes and Eigen Q data are available to plot.
Fields	Basic or derived field quantities calculated on lines or integrated over surfaces or objects will be available to plot.
IE Surface Fields	For an HFSS design that uses IE Regions the solver produces J and Q surface fields for the metallic parts (but not the dielectric parts) of these regions. The Fields Calculator provides access to the IE surface fields quantities.
Far Fields	Radiated fields computed in the far-field region. The following quantities will be available to plot: rE, gain, realized gain, beam area, directivity, axial ratio, polarization ratio, and normalized antenna calculated by HFSS. You can do Contour Plots with a Domain of either Theta, Phi, or Sine Space.

	Note: You must have defined an infinite sphere geometry and at least one radiation or PML boundary to create a far-fields report.
Near Fields	Radiated fields computed in the near-field region. These include: variables, output variables, near E, max near field parameters, and near normalized antenna. You can do Contour Plots with a Domain of either Theta, Phi, or Sine Space Note: You must have defined a near-field line or near-field sphere and at least one radiation or PML boundary to create a near-fields report.
Antenna Parameters	Whereas far field reports are computed as points around an infinite sphere, antenna parameters provide one value per quantity for the entire sphere. Note: You must have defined an infinite sphere geometry and at least one radiation or PML boundary to create an antenna parameters report.
Emission Test	You can conduct an emission test under the same conditions as for a near field report except that.an emission test cannot be conducted for a ports-only solution. You must have defined a near-field line or near-field sphere and at least one radiation or PML boundary.

Data Visualization (Plot & Field)





High Dimension- High Complexity Data

Geometry Sweep
S/Y/Z
Rectangular Plot
3D Sphere
Calculator
Spectrum
Modes
NDE
Polar Plot
Emission Test
Ports
DOE
E/H/J Near Field
Smith Chart
Histogram
Excitations
Far Field
3D Plot
Optimization
Antenna Parameters
Overlay
Contour
Material Sweep
Waveform

輸出格式

- General (.csv)
  - oModule = oDesign.GetModule("ReportSetup")
  - oModule.CreateReport()
  - oModule.ExportToFile()
- Far Field (.ffd):
  - oModule = oDesign.GetModule("RadField")
  - oModule.ExportFieldsToFile()
- Near Field(.nfd)
  - oModule = oDesign.GetModule("FieldsReporter")
  - oModule.ExportOnGrid()

