NeoCASS Tutorial

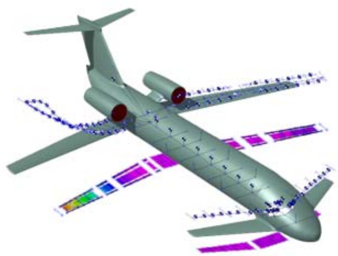
How to run a static aeroelastic analysis

“three maneuver sizing”

Version 2.2(.790)

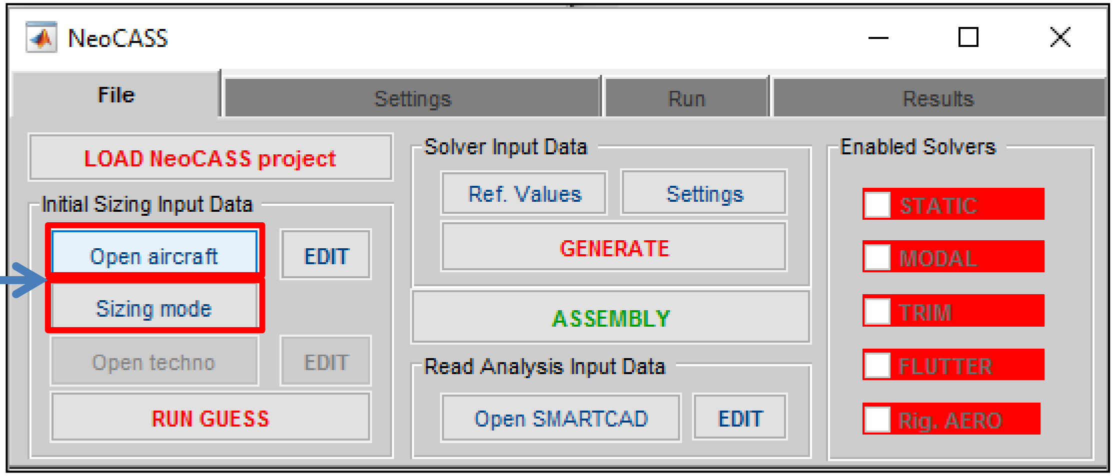
August 2017

Outline

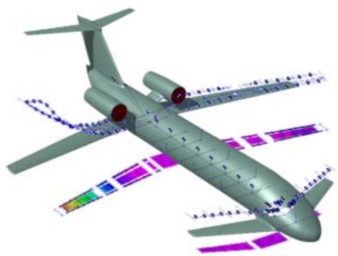


Maneuvers Set Definition

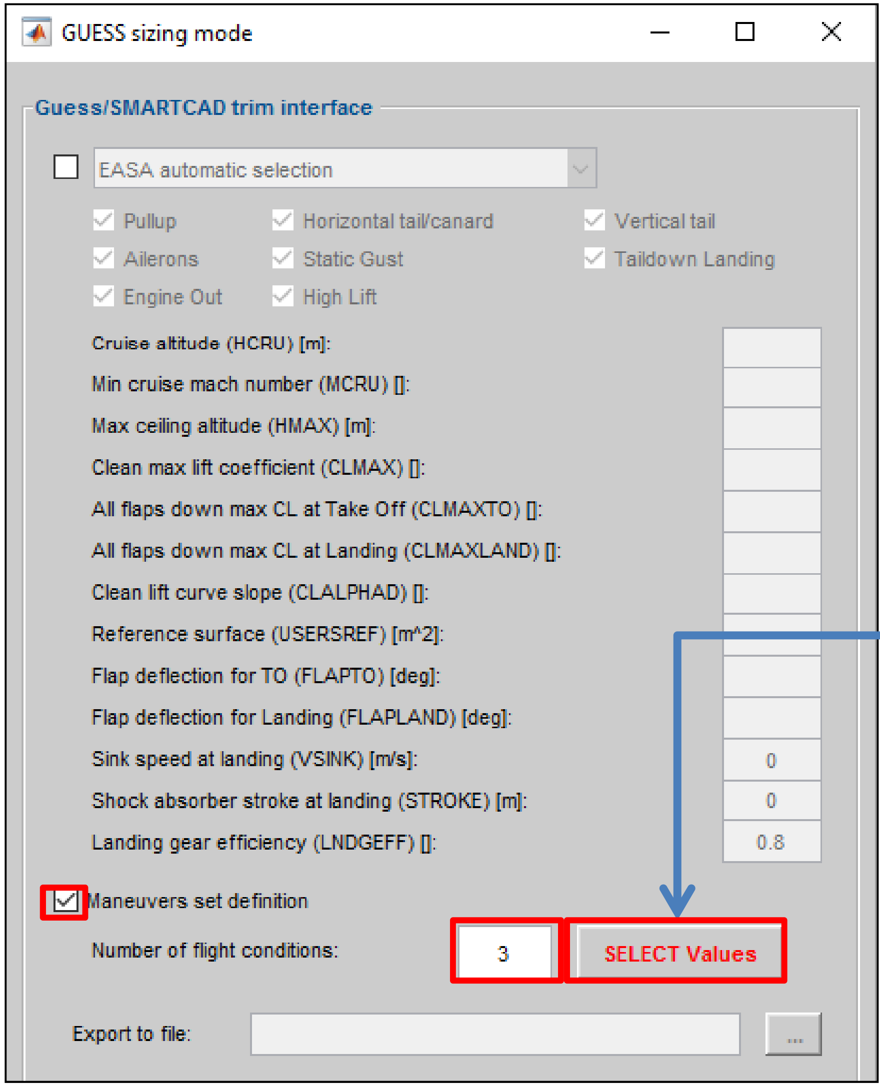
Do not forget to run the script *set_neocass_path* in the installation directory. That allows to include the NeoCASS routines into the current path. Then change directory that you will use for your analysis and start *NeoCASS*, typing it in the command window.

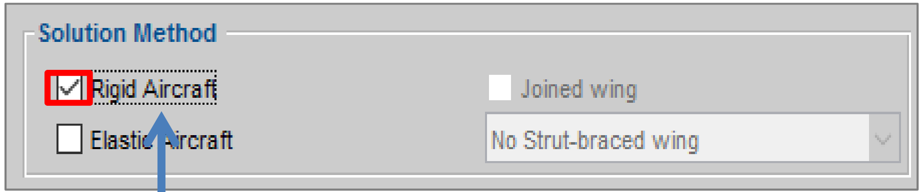


Open the aircraft model ('Open aircraft') and click on 'Sizing mode'. In this tutorial the *B747-400_reference.xml* is used.



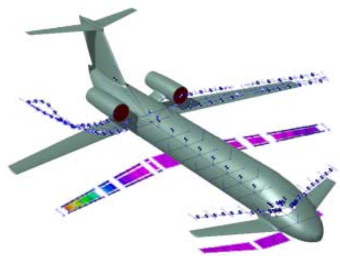
Maneuvers Set Definition



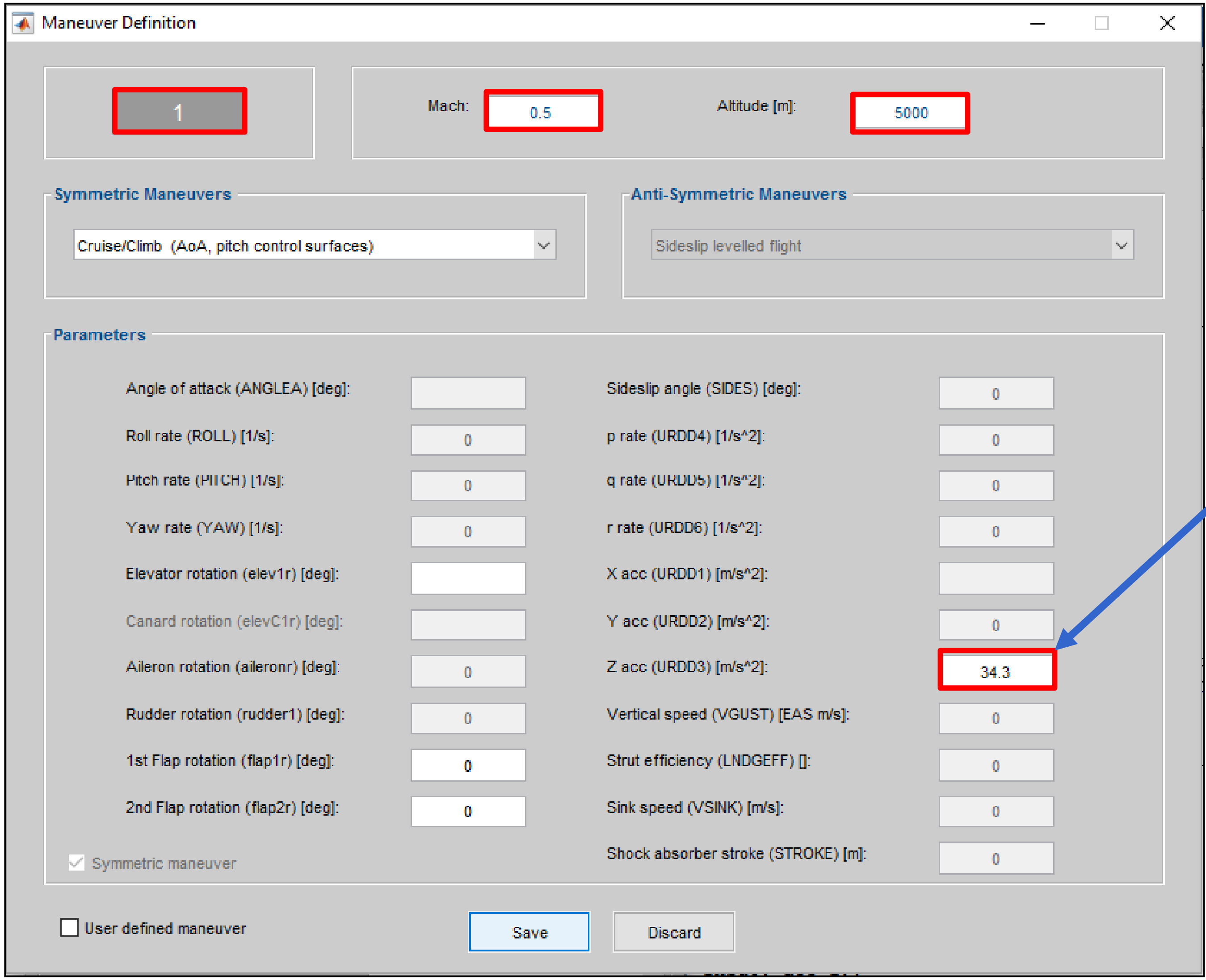


In Solution Method select *'Rigid Aircraft'*.

