

# NeoCASS Tutorial

How to run a flutter analysis

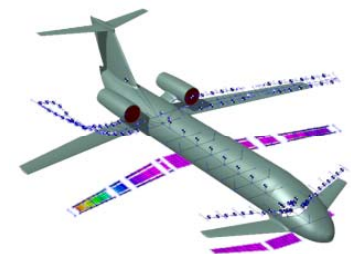
Version 2.2(.790)

August 2017

# Outline

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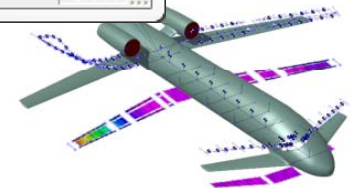
1. How to **Run NeoCASS** pag. 3
2. How to **Run GUESS** pag. 20
3. How to **Run MODAL** analysis with SMARTCAD pag. 29
4. How to **Run FLUTTER** analysis with SMARTCAD pag. 43



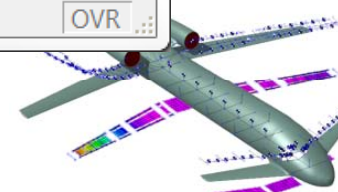
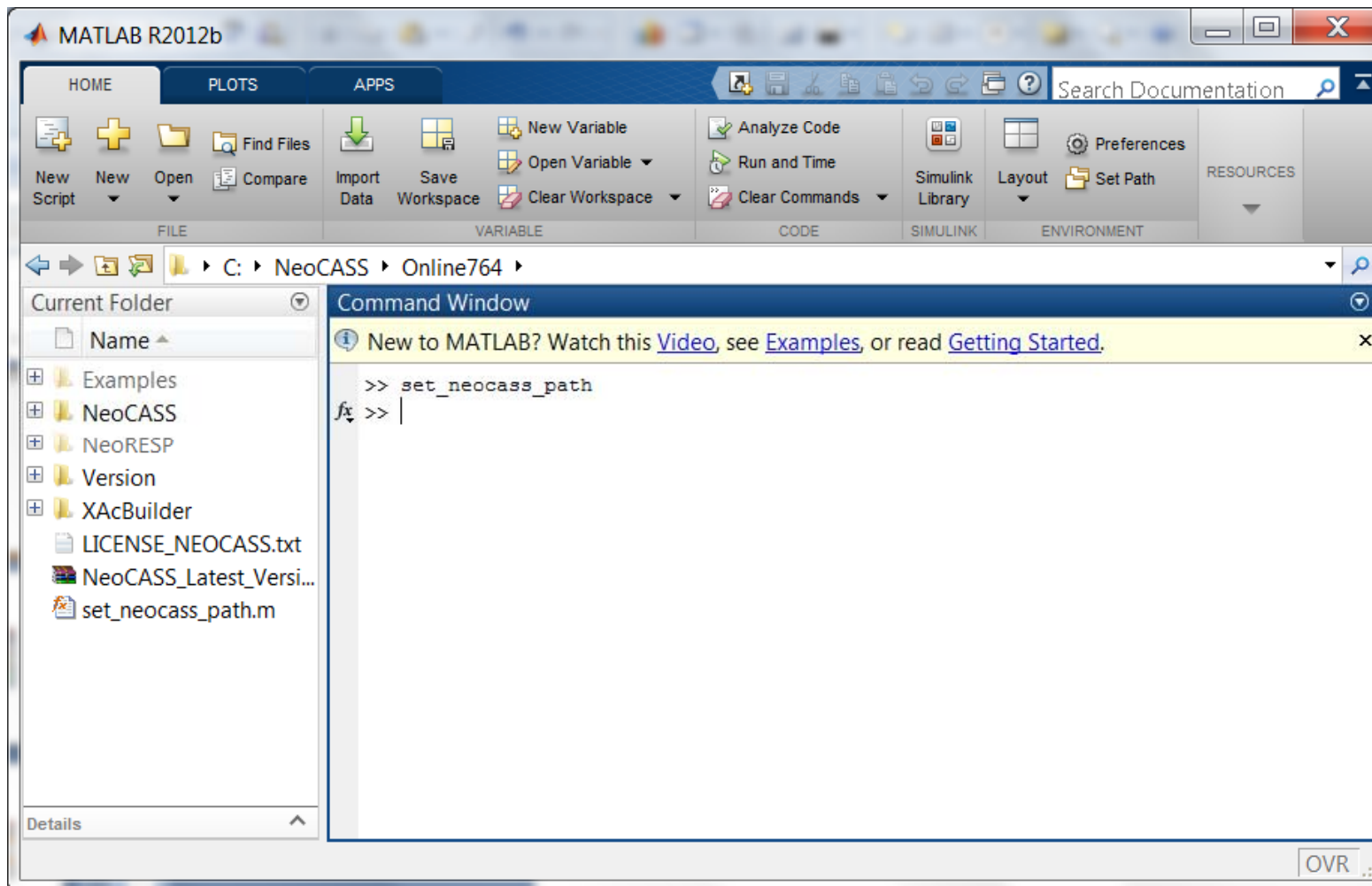
# NeoCASS path definition