範例解說：將CSV輸出成圖檔並整合到HTML報告

Ansys

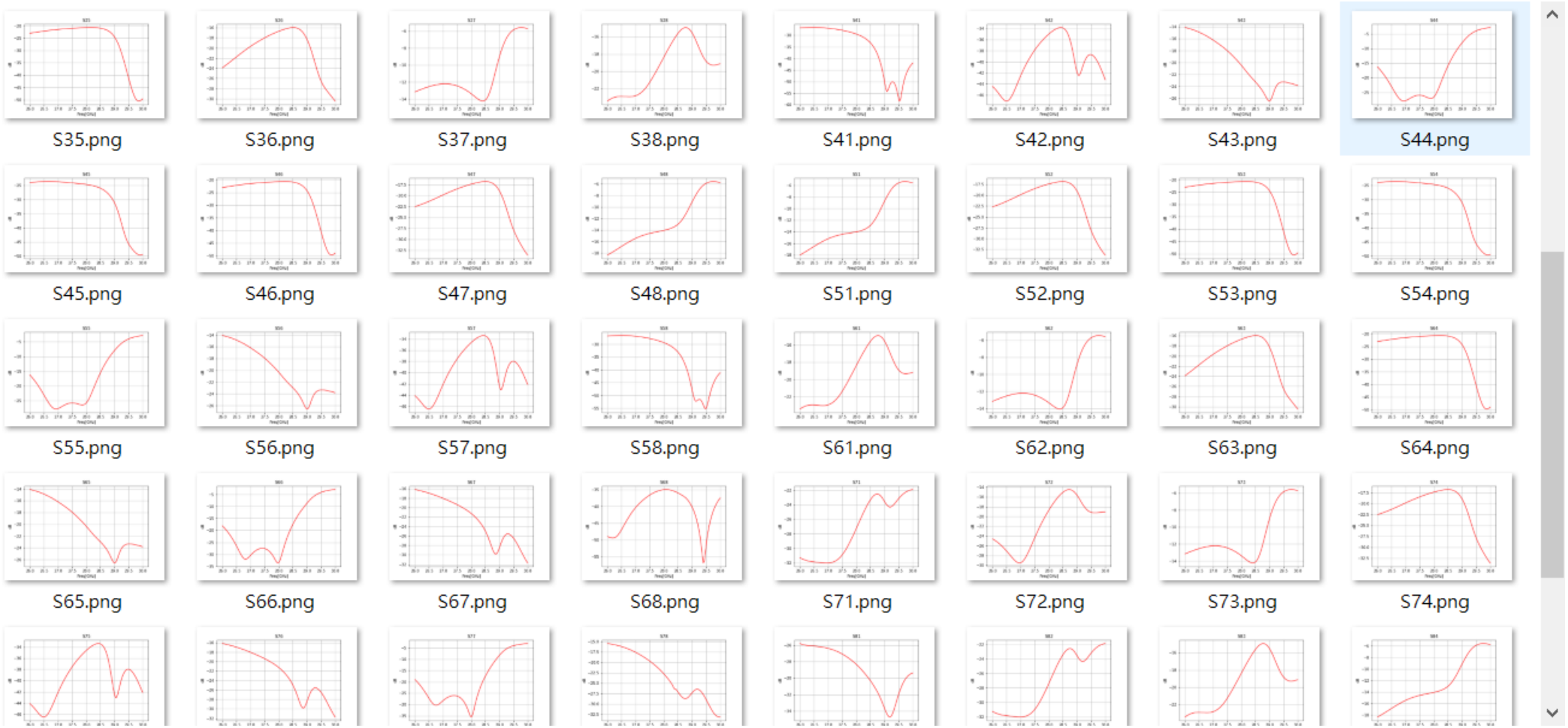
從HFSS輸出S參數表格

```
import ScriptEnv
ScriptEnv.Initialize("Ansoft.ElectronicsDesktop")
oDesktop.RestoreWindow()
oProject = oDesktop.GetActiveProject()
oDesign = oProject.GetActiveDesign()
oModule = oDesign.GetModule("ReportSetup")
Sij = ['S{}{}'.format(i,j) for i in range(1,9) for j in range(1,9)]
oModule.CreateReport(" Table S", "Modal Solution Data", "Data Table", "Setup1 : Sweep",
    [
        "Domain:="      , "Sweep"
    ],
    [
        "Freq:="        , ["All"],
        "dang:="        , ["Nominal"]
    ],
    [
        "X Component:="     , "Freq",
        "Y Component:="     , Sij
    ])
oModule.ExportToFile(" Table S", "C:/demo/Table S.csv", False)

oModule = oDesign.GetModule("ReportSetup")
oModule.DeleteReports([" Table S"])
```

讀入S參數表格並出圖

```
with open('c:/demo/Table S.csv') as f:
    text = f.readlines()

table = []
freq = []
for i in text[1:]:
    f, *x = i.strip().replace(' ','').replace('i','j').split(',')
    x = map(complex, x)
    freq.append(float(f))
    table.append(list(x))
matrix = list(zip(*table))

import cmath
import matplotlib.pyplot as plt
names=[f'S{m}{n}' for m in range(1,9) for n in range(1,9)]

for name, i in zip(names, matrix):
    y=[20*cmath.log10(j) for j in i]
    plt.grid()
    plt.title(name)
    plt.xlabel('Freq[GHz]')
    plt.ylabel('dB')
    plt.plot(freq, y, color='red')
    plt.savefig(f'c:/demo/{name}.png')
    plt.close()
```