To impose three user-defined load conditions click on: *'SELECT Values'*



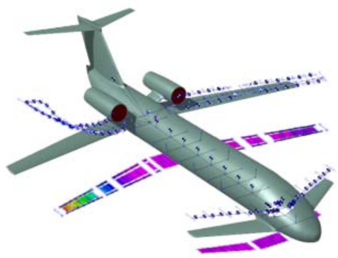
Maneuvers Set Definition: *man. ID 1*



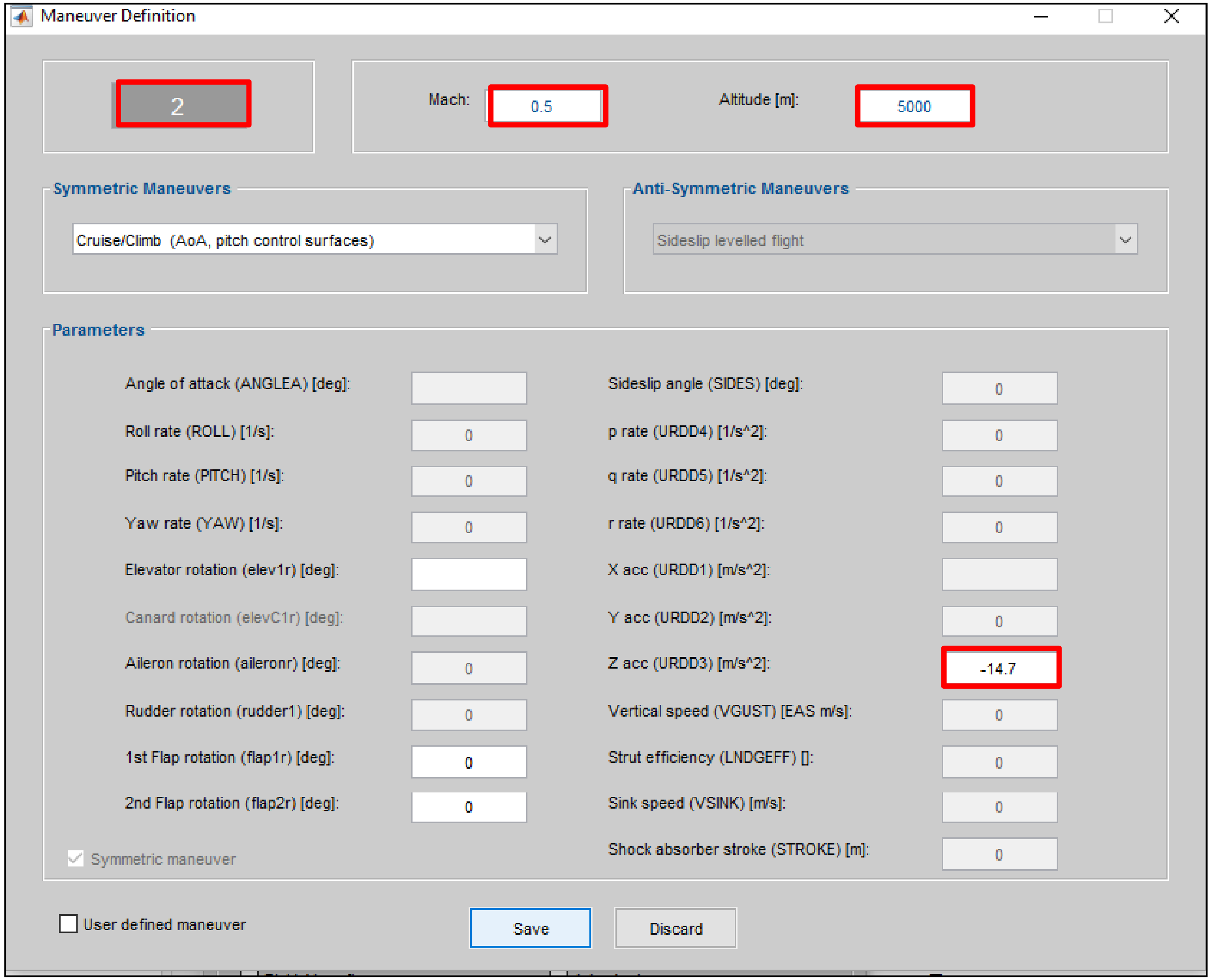
For example, define three maneuvers: two symmetric and one anty-symmetric.

Pull Up maneuver: Z acceleration = 3,5*g.

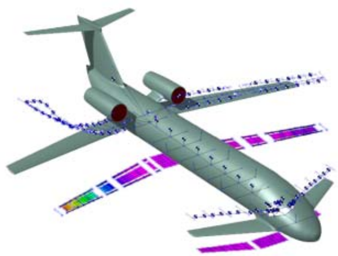
Clicking 'Save' the next maneuver's setting window will appear.



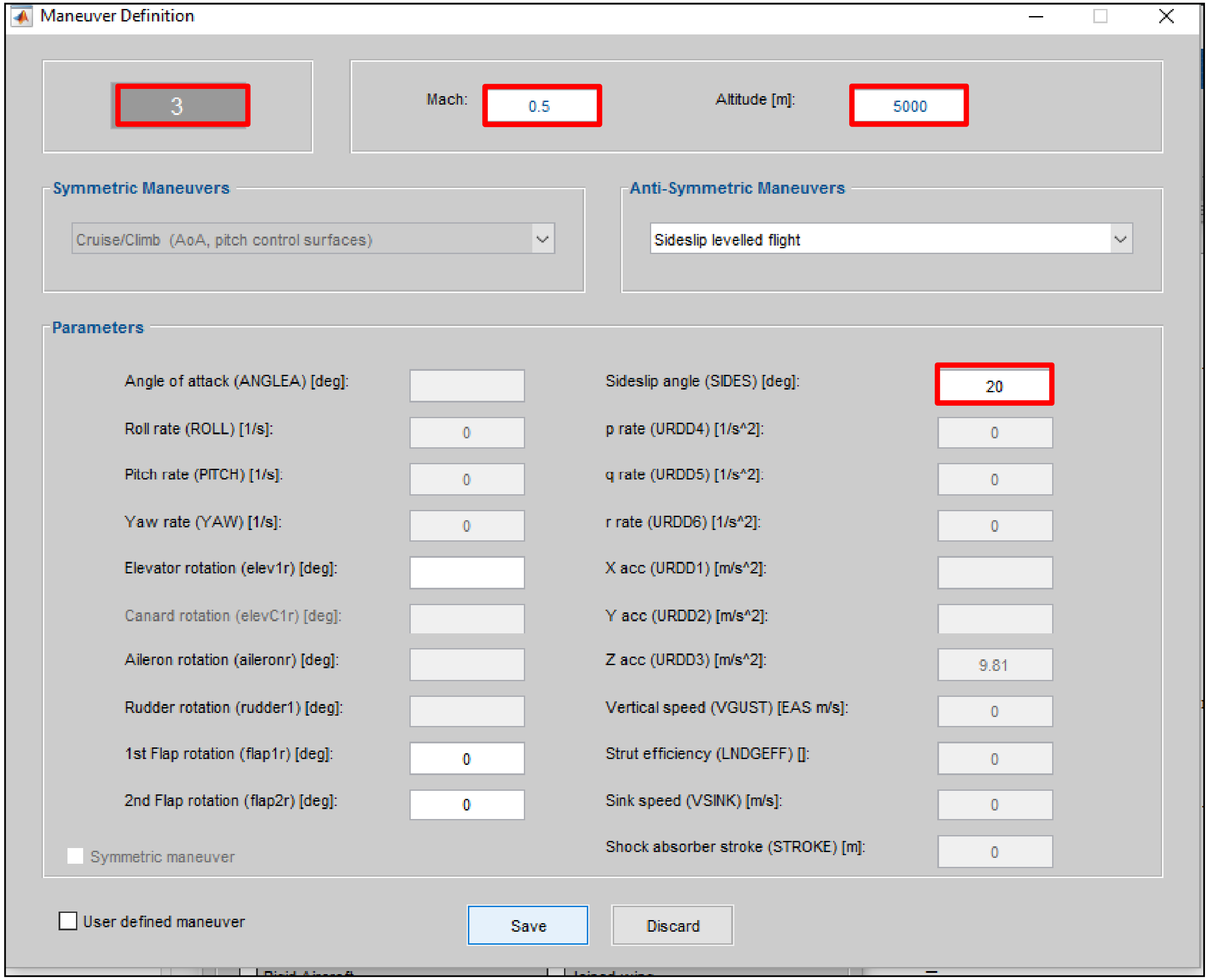
Maneuvers Set Definition: *man. ID 2*



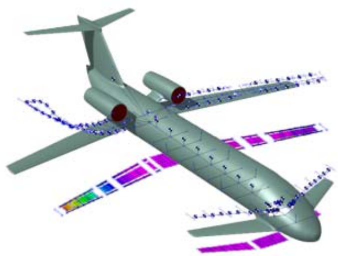
Negative g maneuver:
Z acceleration = -1,5*g.