The screenshot shows the MATLAB R2012b environment. The Command Window is active, displaying the command `set_neocass_path` entered at the prompt. A blue callout box is overlaid on the Command Window, containing the text: "Run the script *set\_neocass\_path* in the installation directory. That allows to include the NeoCASS routines into the current path." The left sidebar shows the file explorer with the current folder set to `C:\NeoCASS\Online764`. The file list includes folders like `Examples`, `NeoCASS`, `NeoRESP`, `Version`, and `XAcBuilder`, as well as files like `LICENSE_NEOCASS.txt`, `NeoCASS_Latest_Versi...`, and `set_neocass_path.m`.



# NeoCASS path definition



# Running NeoCASS from the working directory

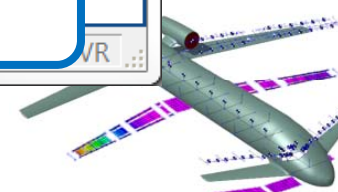


The screenshot shows the MATLAB R2012b interface. The Command Window contains the following text:

```
New to MATLAB? Watch this Video, see Examples, or read Getting Started.  
  
>> set_neocass_path  
>> ls  
  
.  
..  
          B747-400_reference.xml  
  
fx >> NeoCASS|
```

A callout box with a blue border contains the following text:

Create a new folder and save there the example file to be analyzed. It is important to run *NeoCASS* working in a folder different from one where NeoCASS is installed.  
Type *NeoCASS* and run!



# NeoCASS GUI Panel



The screenshot shows the MATLAB R2012b environment. The NeoCASS GUI panel is open, displaying various tabs: File, Settings, Run, and Results. The File tab is active, showing options like 'LOAD NeoCASS project', 'Initial Sizing Input Data' (with 'Open aircraft', 'Sizing mode', 'Open techno', and 'RUN GUESS' buttons), 'Solver Input Data' (with 'Ref. Values', 'Settings', and 'GENERATE' buttons), 'Read Analysis Input Data' (with 'Open SMARTCAD' and 'EDIT' buttons), and 'Enabled Solvers' (with checkboxes for STATIC, MODAL, TRIM, FLUTTER, and Riq. AERO).

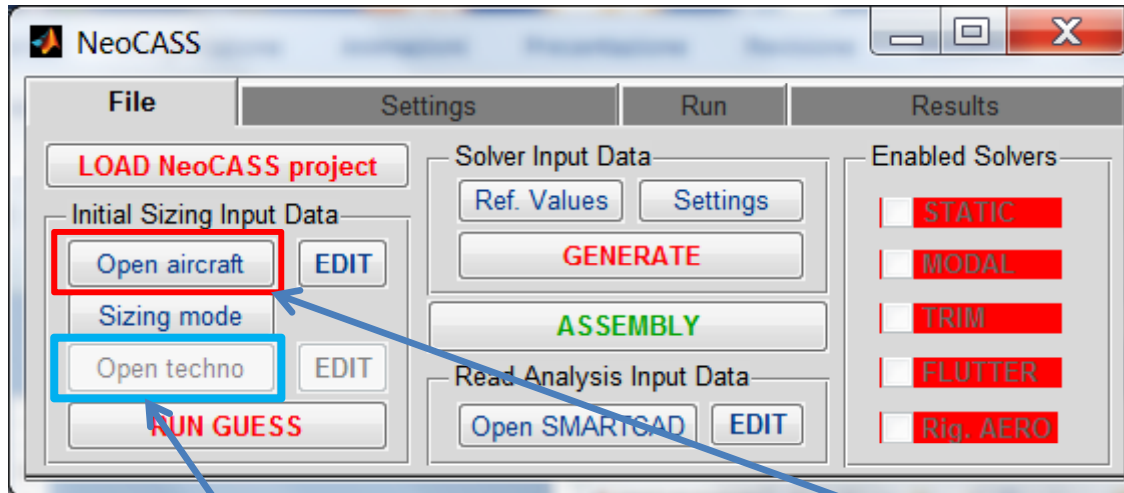
The Command Window shows the following output:

```
>> set_neocas  
>> ls  
  
.  
..  
  
B747-400_reference.xml  
  
>> NeoCASS  
.  
- NeoCASS version 2.2.764. Release date: 06-Oct-2015 09:41:00  
- Initializing NeoCASS GUI database...done.  
fx >> |
```

A blue callout box labeled "Code version" points to the line "- NeoCASS version 2.2.764. Release date: 06-Oct-2015 09:41:00". Another blue callout box at the bottom right contains the text "After some initial settings, the NeoCASS GUI pops up on the screen".