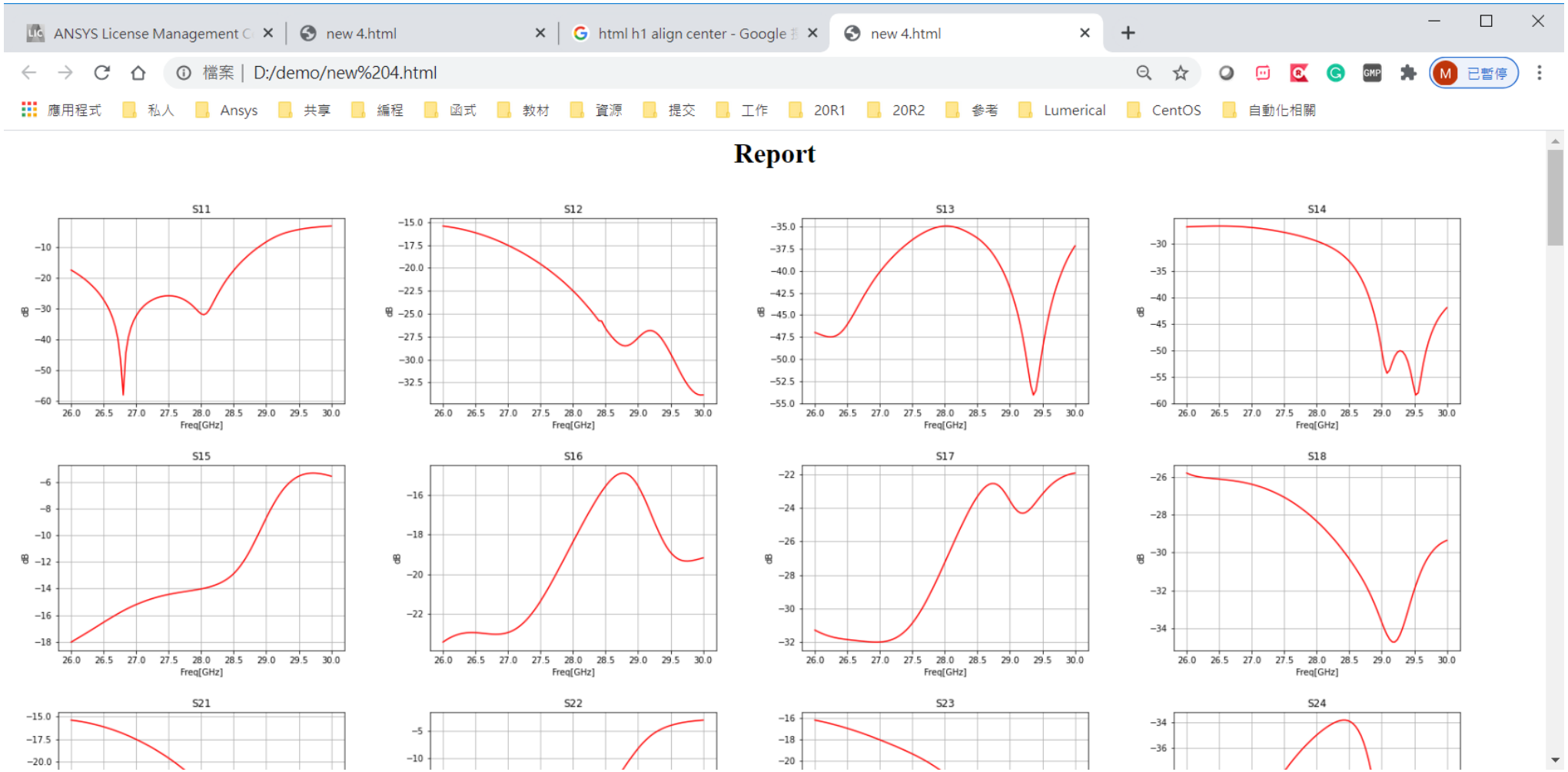
輸出S參數PNG檔


S35.png
S36.png
S37.png
S38.png
S41.png
S42.png
S43.png
S44.png
S45.png
S46.png
S47.png
S48.png
S51.png
S52.png
S53.png
S54.png
S55.png
S56.png
S57.png
S58.png
S61.png
S62.png
S63.png
S64.png
S65.png
S66.png
S67.png
S68.png
S71.png
S72.png
S73.png
S74.png