Maneuvers Set Definition: *man. ID 3*

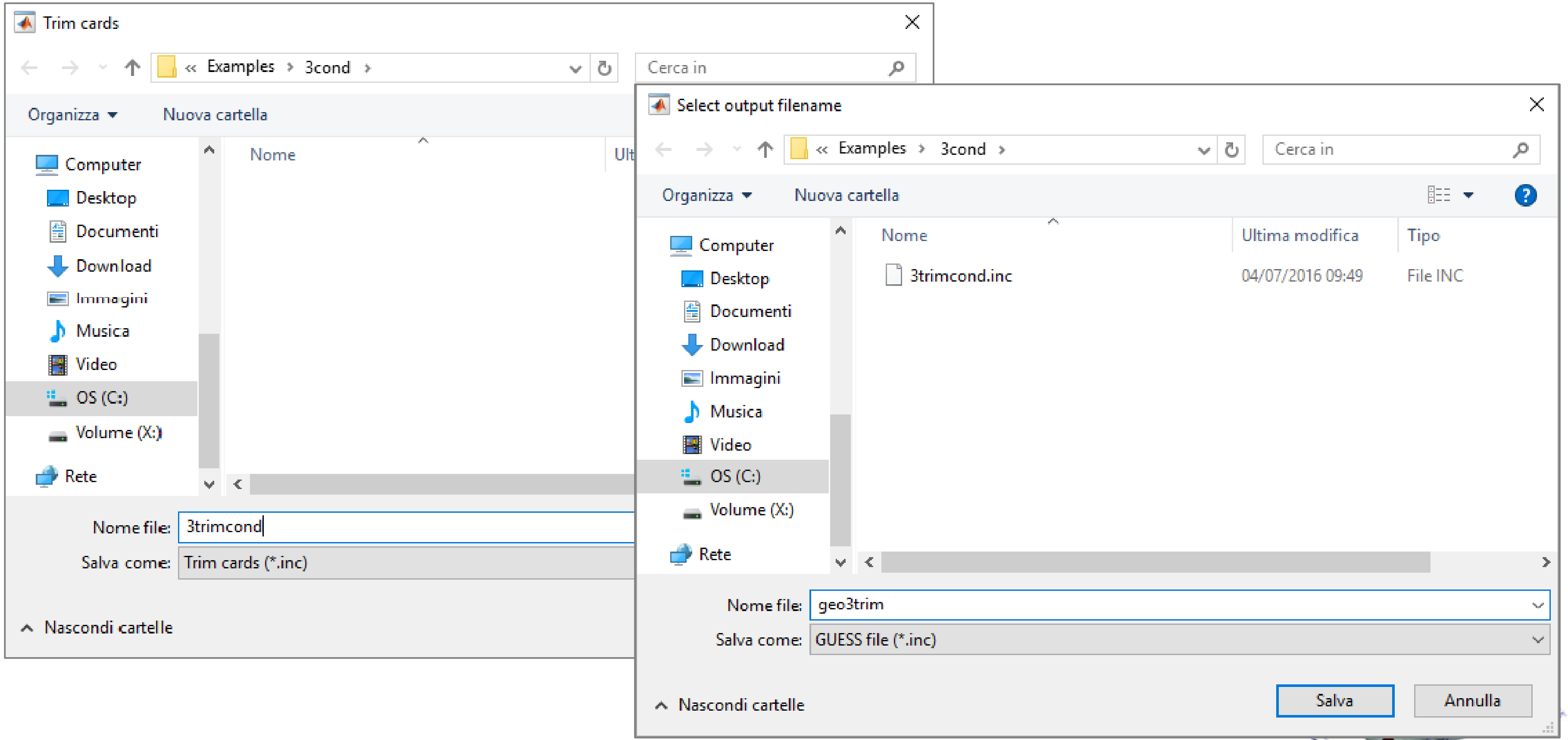


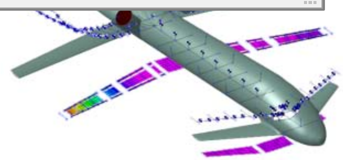
Sideslip maneuver:
sideslip angle = 20°



Running GUESS

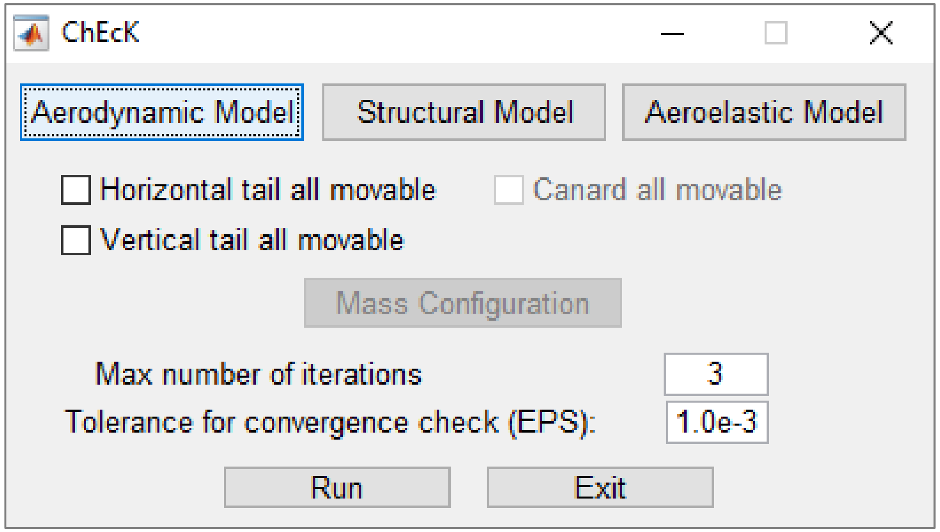
Save the trim condition in a .inc file (*3trimcond.inc*) and run guess creating *geo3trim.inc*

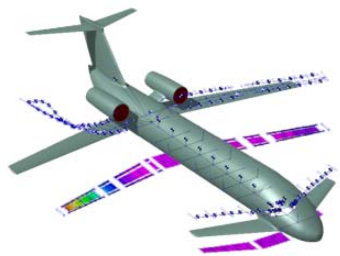




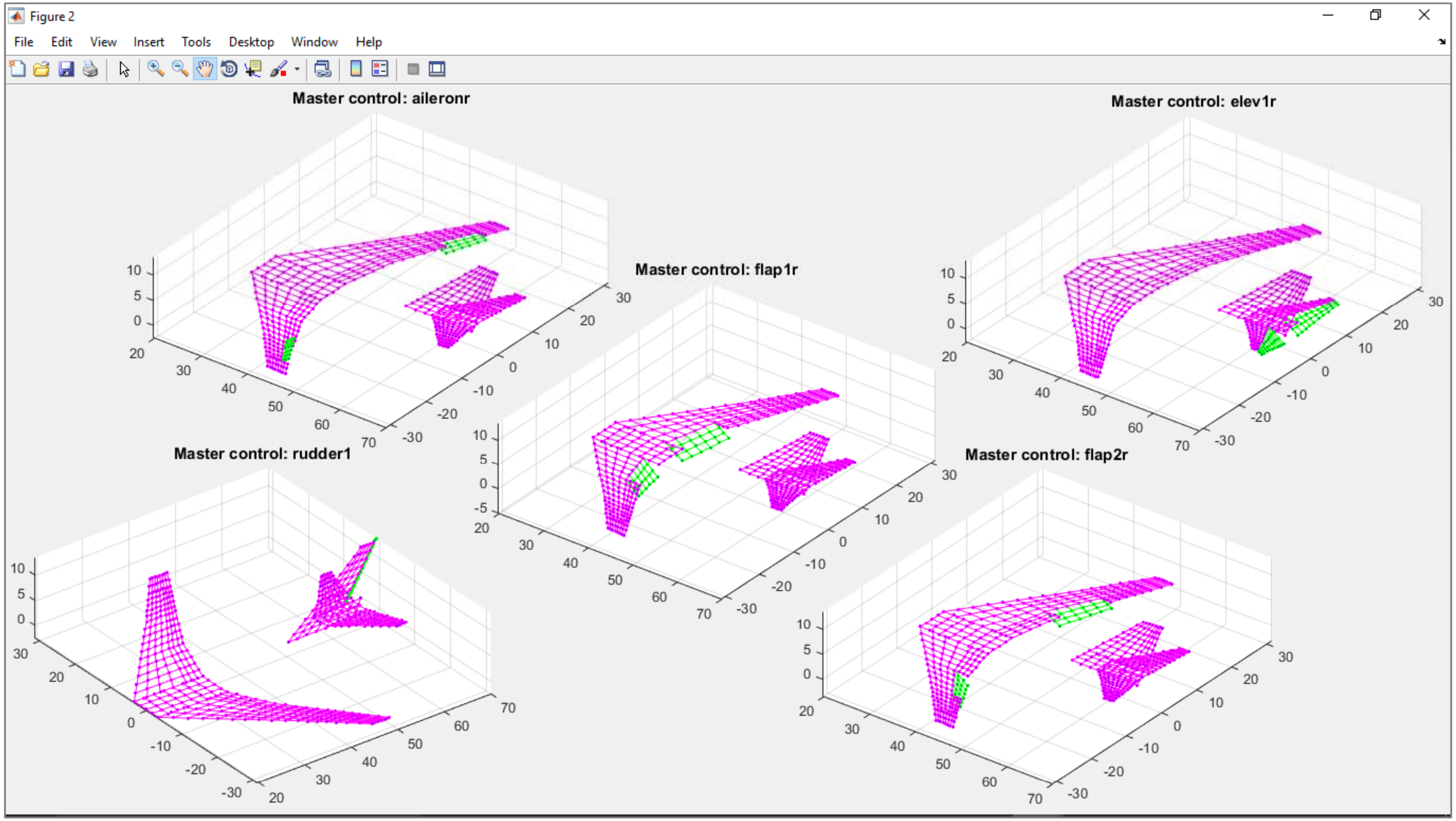
ChEcK phase

The *ChEcK window* comes up in order to check the way your aircraft is modeled. In the three slide below there is an output example of *Aerodynamic, Structural and Aeroelastic Models* of *B747-400*.