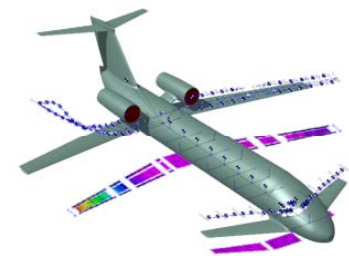


# 1st STEP: loading the XML file

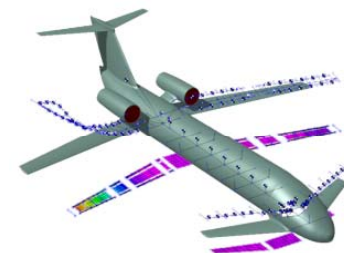
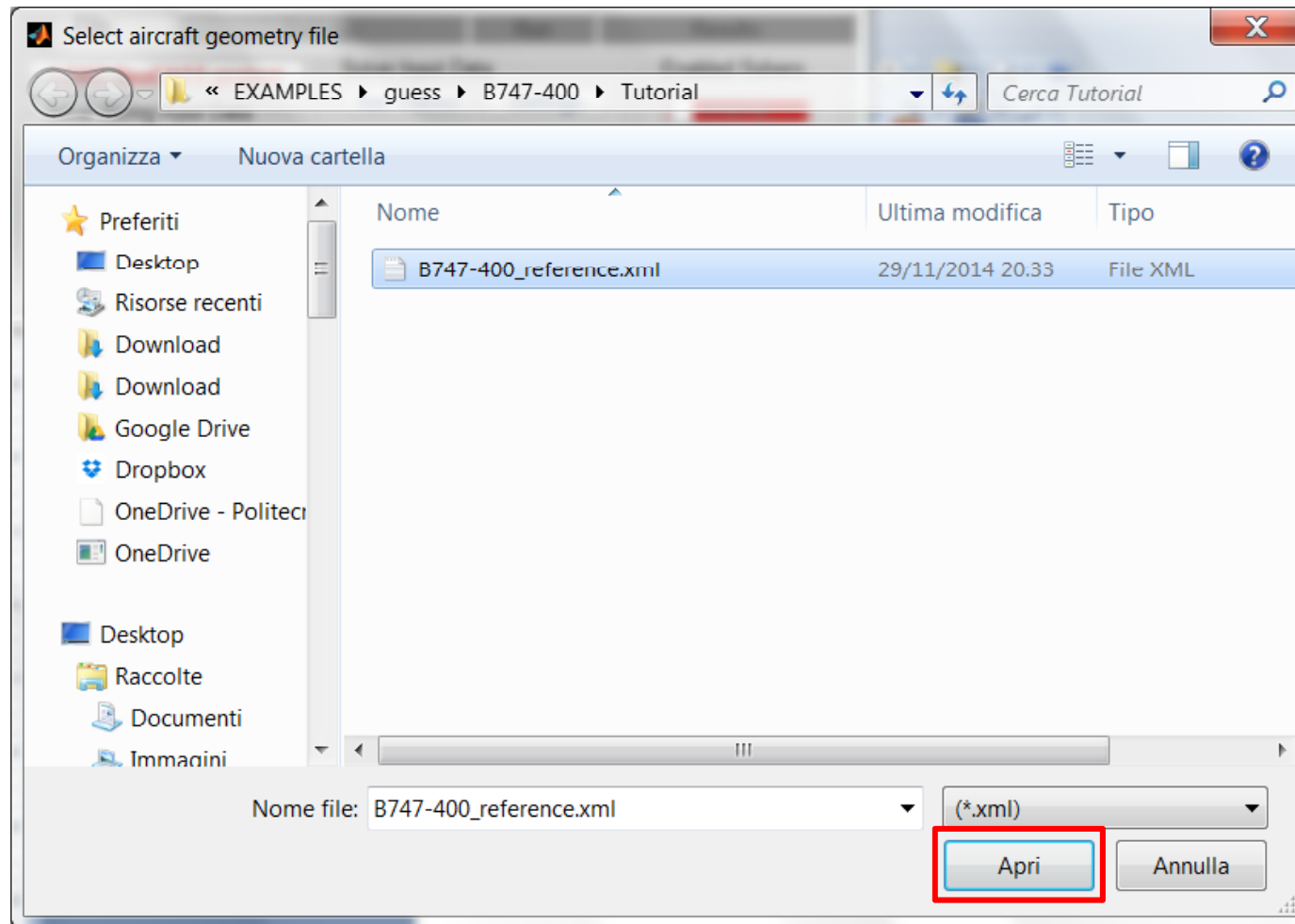


The *Open techno* button is not active when the technology info are already included into XML file.