生成HTML Report

```
import webbrowser

def trow(figs):
    return '''
      <tr>
        <td><img src="{}"></td>
        <td><img src="{}"></td>
        <td><img src="{}"></td>
        <td><img src="{}"></td>
      </tr>
      '''.format(*figs)

html='''
<H1>Report</H1>
<table>
{}
</table>'''

names=[f'c:/demo/S{m}{n}.png' for m in range(1,9) for n in range(1,9)]

y=''
for i in [names[i:i+4] for i in range(0, len(names), 4)]:
    y+=trow(i)

html2 = html.format(y)

with open ('c:/demo/report.html', 'w') as f:
    f.write(html2)
webbrowser.open('c:/demo/report.html')
```

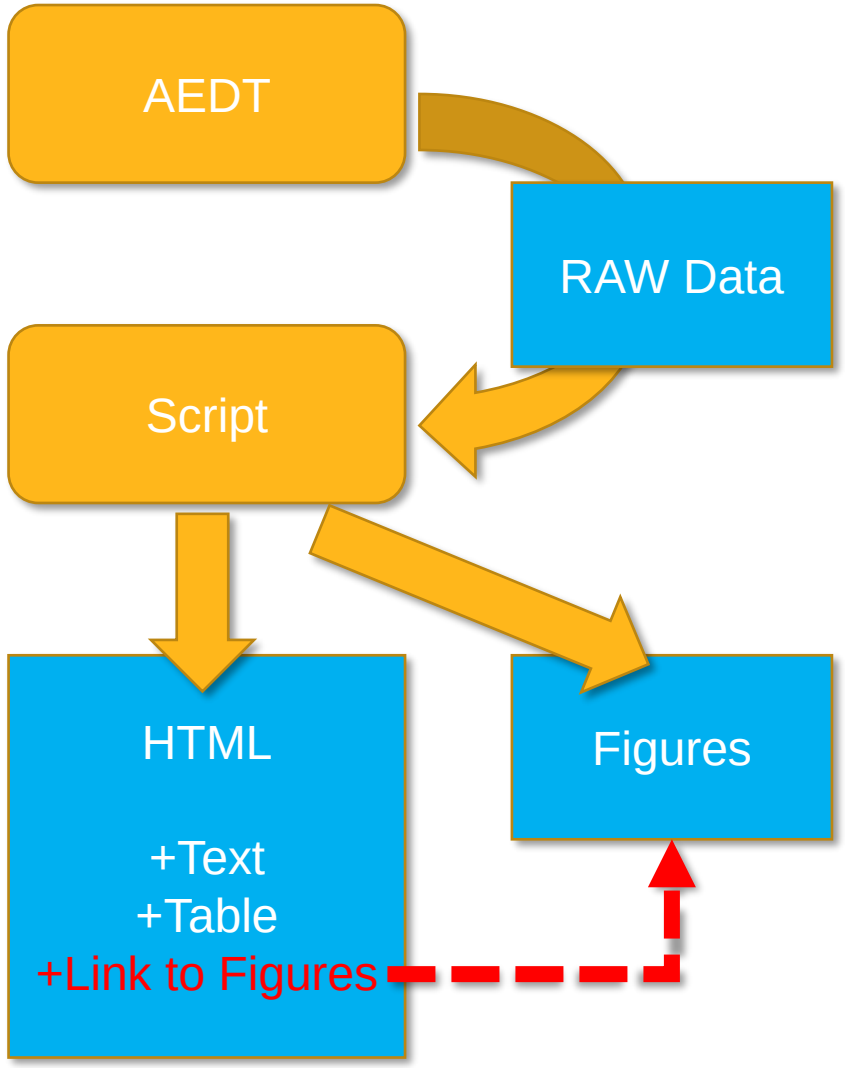
整合至HTML報告


ANSYS License Management C
new 4.html
html h1 align center - Google
new 4.html
檔案 | D:/demo/new%204.html
已暫停
應用程式
私人
Ansys
共享
編程
函式
教材
資源
提交
工作
20R1
20R2
參考
Lumerical
CentOS
自動化相關
Report
S11
S12
S13
S14
S15
S16
S17
S18
S21
S22
S23
S24
dB
Freq[GHz]