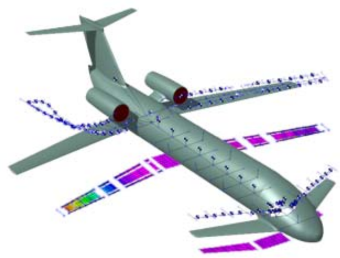




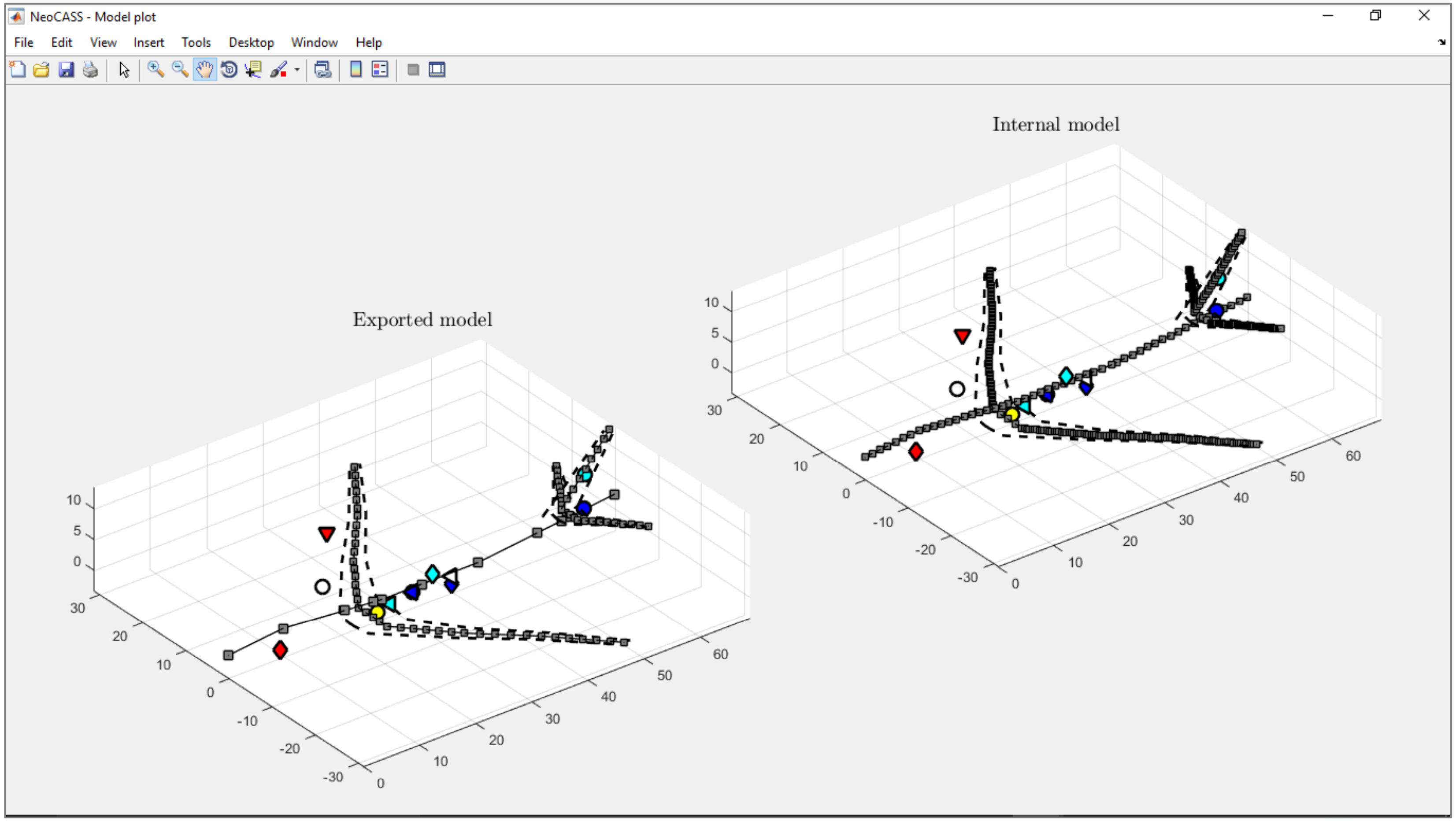
ChEcK phase



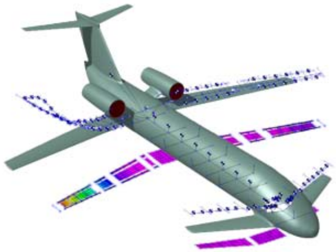
Aerodynamic Model



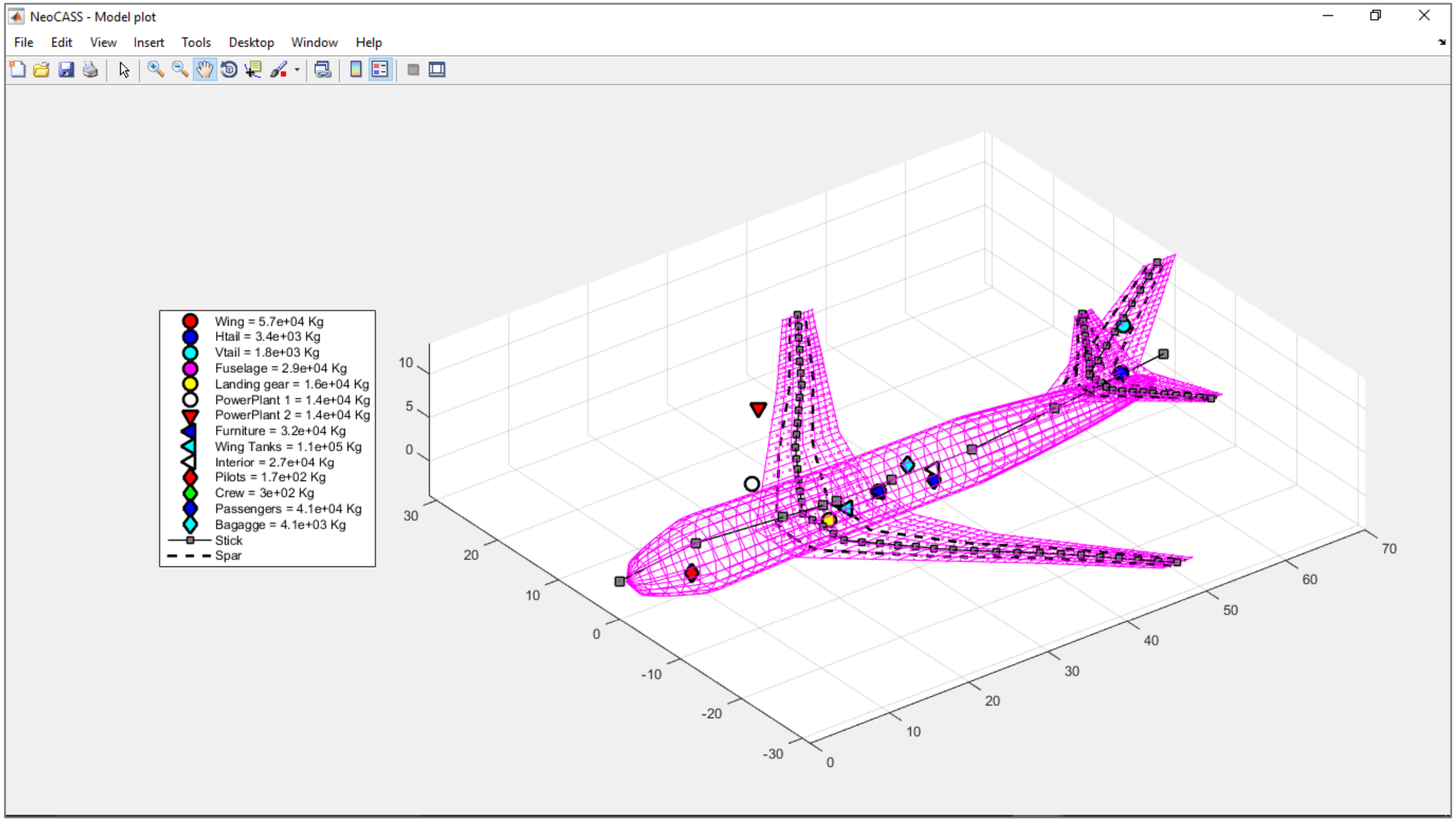
ChEcK phase



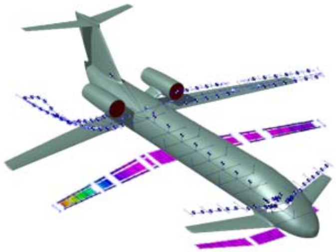
Structural Model



ChEcK phase



Aeroelastic Model



Dimensioning Maneuvers

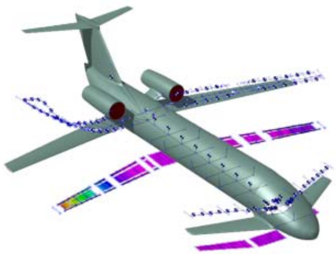
If everything goes well, the output will be similar to this one:

```
------------------------------------------ CONVERGENCE ------------------------------------------
- Refinement loop history:
    Iter     1: Total structural mass: 155434 Kg. Tolerance: 1.284e-03.
    Iter     2: Total structural mass: 152528 Kg. Tolerance: 1.867e-02.

- GUESS model saved in C:\NeoCASS_PG\Examples\PROVA\static_3cond\geo3trim_guess.mat file.
- GUESS summary saved in C:\NeoCASS_PG\Examples\PROVA\static_3cond\geo3trim_guess.txt file.
- SMARTCAD main file with OEW configuration saved in C:\NeoCASS_PG\Examples\PROVA\static_3cond\geo3trim.inc.
- SMARTCAD configuration file saved in C:\NeoCASS_PG\Examples\PROVA\static_3cond\geo3trimCONM_CONF1.inc file.
```

In order to view which maneuver was the most accountable for each a/c part (in terms of bending, shear and torque), one have to load the guess result and process these data through the *'plot_sizing_man'* function.

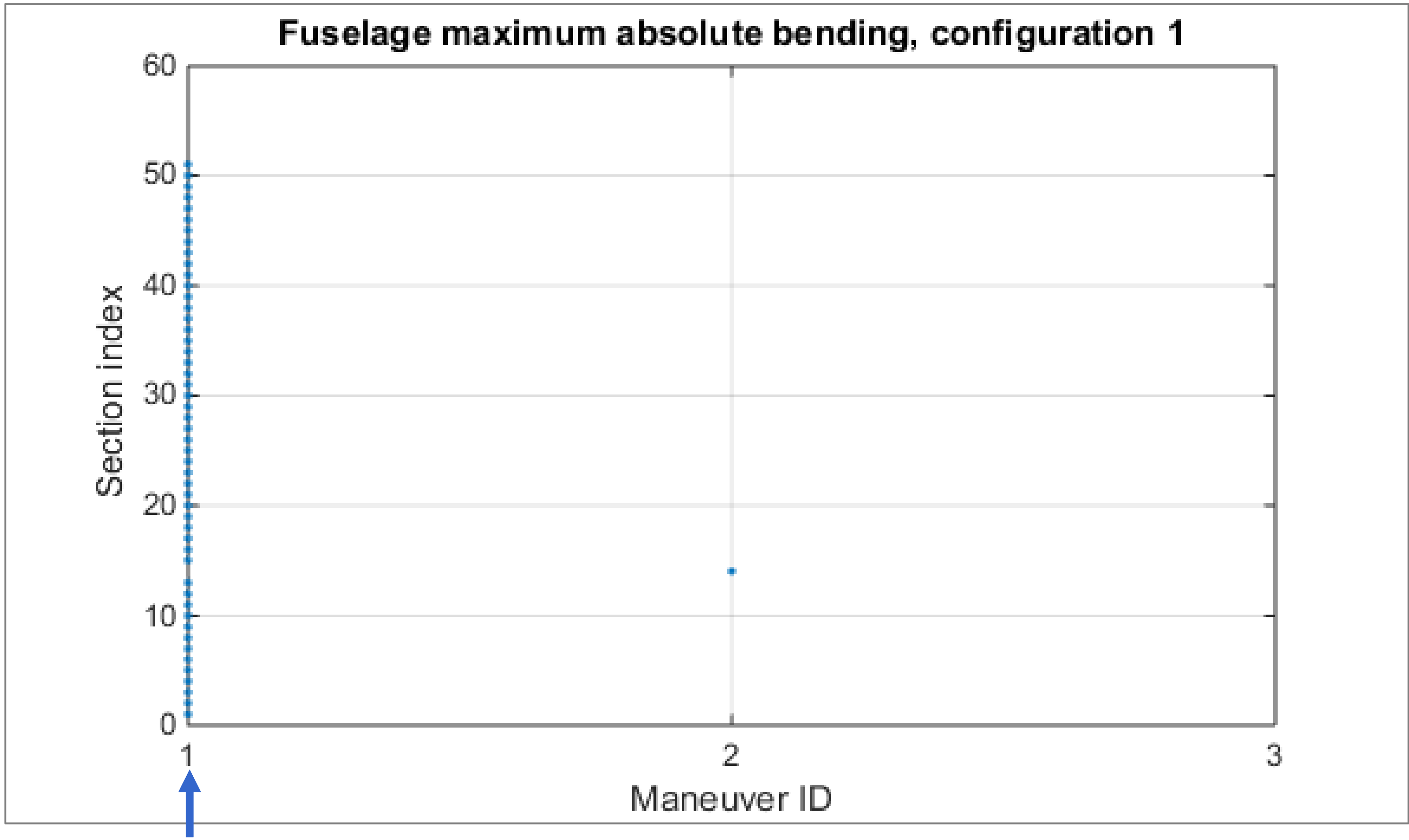
p

```
>> load('geo3trim_guess.mat')
>> plot_sizing_man(guess_model.loads, guess_model, 1, [0.1:0.1:0.9], 1)
```

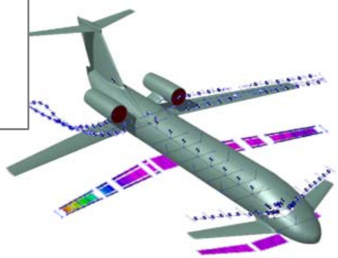


Dimensioning Maneuvers

For instance, the sizing maneuver of the fuselage in bending loading is predictably the pull-up m. (ID 1)