Click *Open aircraft* button to load the XML file



# 1st STEP: loading the XML file





# 1st STEP: loading the XML file



The screenshot shows the MATLAB R2012b environment. The Command Window displays the following output:

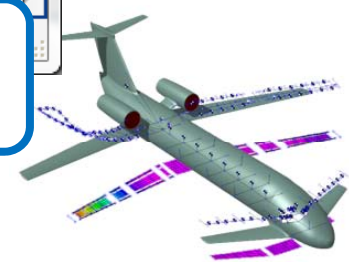
```
>> set_neocass_path
>> ls

      B747-400_reference.xml
..
..

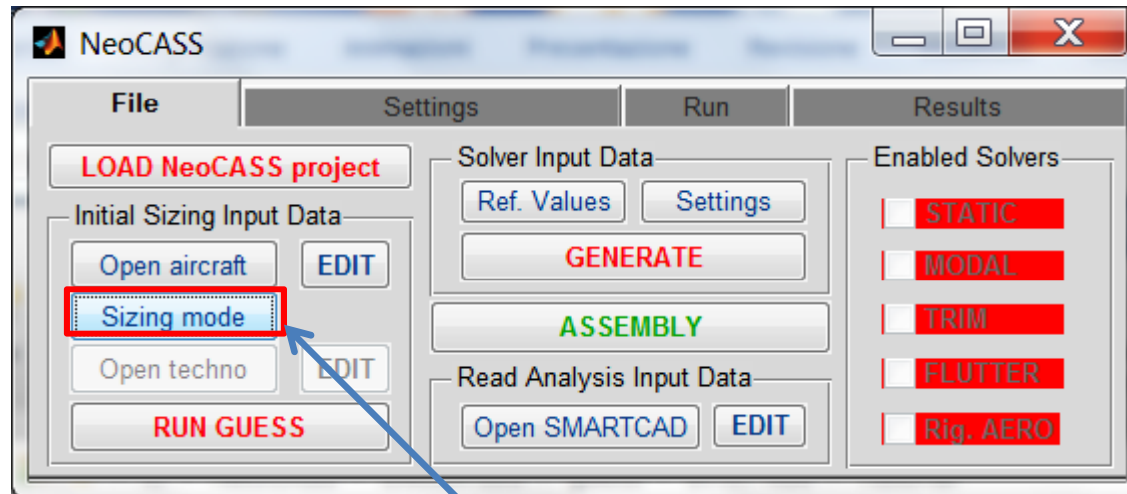
>> NeoCASS
.
- NeoCASS version 2.2.764. Release date: 06-Oct-2015 09:41:00
- Initializing NeoCASS GUI database...done.
- GUESS aircraft filename: C:\NeoCASS\EXAMPLES\guess\B747-400\Tutorial\B747-400_refe
fx >
```

A red rectangular box highlights the line: `GUESS aircraft filename: C:\NeoCASS\EXAMPLES\guess\B747-400\Tutorial\B747-400_refe`

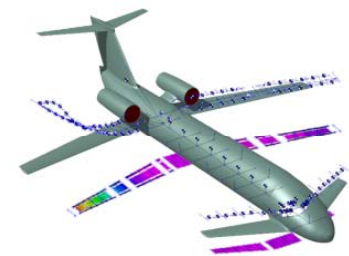
The XML file has been successfully found and loaded.