概念解説

模擬報告自動化

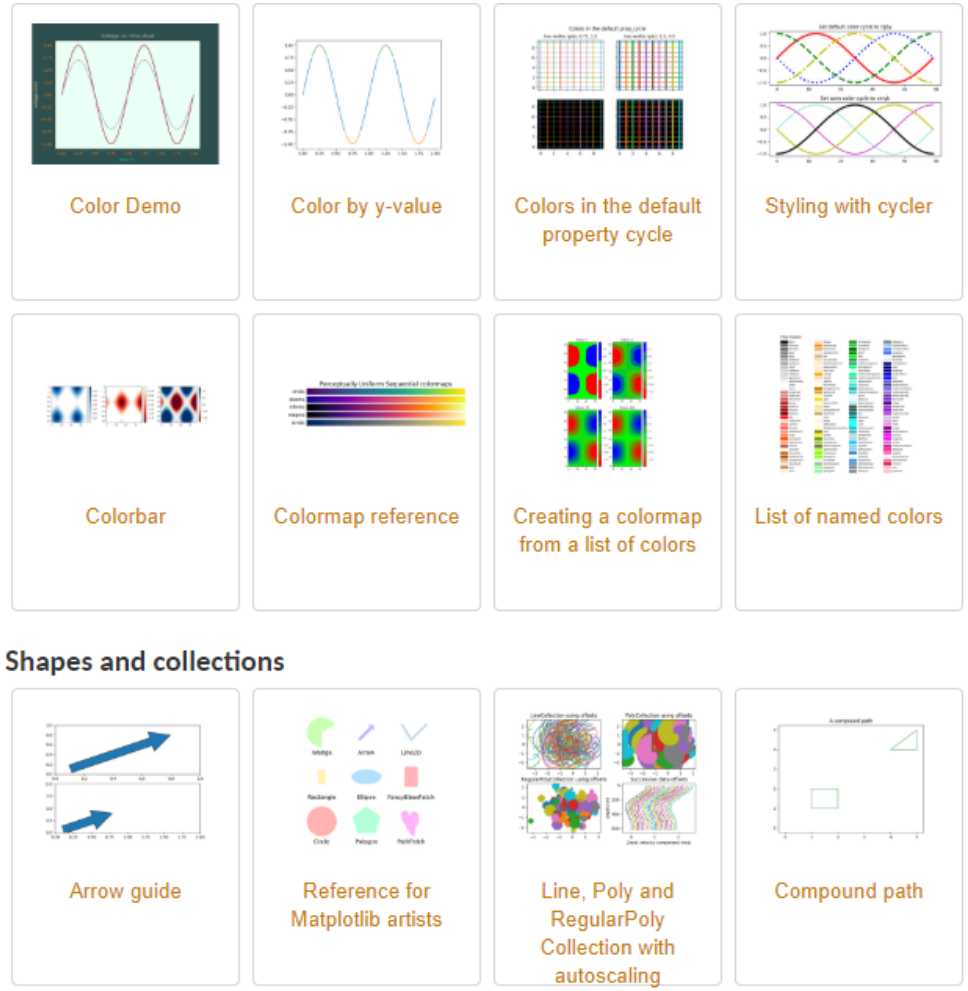
一般在完成模擬之後，工程師必須輸出圖表並擷取必要的資料，複製貼上到word或ppt當中來產生報告，以提供給主管或客戶參考，這是一件吃力不討好的工作，資料一多整理起來更是苦不堪言，一旦設計改版，全部的工作又必須重來一次。如果將報告的生成工作自動化，便可以讓工程師可以從繁瑣的剪貼操作解脫，去從事更有價值的技術研究。