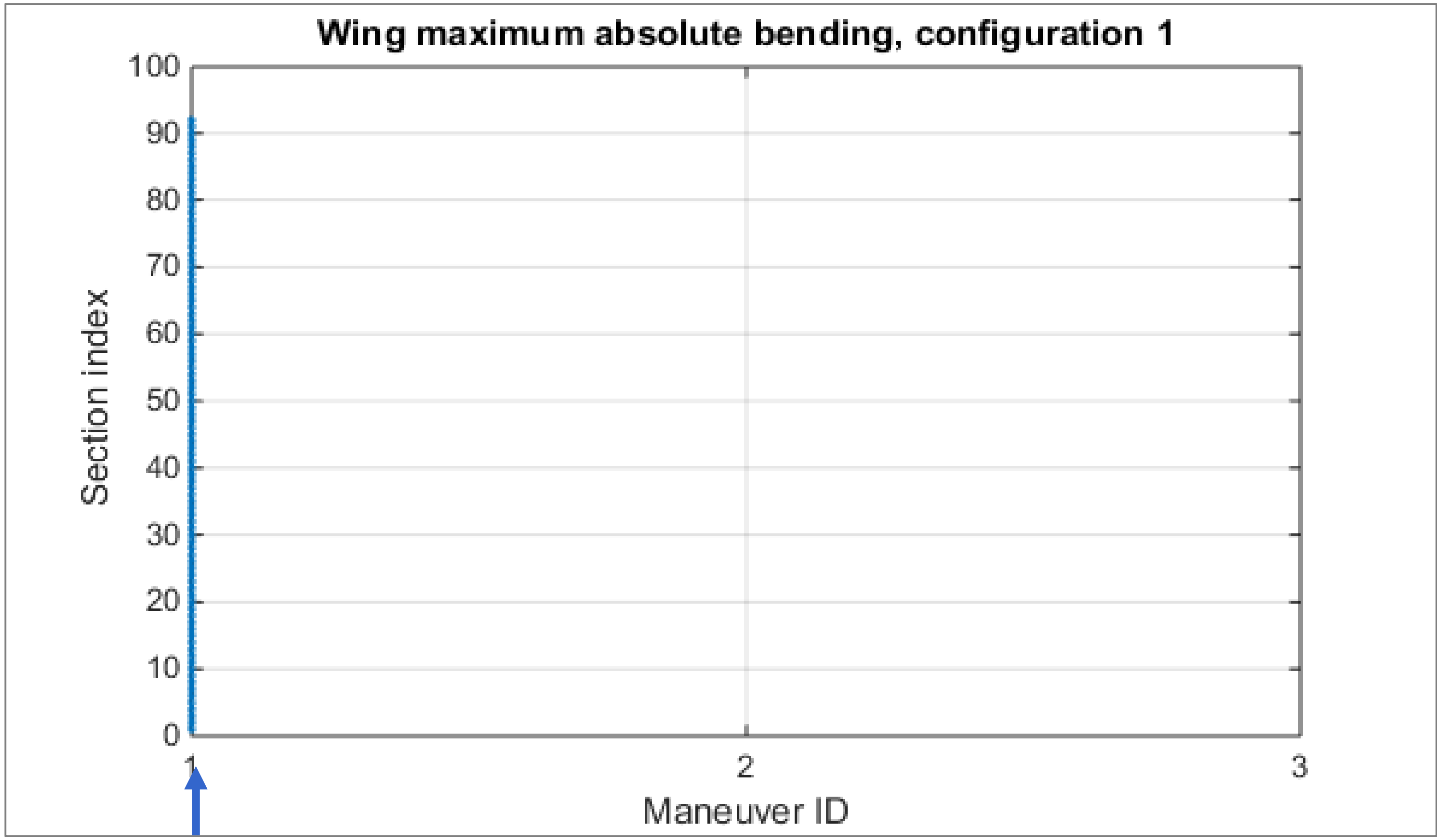


p = 1 : fuselage

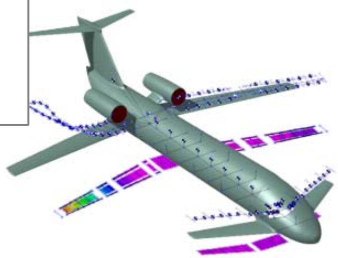


Dimensioning Maneuvers

The same will be for bend, torque and shear of wings.

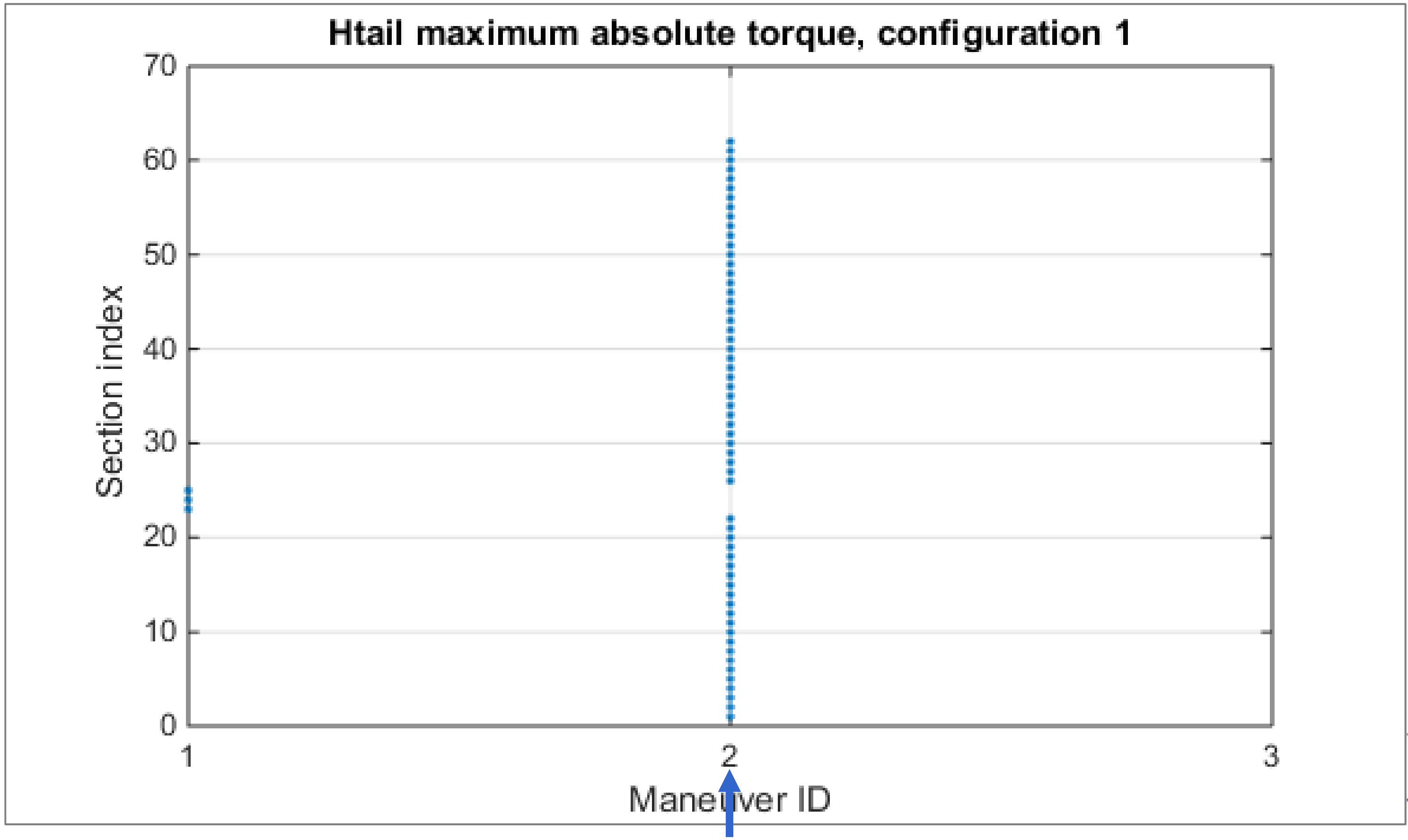


p = 2 : wings

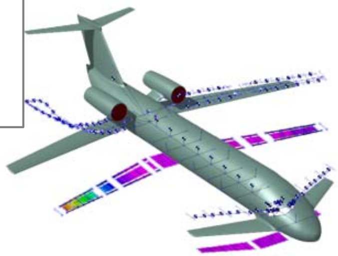


Dimensioning Maneuvers

The negative g maneuver (ID 2) is the dimensioning one for horizontal tail as far as the torque loading is considered.

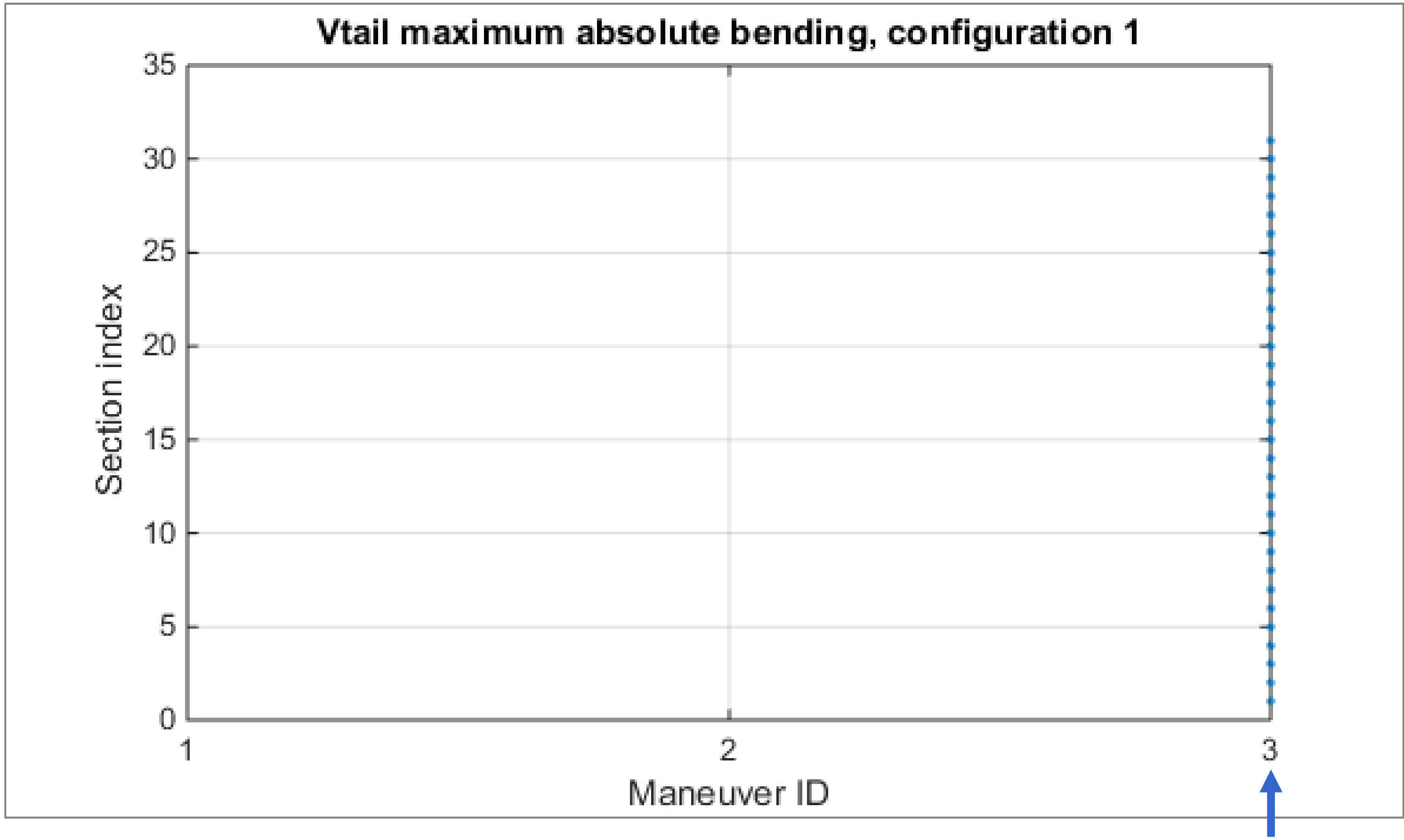


p = 3 : horizontal tail

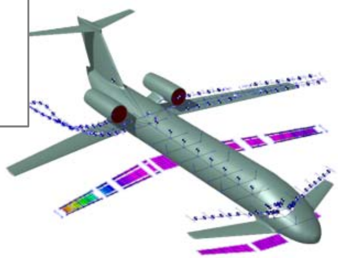


Dimensioning Maneuvers

Finally, the side slip m. (ID 3) is the most significant for the vertical tail sizing.

