TERM PROJECT

MECH-530

Progress Report 3

Elaine Craigie

(260476434)

October 3, 2014

Overview: This progress report features the output of a Python script in IPython Notebook. The input interface has been modified to receive an off-axis resultant stress and output the corresponding stresses and strains based on a pre-defined layup read from a .xlsx file.

In [1]:
```
run MECH530_main.py
```

```
PLYBOOK (READ FROM EXCEL FILE AND SUMMARIZED HERE)

The laminate is given by the following plybook where the highest ply number '14
' indicates the top layer, while the first ply number '1' indicates the bottom
layer.

Unique Ply #, Fiber/Matrix, Orientation, Thickness
                              (degrees)      (mm)
    14         T300/N5208        10         0.125
    13         T300/N5208       -10         0.125
    12         T300/N5208        90         0.125
    11         T300/N5208         0         0.125
    10         T300/N5208         0         0.125
     9         T300/N5208        50         0.125
     8         T300/N5208       -50         0.125
     7         T300/N5208       -50         0.125
     6         T300/N5208        50         0.125
     5         T300/N5208         0         0.125
     4         T300/N5208         0         0.125
     3         T300/N5208        90         0.125
     2         T300/N5208       -10         0.125
     1         T300/N5208        10         0.125

PLIES AND THICKNESSES
-Total number of plies in the laminate: 14
-Total thickness of laminate is: 1.750 mm
-There is no core in the laminate (Zc = 0 mm)
-Laminate contains 1 Fiber/Matrix combination. The material properties for this
 combination shall be listed below.

--------------------------------------------------------------------------------
MATERIALS AND MATERIAL PROPERTIES

RESIN/MATRIX 1 of 1: For T300/N5208, the given material properties are:

-Stiffness and Strength:

Ex = 181.0000 GPa, Ey =  10.3000 GPa, Es =   7.1700 GPa and nu_x =   0.2800

Xt = 1500.0000 MPa, Xc = 1500.0000 MPa, Yt =  40.0000f MPa, Yc = 246.0000 MPa a
nd Sc =  68.0000 MPa.

-The 'on-axis' matrices are given by the following:
S_on =
[[   0.0055   -0.0015       0.0]
 [  -0.0015    0.0971       0.0]
 [      0.0       0.0    0.1395]] [1/GPa]

Q_on =
[[ 181.8111    2.8969       0.0]
 [   2.8969   10.3462       0.0]
 [      0.0       0.0    7.1700]] [GPa]
```

```
-The linear combinations of the modulus, independent of ply angle are the follo
wing:
Us_1 =    0.0555 [1/GPa]
Us_2 =   -0.0458 [1/GPa]
Us_3 =   -0.0042 [1/GPa]
Us_4 =   -0.0058 [1/GPa]
Us_5 =    0.1226 [1/GPa]

-The linear combinations of the modulus, dependent on ply angle are the followi
ng:
Uq_1 =   76.3682 GPa
Uq_2 =   85.7325 GPa
Uq_3 =   19.7104 GPa
Uq_4 =   22.6074 GPa
Uq_5 =   26.8804 GPa

-The 'Stiffness' [A] and 'Compliance' [a] matrices are given by the following:
A =
[[   0.2010    0.0265    0.0000]
 [   0.0265    0.0924    0.0000]
 [   0.0000    0.0000    0.0340]] [GN/m]

a =
[[   5.1708   -1.4817    0.0000]
 [  -1.4817   11.2418   -0.0000]
 [   0.0000   -0.0000   29.4384]] [m/GN]


--------------------------------------------------------------------------------
INPUTS:

Would you like to input an applied stress? ON/OFF/NO