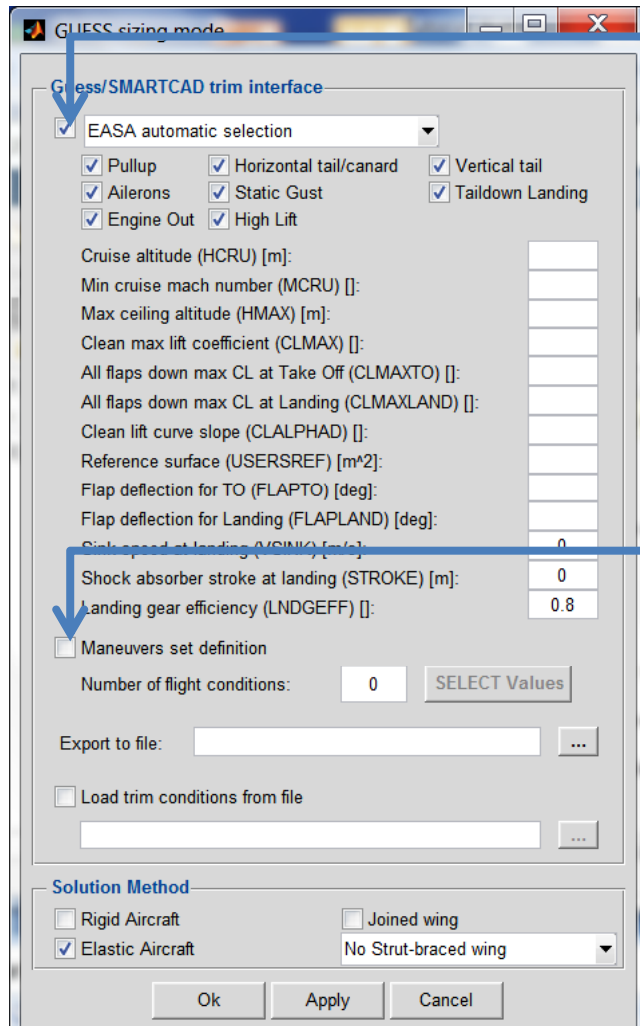
## 2nd STEP: Selecting the sizing mode



Click the *Sizing mode* button to select the sizing loads

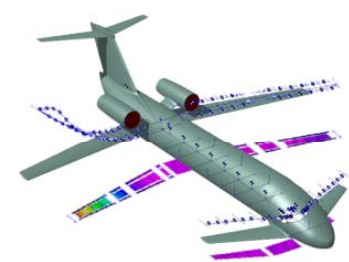


# 2nd STEP: Selecting the sizing mode

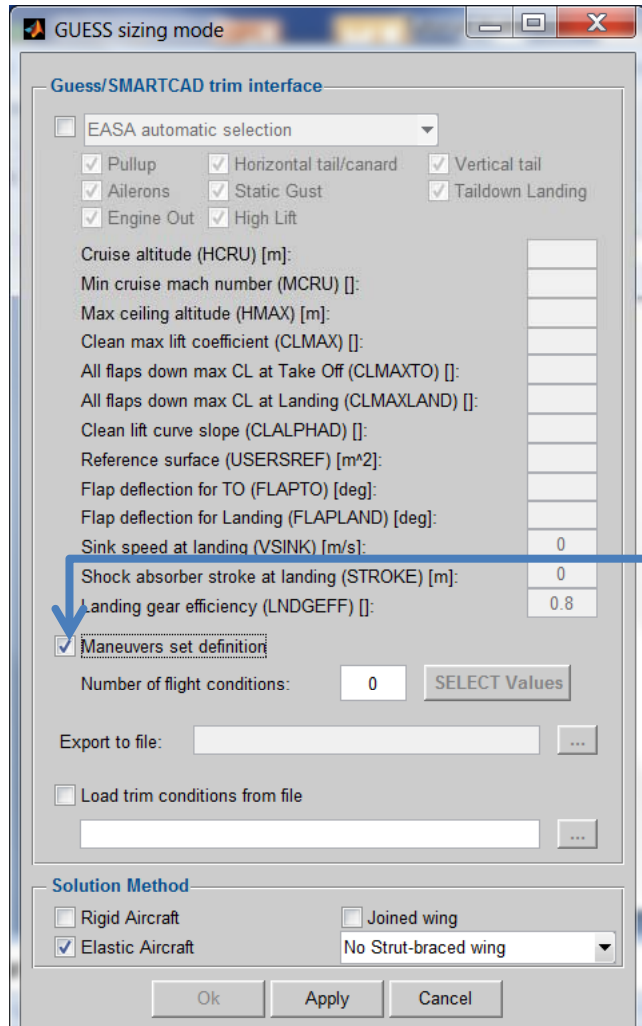


To automatically generate the load conditions on the basis of certification rules

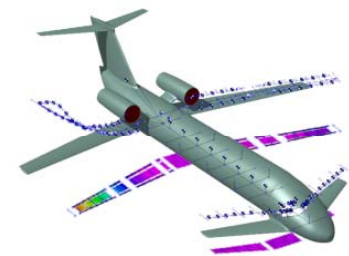
To impose user-defined load conditions. This option is suggested for new examples.