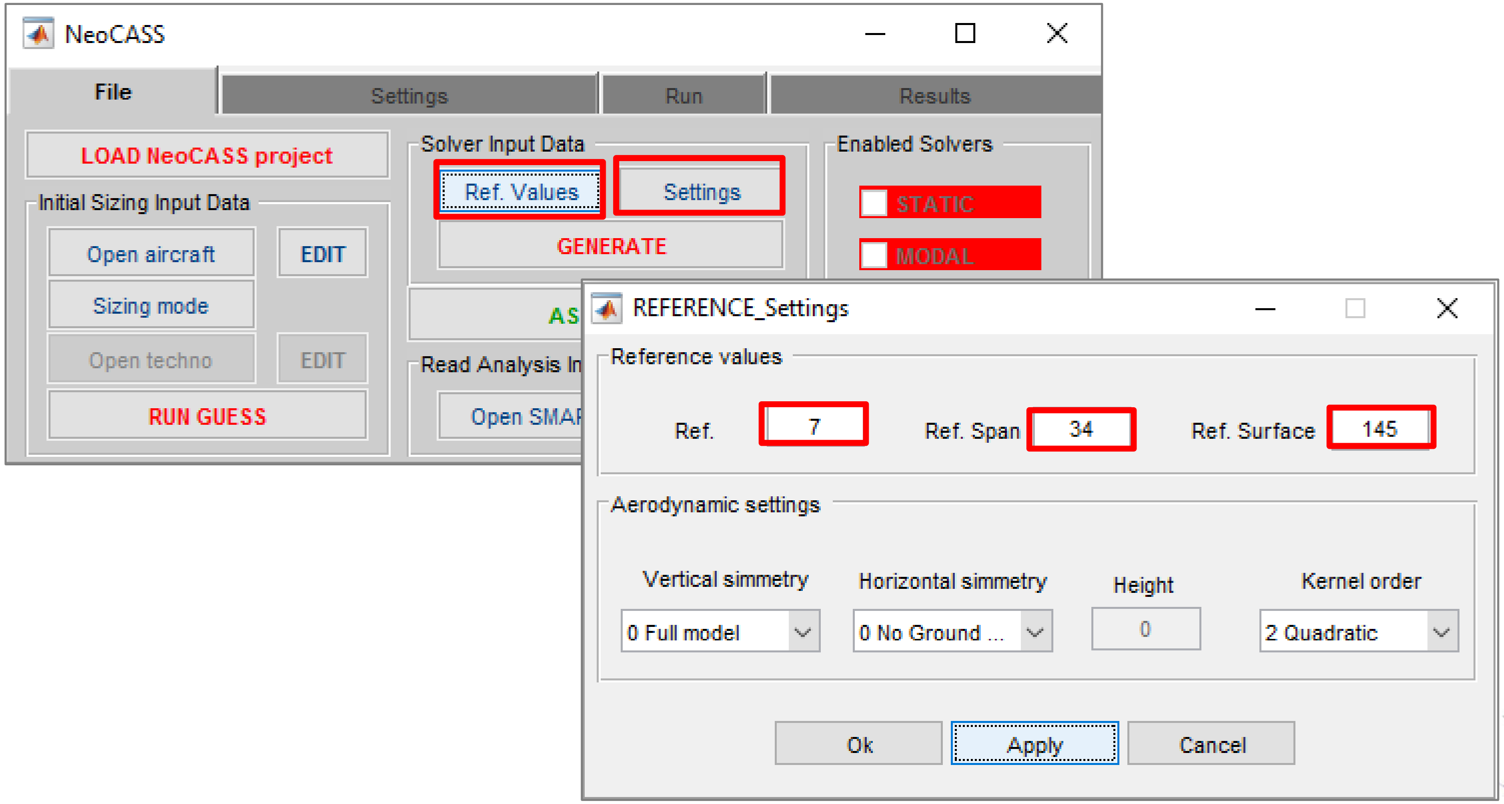


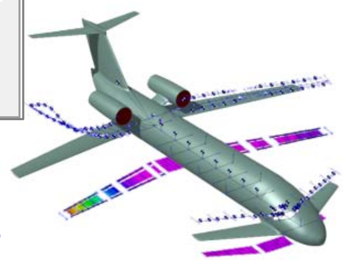
p = 4 :
vertical tail



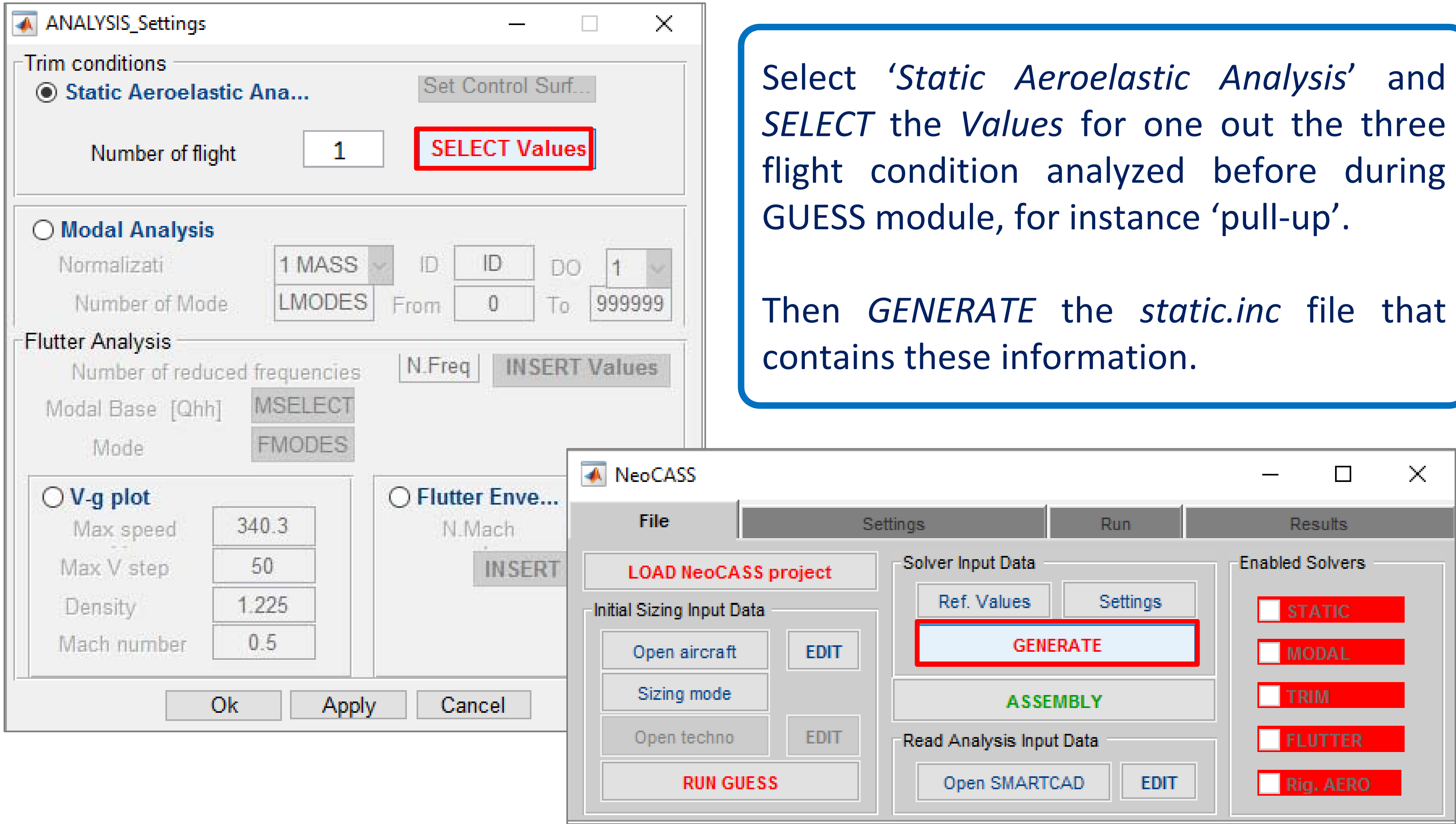
Running a 'TRIM' analysis

Set *Reference Values* and then press *Settings* for assigning loading details for further analysis.



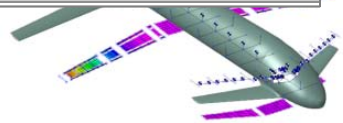


Running a ‘TRIM’ analysis

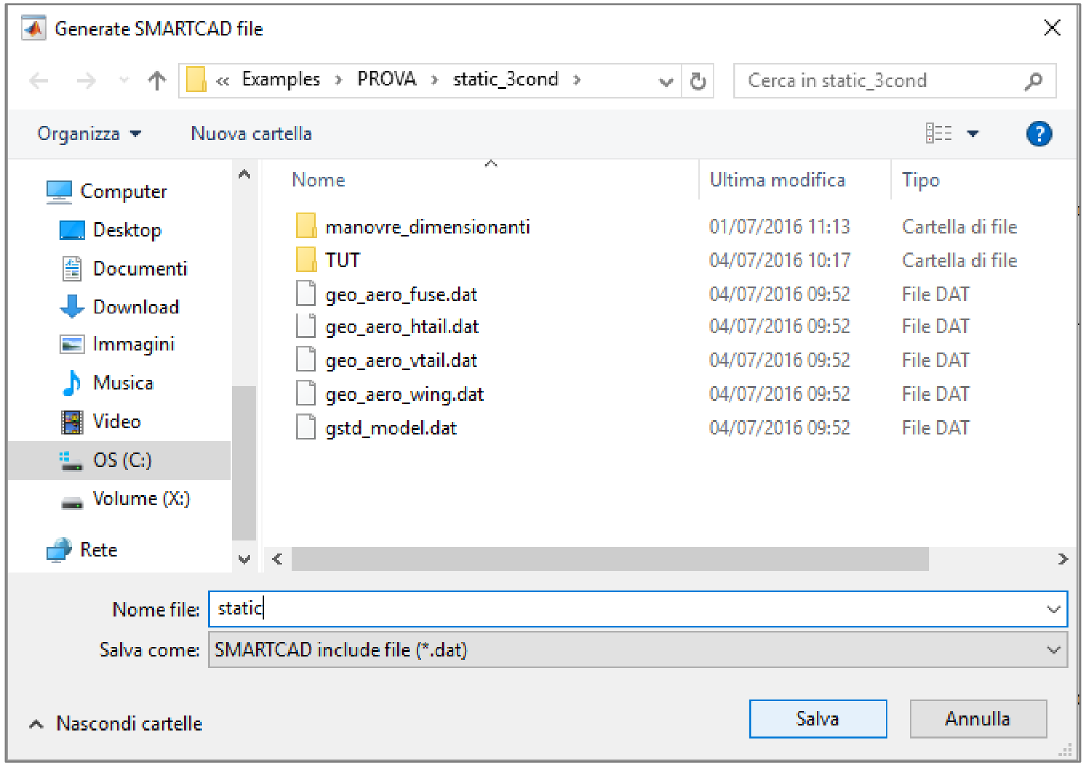


Select *‘Static Aeroelastic Analysis’* and *SELECT* the *Values* for one out the three flight condition analyzed before during GUESS module, for instance ‘pull-up’.