AEDT就有提供繪圖的功能，為何還需要使用matplotlib？

首先，AEDT的所提供的繪圖種類遠不及matplotlib豐富，處裡速度也稍嫌緩慢，當輸出的圖片數量一多，差異就明顯看得出來。此外，有些資料需要先行處理再進行繪圖，如果外部處理完再匯回AEDT作圖豈不是多此一舉。然而，仍然有些圖必須由AEDT匯出，像是3D結構體或3D遠場圖。

Matplotlib庫的函式可以讓使用者將大量的數值資料轉換成各式得圖表。圖表的格式極為豐富，請參考：
https://matplotlib.org/3.1.1/gallery/index.html



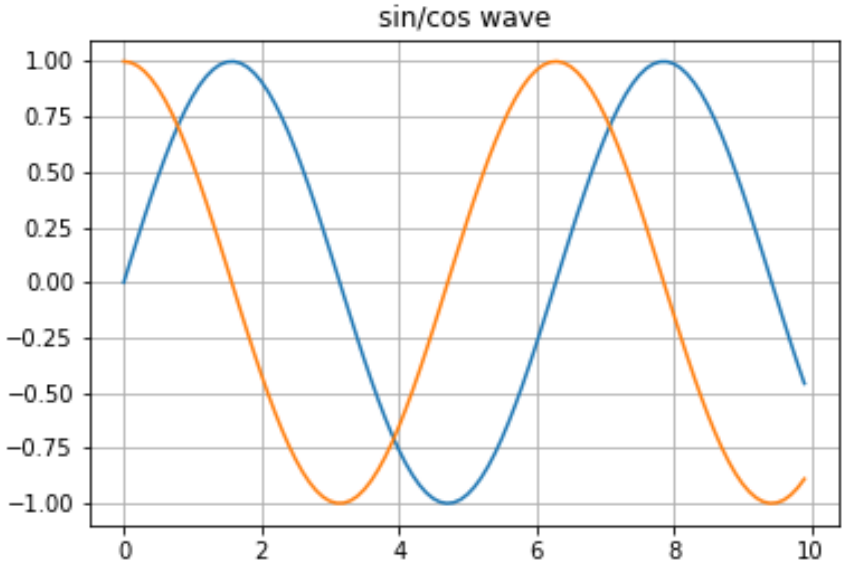
為什麼是用python而不是matlab來產生圖表及報告

原因如下

- Python可以免費使用，這是最大的優點。
- 多數的工程圖表類型都可透過matplotlib支援，矩陣運算則由numpy及scipy負責。應付絕大多數的資料後處理綽綽有餘。
- 可以無縫接軌文本處理及輸出格式化，字串處理功能強大。
- 網路資源豐富且可無償取用，不需申請帳號或付費。
- 擴充性高，比方說可連結excel，wpf視窗設計甚至是網站伺服器等等。
- Anaconda Spyder提供類Matlab編程環境。

XY圖輸出PNG檔

```
 7 import math
 8 import matplotlib.pyplot as plt
 9
10 x = [0.1*i for i in range(100)]
11 y1 = [math.sin(i) for i in x]
12 y2 = [math.cos(i) for i in x]
13 plt.grid()
14 plt.title("sin/cos wave")
15 plt.plot(x, y1)
16 plt.plot(x, y2)
17 plt.savefig('d:/demo/sin_cos.png')
18 plt.show()
19
```



如何整合圖片及數據甚或文字來產生報告？

報告生成可以透過html來完成，html提供了各式的標籤，我們可以透過標籤來格式化文件，產生不同的字型大小，顏色，表格等。透過標籤也可以連接圖片及影片檔。由於html是文字格式，只要了解標籤的使用方式，我們便可以輕易地完成報告的編排。之後透過瀏覽器便可以檢視報告，並輸出pdf檔。

另一種方式是輸出到ppt當中。由於ironpython基於微軟.NET框架，不需另外安裝庫即可以使用內建函式讀寫Word, Excel, PowerPoint 等檔案。但是這部分的程式碼較為繁複，有興趣者可以上網查詢相關函式的使用方式。