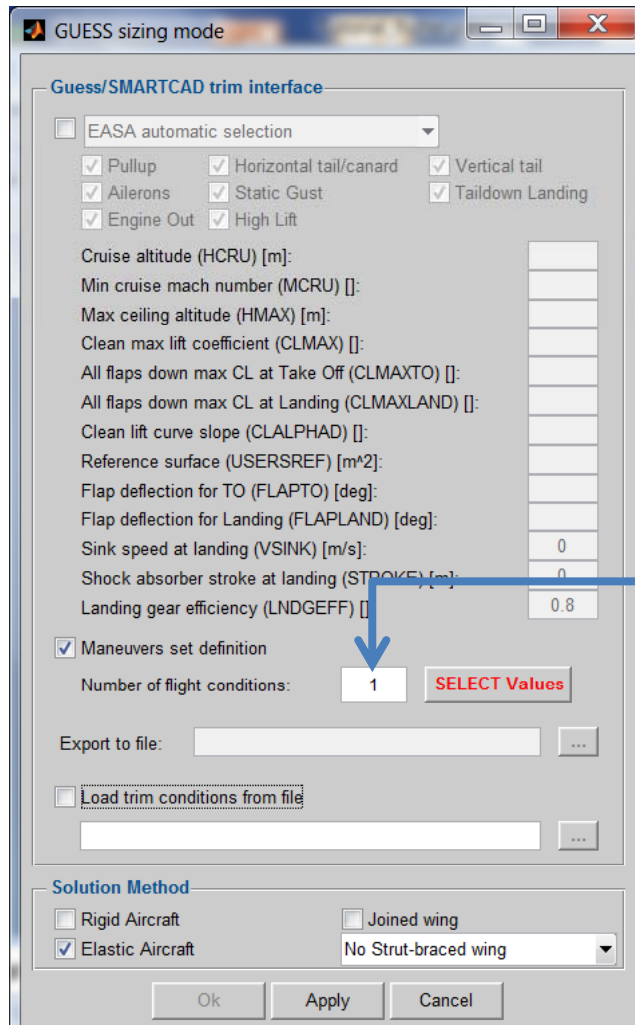
# 2nd STEP: Selecting the sizing mode



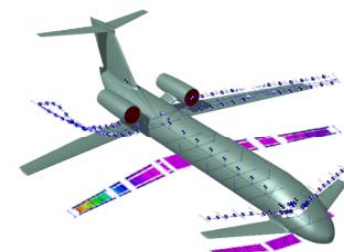
Using a single user defined maneuver is highly recommended the first time you analyze a new aircraft.



## 2nd STEP: Selecting the sizing mode



A single load condition is imposed.  
Click on *SELECT Values ...*



# Selection of the trim maneuvers



Maneuver Definition

1

Mach: 0      Altitude [m]: 0

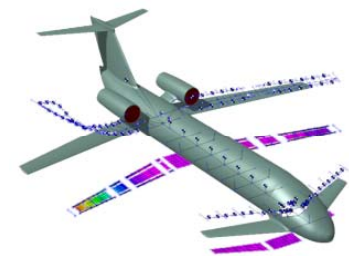
**Symmetric Maneuvers**  
Cruise/Climb (AoA, pitch control surfaces)

**Anti-Symmetric Maneuvers**  
Sideslip levelled flight

**Parameters**

Angle of attack (ANGLEA) [deg]:		Sideslip angle (SIDES) [deg]:	0
Roll rate (ROLL) [1/s]:	0	p rate (URDD4) [1/s^2]:	0
Pitch rate (PITCH) [1/s]:	0	q rate (URDD5) [1/s^2]:	0
Yaw rate (YAW) [1/s]:	0	r rate (URDD6) [1/s^2]:	0
Elevator rotation (elev1r) [deg]:		X acc (URDD1) [m/s^2]:	
Canard rotation (elevC1r) [deg]:		Y acc (URDD2) [m/s^2]:	0
Aileron rotation (aileronr) [deg]:	0	Z acc (URDD3) [m/s^2]:	9.81
Rudder rotation (rudder1) [deg]:	0	Vertical speed (VGUST) [EAS m/s]:	0
1st Flap rotation (flap1r) [deg]:	0	Strut efficiency (LNDGEFF) []:	0
2nd Flap rotation (flap2r) [deg]:	0	Sink speed (VSINK) [m/s]:	0
<input checked="" type="checkbox"/> Symmetric maneuver		Shock absorber stroke (STROKE) [m]:	0
<input type="checkbox"/> User defined maneuver			