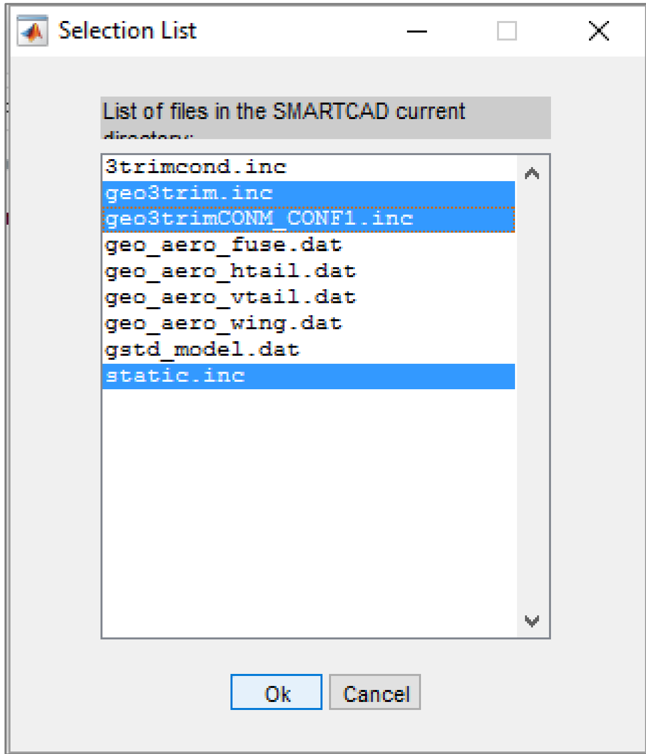
Then *GENERATE* the *static.inc* file that contains these information.

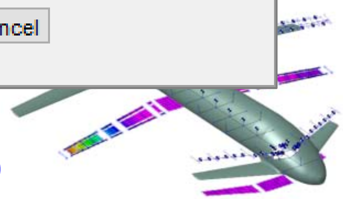


Running a ‘TRIM’ analysis



Finally, as usual, collect the geometric and analysis settings in one *static.dat* file.

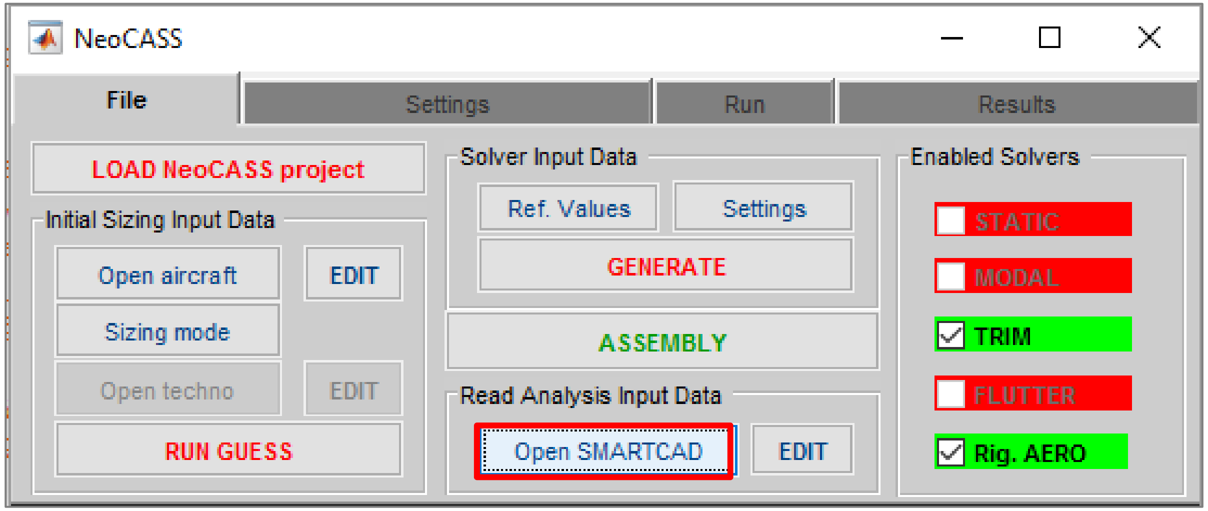


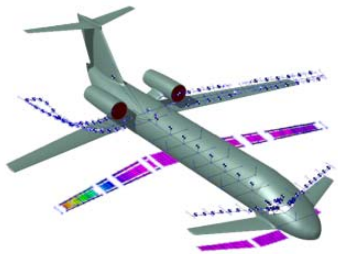


Running a 'TRIM' analysis

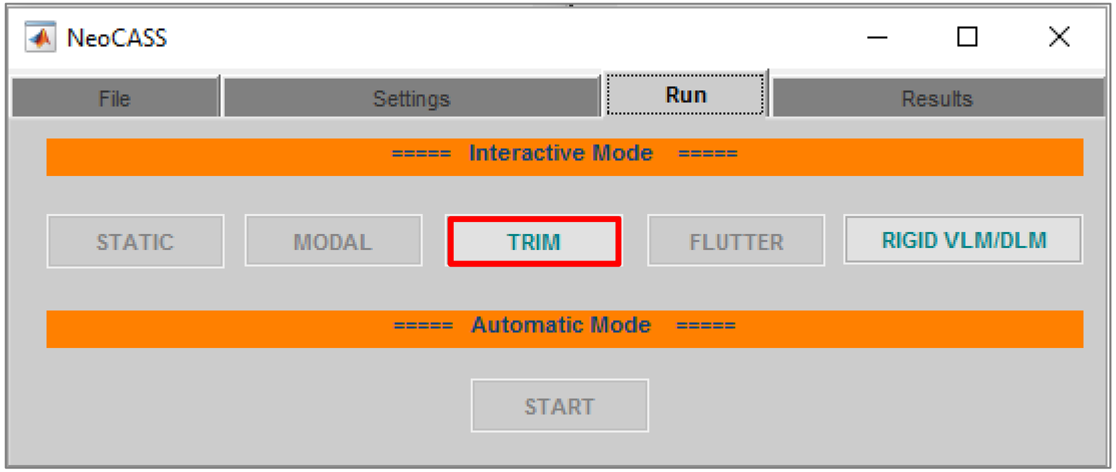
```
- Solver input data file: C:\NeoCASS_PG\Examples\PROVA\static_3cond\static.inc.

- Exporting parameters for steady VLM solver...done.

- SMARTCAD file: C:\NeoCASS_PG\Examples\PROVA\static_3cond\static.dat.
```

Loading the SMARTCAD file *static.dat* enables the TRIM and Rigid AERO analysis.

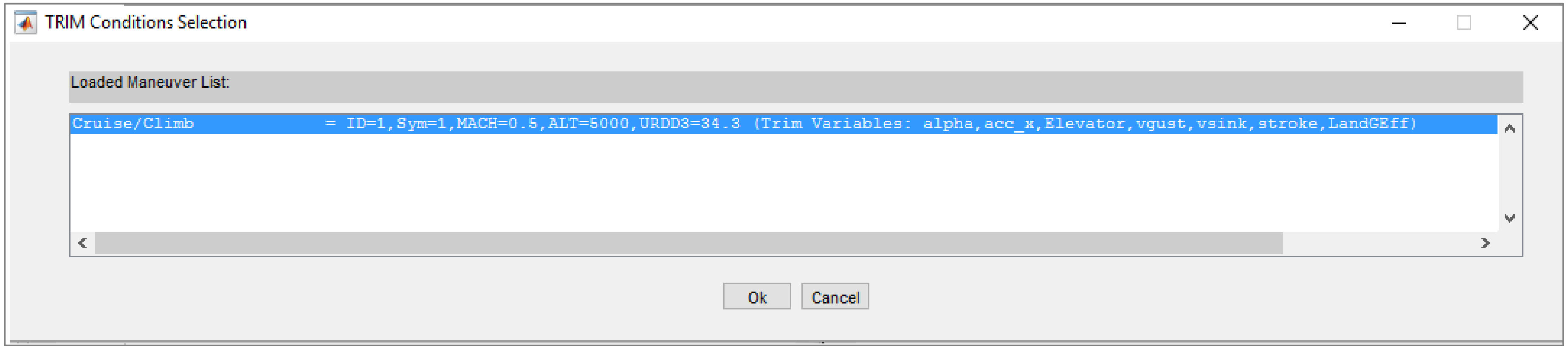


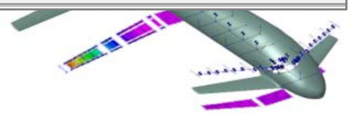


Running a 'TRIM' analysis



Start running the TRIM process that equilibrate the ac in the selected flight condition.

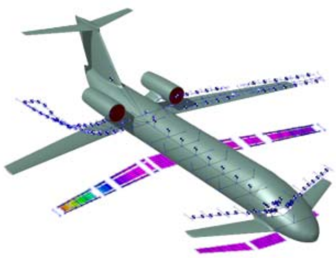




Running a 'TRIM' analysis

In the command window the solver tells you about the actual process.

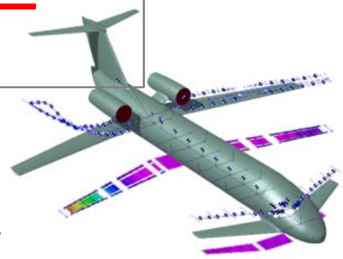
```
Solving linear static unrestrained trim (ID 1)...


- Setting internal database...done.
- Building aero-structural interpolation matrices...
     - Method: 1.
     - Assemblying collocation points interpolation matrix...done.
     - Assemblying nodes interpolation matrix...done.
     - Assemblying verticies interpolation matrix...done.
     - Assemblying vortices midpoint interpolation matrix...done.
     - Assemblying body collocation points interpolation matrix...done.
  done.

- Assemblying stiffness matrix...done.
- Assemblying mass matrix...done.
  etc...
```



Running a ‘TRIM’ analysis

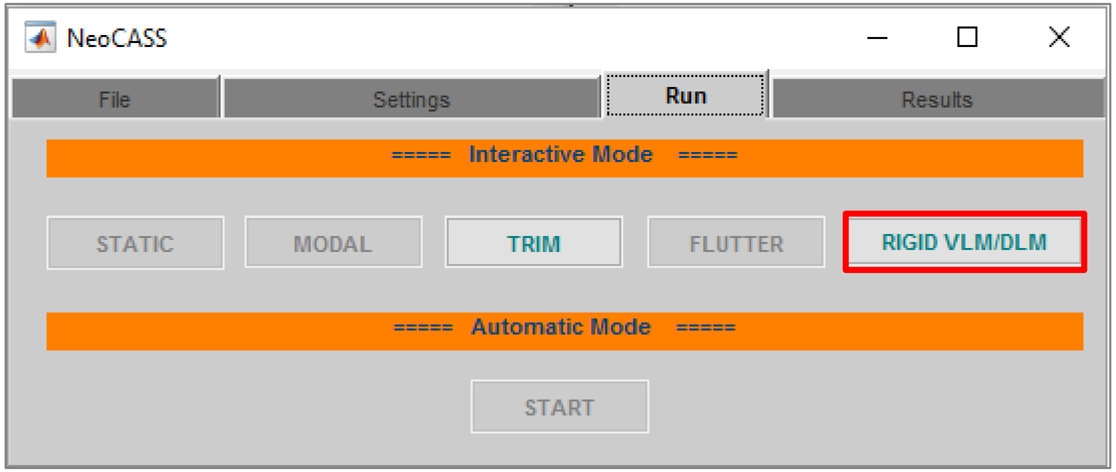
The trim condition is solved.