可以簡單的說明html標籤的使用方式嗎？

Html的標籤是由<標籤名></標籤名>所組成。像是<H1>xxx</H1>當中xxx的輸出格式即是由標籤所控制。舉例來說H1到H6代表了不同標題文字的大小，可用來表示報告不同章節的副標題。所有的標籤定義可參考以下連結

https://www.w3schools.com/tags/ref_byfunc.asp

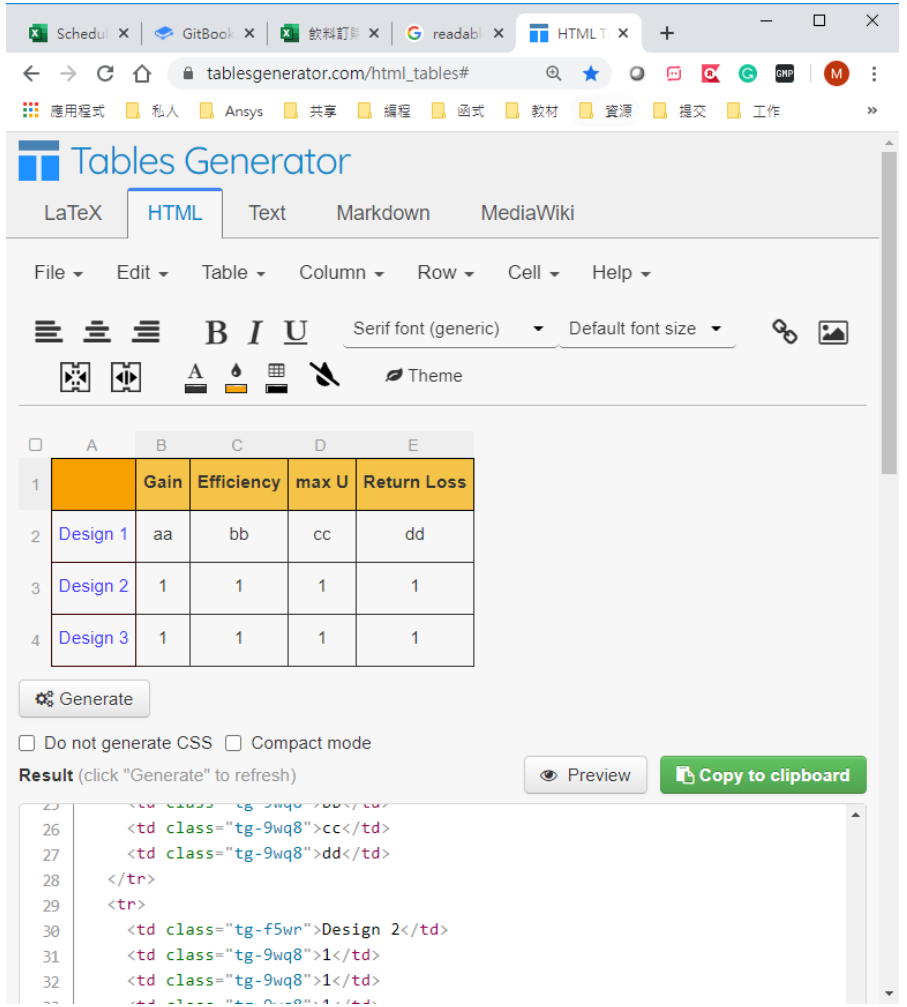
Basic HTML

Tag	Description
<!DOCTYPE>	Defines the document type
<html>	Defines an HTML document
<head>	Contains metadata/information for the document
<title>	Defines a title for the document
<body>	Defines the document's body
<h1> to <h6>	Defines HTML headings
<p>	Defines a paragraph
 	Inserts a single line break
<hr>	Defines a thematic change in the content
<!--...-->	Defines a comment

如何快速產生格式化HTML表格？

我們可以透過標籤來建立表格。如果表格欄位很多且又存在合併欄位的話，要正確排列表格的標籤需要花一番功夫。所幸已經有人想到了這個問題並提供了方法：Tables Generator。

Tables Generator提供了視覺化工具，可以讓使用者透過點選的方式，輕易的建立表格格式並輸出對應的html標籤。只要加以包裹成函式，便可以輕鬆的輸出表格的html檔。




Ansys