Save      Discard



# Selection of the trim maneuvers



Maneuver Definition

1

Mach: 0 Altitude [m]:

**Symmetric Maneuvers**

- Cruise/Climb (AoA, pitch control surfaces)
- Cruise/Climb (AoA, pitch control surfaces)
- Climb fixed AoA (Z acc, pitch control surfaces)
- Vertical gust (AoA, pitch control surfaces)
- Landing (AoA, pitch control surfaces)

**Anti-Symmetric Maneuvers**

- Sideslip levelled flight

Angle of attack (ANGLEA) [deg]:

Roll rate (ROLL) [1/s]: 0

Pitch rate (PITCH) [1/s]: 0

Yaw rate (YAW) [1/s]: 0

Elevator rotation (elev1r) [deg]:

Canard rotation (elevC1r) [deg]:

Aileron rotation (aileronr) [deg]: 0

Rudder rotation (rudder1) [deg]: 0

1st Flap rotation (flap1r) [deg]: 0

2nd Flap rotation (flap2r) [deg]: 0

Sideslip angle (SIDES) [deg]: 0

p rate (URDD4) [1/s^2]: 0

q rate (URDD5) [1/s^2]: 0

r rate (URDD6) [1/s^2]: 0

X acc (URDD1) [m/s^2]:

Y acc (URDD2) [m/s^2]: 0

Z acc (URDD3) [m/s^2]: 9.81

Vertical speed (VGUST) [EAS m/s]: 0

Strut efficiency (LNDGEFF) []: 0

Sink speed (VSINK) [m/s]: 0

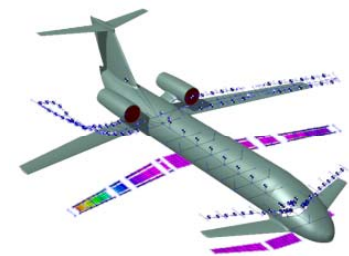
Shock absorber stroke (STROKE) [m]: 0

Symmetric maneuver

User defined maneuver

Save Discard

List of pre-defined symmetric maneuvers



# Selection of the trim maneuvers



List of pre-defined anti symmetric maneuvers

Maneuver Definition

Mach: 0 Altitude [m]: 0

Anti-Symmetric Maneuvers

- Sideslip levelled flight
- Aileron abrupt input (p rate)
- Aileron steady roll response (roll rate)
- Steady roll pullout maneuver (roll rate)
- Snap roll (accs)

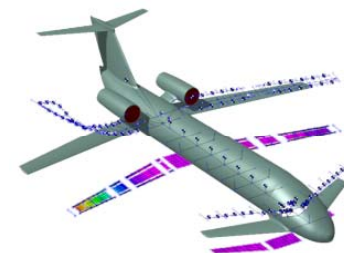
Parameters

Angle of attack (ANGLEA) [deg]:		Sideslip (SIDESLIP) [deg]:	
Roll rate (ROLL) [1/s]:	0	p rate (URDD4) [1/s^2]:	0
Pitch rate (PITCH) [1/s]:	0	q rate (URDD5) [1/s^2]:	0
Yaw rate (YAW) [1/s]:	0	r rate (URDD6) [1/s^2]:	0
Elevator rotation (elev1r) [deg]:		X acc (URDD1) [m/s^2]:	
Canard rotation (elevC1r) [deg]:		Y acc (URDU2) [m/s^2]:	0
Aileron rotation (aileronr) [deg]:	0	Z acc (URDD3) [m/s^2]:	9.81
Rudder rotation (rudder1) [deg]:	0	Vertical speed (VGUST) [EAS m/s]:	0
1st Flap rotation (flap1r) [deg]:	0	Strut efficiency (LNDGEFF) []:	0
2nd Flap rotation (flap2r) [deg]:	0	Sink speed (VSINK) [m/s]:	0

Symmetric maneuver

User defined maneuver

Save Discard





# Definition of a single pull-up maneuver at +2.5 g



Maneuver Definition

1

Mach: 0.5      Altitude [m]: 5000

**Symmetric Maneuvers**

Cruise/Climb (AoA, pitch control surfaces)