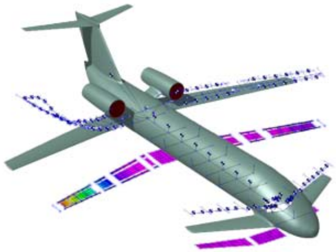
```
Solving deformable aircraft trim condition...
 - X acc:       -6.88209e-12 [m/s^2].
 - Y acc:       0 [m/s^2].
 - Z acc:       34.3 [m/s^2].
 - P-DOT:       0 [rad/s^2].
 - Q-DOT:       0 [rad/s^2].
 - R-DOT:       0 [rad/s^2].

 - Alpha:       38.1965 [deg].
 - Sideslip:    0 [deg].
 - Roll rate:   0 [-] (p*BREF/(2VREF)).
 - Pitch rate:  0 [-] (q*CREF/(2VREF)).
 - Yaw rate:    0 [-] (r*BREF/(2VREF)).
 - Control flap1r:    0 [deg].
 - Control flap2r:    0 [deg].
 - Control aileronr:    0 [deg].
 - Control elev1r:   -6.25167 [deg].
 - Control rudder1:    0 [deg].
done.
 - Updating vlm model in Aero.lattice_defo...done.
 - Solution summary exported to C:\NeoCASS_PG\Examples\PROVA\static_3cond\static_man_1.txt file.

completed.
```



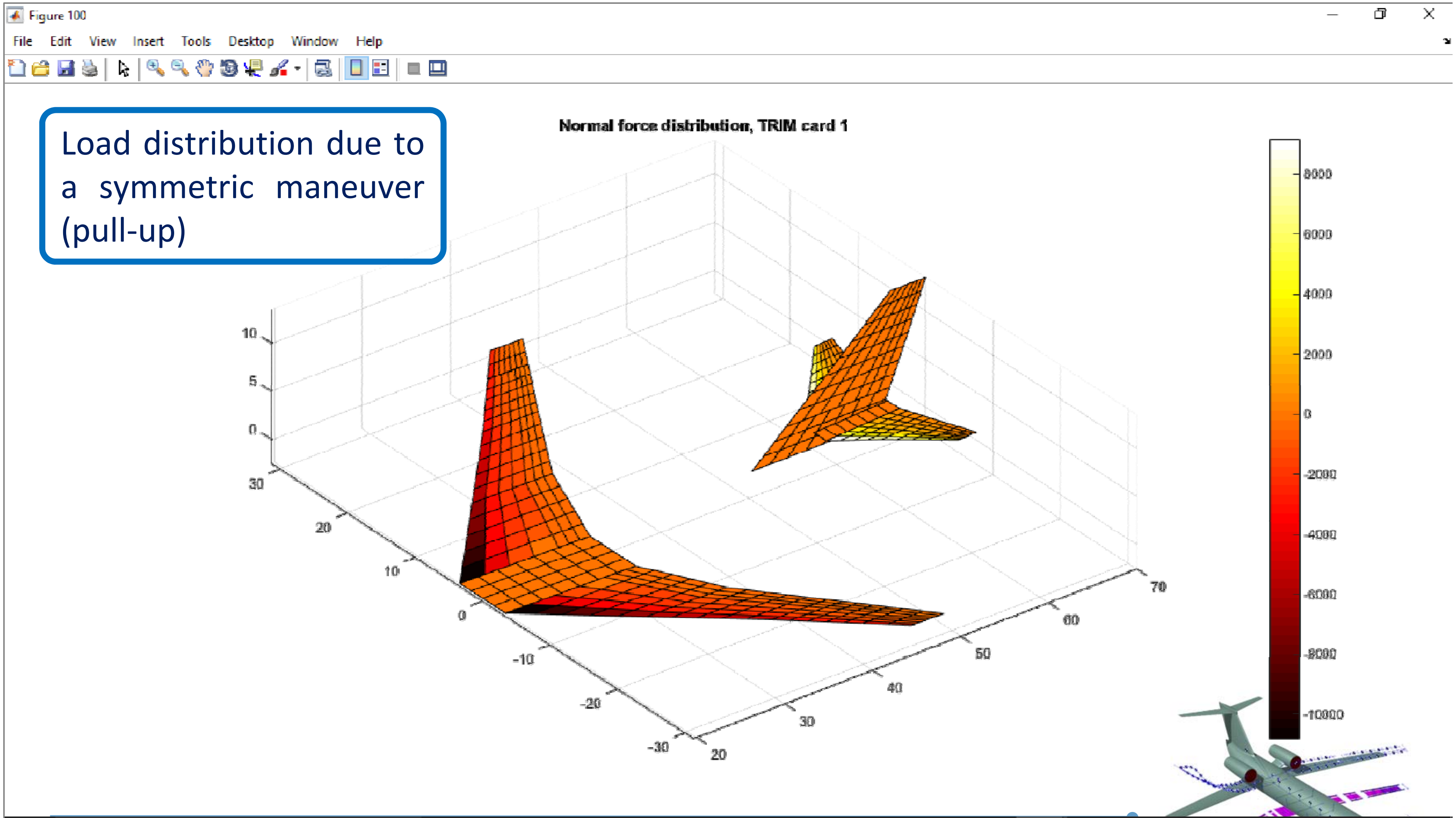
Running a ‘Rigid VLM/DLM’ analysis

Now one could also run the ‘Rigid VLM/DLM analysis’. By clicking it the analysis will start automatically.



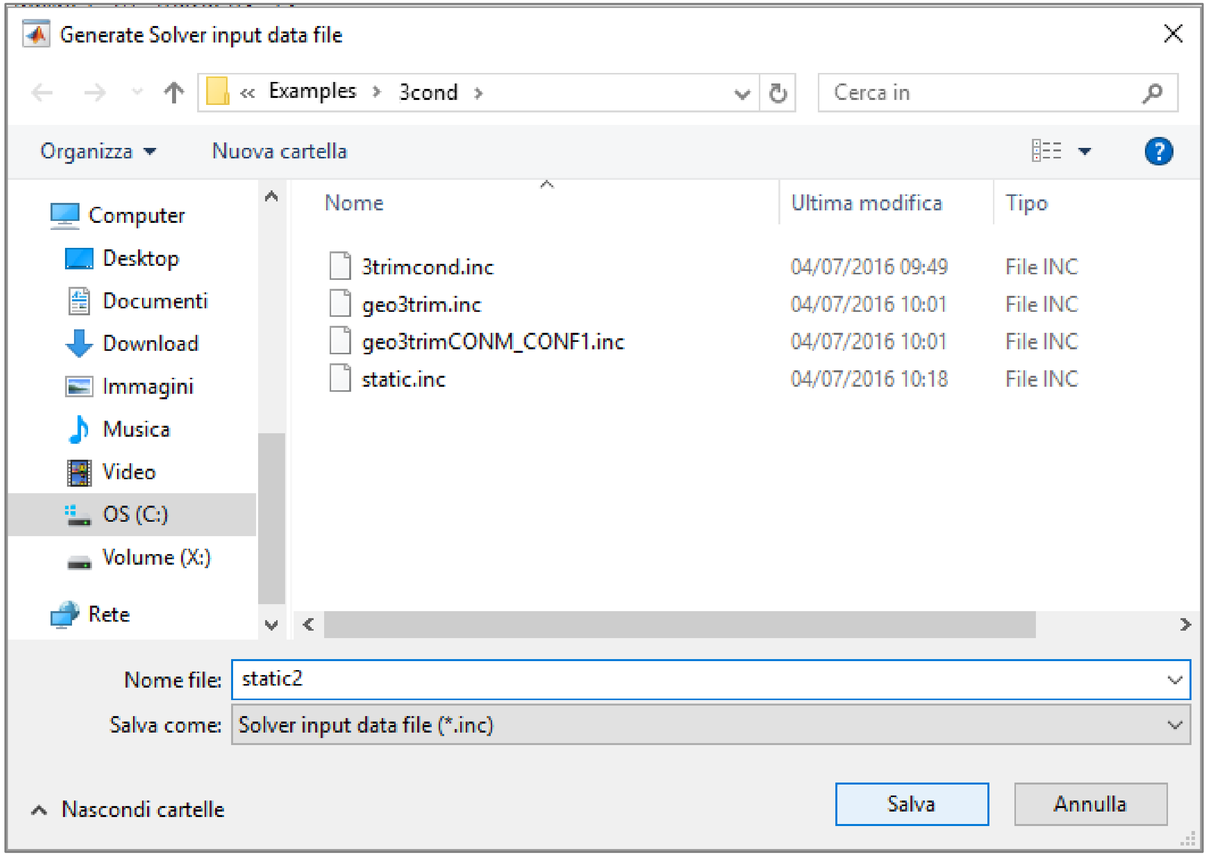


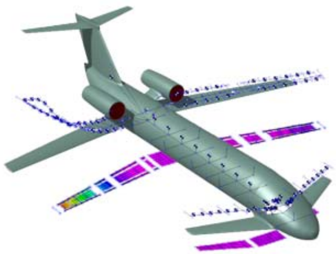
Running a ‘Rigid VLM/DLM’ analysis



Running another 'TRIM' and 'Rigid VLM/DLM' analysis

In order to analyze another loading condition, return to the 18th slide and repeat the procedure for 'sideslip'.

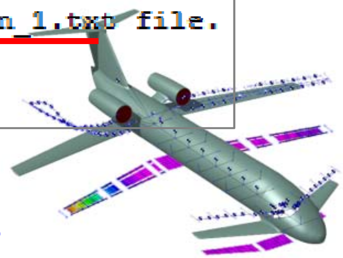




Running another 'TRIM' and 'Rigid VLM/DLM' analysis

The new trim condition is solved:

```
Solving deformable aircraft trim condition...
 - X acc:      -3.36379e-12 [m/s^2].
 - Y acc:      1.04461 [m/s^2].
 - Z acc:      9.81 [m/s^2].
 - P-DOT:      0 [rad/s^2].
 - Q-DOT:      0 [rad/s^2].
 - R-DOT:      0 [rad/s^2].

 - Alpha:      10.2084 [deg].
 - Sideslip:   20 [deg].
 - Roll rate:  0 [-] (p*BREF/(2VREF)).
 - Pitch rate: 0 [-] (q*CREF/(2VREF)).
 - Yaw rate:   0 [-] (r*BREF/(2VREF)).
 - Control flap1r:   0 [deg].
 - Control flap2r:   0 [deg].
 - Control aileronr:   18.9543 [deg].
 - Control elev1r:   4.89144 [deg].
 - Control rudder1:   19.3475 [deg].
done.
 - Updating vlm model in Aero.lattice_defo...done.
 - Solution summary exported to C:\NeoCASS_PG\Examples\PROVA\static_3cond\static2_man_1.txt file.

completed.
```



Running another ‘TRIM’ and ‘Rigid VLM/DLM’ analysis