OFF
Enter the applied stress resultant vector [N1, N2, N6] [N/m].
N1 = 450000
N2 = -110000
N6 = -130000

--------------------------------------------------------------------------------
OFF-AXIS STRESSES AND STRAINS:

(INPUT) Off-axis Applied stress resultant =
[[  0.00045]
 [ -0.00011]
 [ -0.00013]] [GN/m]

Off-axis stress =
[[  0.25714]
 [ -0.06286]
 [ -0.07429]] [GPa]

Off-axis strain =
[[  0.00249]
 [ -0.00190]
 [ -0.00383]] [unitless]
```

```
--------------------------------------------------------------------------------
ON-AXIS STRESSES AND STRAINS:

PLY: 14
ORIENTATION: 10 degrees

Transpose of On-axis stress =
[[  0.30637  -0.00662  -0.03656]] [GPa]

Transpose of On-axis strain =
[[  0.00170  -0.00112  -0.00510]] [unitless]

PLY: 13
ORIENTATION: -10 degrees

Transpose of On-axis stress =
[[  0.54056  -0.01637  -0.01501]] [GPa]

Transpose of On-axis strain =
[[  0.00301  -0.00243  -0.00209]] [unitless]

PLY: 12
ORIENTATION: 90 degrees

Transpose of On-axis stress =
[[ -0.33884   0.02025   0.02744]] [GPa]

Transpose of On-axis strain =
[[ -0.00190   0.00249   0.00383]] [unitless]

PLY: 11
ORIENTATION: 0 degrees

Transpose of On-axis stress =
[[  0.44717  -0.01248  -0.02744]] [GPa]

Transpose of On-axis strain =
[[  0.00249  -0.00190  -0.00383]] [unitless]

PLY: 10
ORIENTATION: 0 degrees

Transpose of On-axis stress =
[[  0.44717  -0.01248  -0.02744]] [GPa]

Transpose of On-axis strain =
[[  0.00249  -0.00190  -0.00383]] [unitless]

PLY: 9
ORIENTATION: 50 degrees

Transpose of On-axis stress =
[[ -0.35123   0.02076  -0.02626]] [GPa]

Transpose of On-axis strain =
```

```
[[ -0.00197   0.00256  -0.00366]] [unitless]

PLY: 8
ORIENTATION: -50 degrees

Transpose of On-axis stress =
[[  0.32307  -0.00731   0.03579]] [GPa]

Transpose of On-axis strain =
[[  0.00180  -0.00121   0.00499]] [unitless]

PLY: 7
ORIENTATION: -50 degrees

Transpose of On-axis stress =
[[  0.32307  -0.00731   0.03579]] [GPa]

Transpose of On-axis strain =
[[  0.00180  -0.00121   0.00499]] [unitless]

PLY: 6
ORIENTATION: 50 degrees

Transpose of On-axis stress =
[[ -0.35123   0.02076  -0.02626]] [GPa]

Transpose of On-axis strain =
[[ -0.00197   0.00256  -0.00366]] [unitless]

PLY: 5
ORIENTATION: 0 degrees

Transpose of On-axis stress =
[[  0.44717  -0.01248  -0.02744]] [GPa]

Transpose of On-axis strain =
[[  0.00249  -0.00190  -0.00383]] [unitless]

PLY: 4
ORIENTATION: 0 degrees

Transpose of On-axis stress =
[[  0.44717  -0.01248  -0.02744]] [GPa]

Transpose of On-axis strain =
[[  0.00249  -0.00190  -0.00383]] [unitless]

PLY: 3
ORIENTATION: 90 degrees

Transpose of On-axis stress =
[[ -0.33884   0.02025   0.02744]] [GPa]

Transpose of On-axis strain =
[[ -0.00190   0.00249   0.00383]] [unitless]
```

```
PLY: 2
ORIENTATION: -10 degrees

Transpose of On-axis stress =
[[  0.54056  -0.01637  -0.01501]] [GPa]

Transpose of On-axis strain =
[[  0.00301  -0.00243  -0.00209]] [unitless]

PLY: 1
ORIENTATION: 10 degrees

Transpose of On-axis stress =
[[  0.30637  -0.00662  -0.03656]] [GPa]

Transpose of On-axis strain =
[[  0.00170  -0.00112  -0.00510]] [unitless]

--------------------------------------------------------------------------------
```