**Anti-Symmetric Maneuvers**

Sideslip levelled flight

**Parameters**

Angle of attack (ANGLEA) [deg]:		Sideslip angle (SIDES) [deg]:	
Roll rate (ROLL) [1/s]:	0	p rate (URDD4) [1/s^2]:	0
Pitch rate (PITCH) [1/s]:	0	q rate (URDD5) [1/s^2]:	0
Yaw rate (YAW) [1/s]:	0	r rate (URDD6) [1/s^2]:	0
Elevator rotation (elev1r) [deg]:		X acc (URDD1) [m/s^2]:	
Canard rotation (elevC1r) [deg]:		Y acc (URDD2) [m/s^2]:	
Aileron rotation (aileronr) [deg]:	0	Z acc (URDD3) [m/s^2]:	24.5
Rudder rotation (rudder1) [deg]:	0	Vertical speed (VGUST) [EAS m/s]:	0
1st Flap rotation (flap1r) [deg]:	0	Strut efficiency (LNDGEEFF) []:	0
2nd Flap rotation (flap2r) [deg]:	0	Sink speed (VSINK) [m/s]:	0
		Shock absorber stroke (STROKE) [m]:	0

Symmetric maneuver

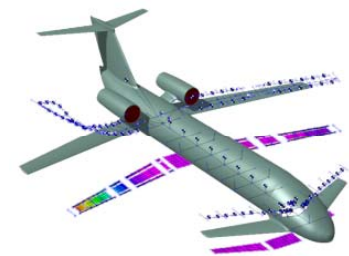
User defined maneuver

Save      Discard

Blank field: trim variable to be defined during the trimming calculation.

Z acceleration, about 2.5g

Save trim data in a file



# Saving the trim conditions



Trim cards

« EXAMPLES ▶ guess ▶ B747-400 ▶ Tutorial

Organizza Nuova cartella

Nome Ultima modifica Tip

Nessun elemento corrisponde ai criteri di ricerca.

Nome file: pullup.inc

Salva come: Trim cards (\*.inc)

Salva Annulla

Maneuvers set definition

Number of flight conditions: 1 **SELECT Values**

Export to file: [ ]

Load trim conditions from file [ ]

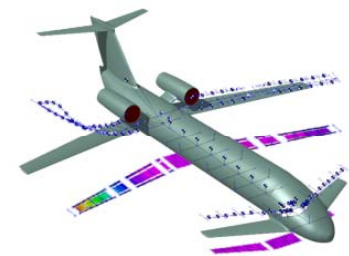
Solution Method

Rigid Aircraft  Joined wing

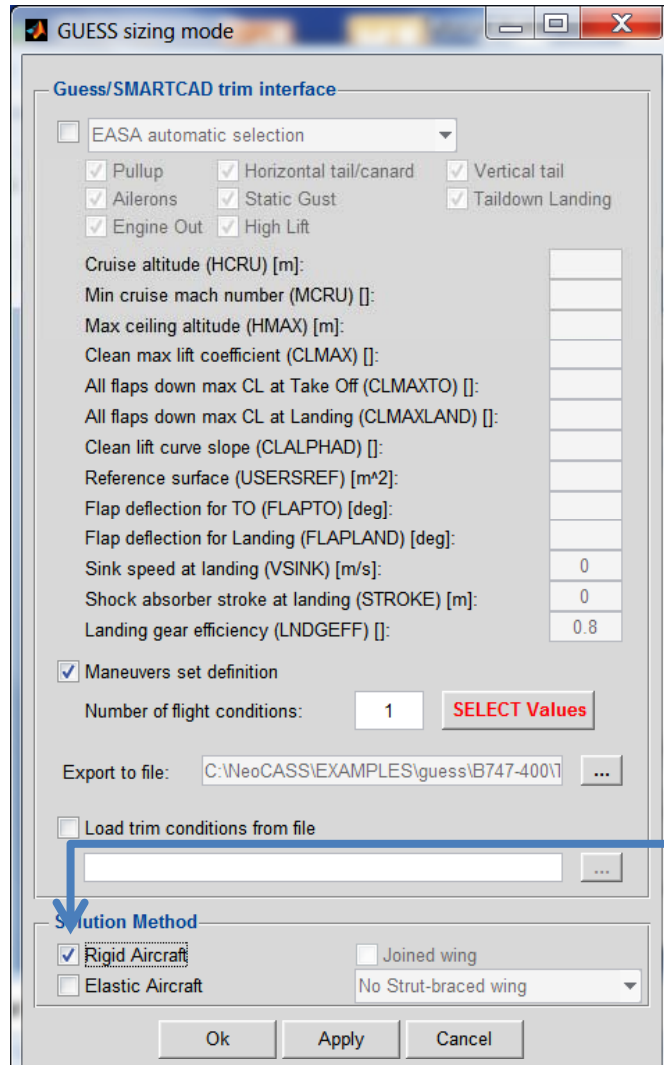
Elastic Aircraft  No Strut-braced wing

Ok Apply Cancel

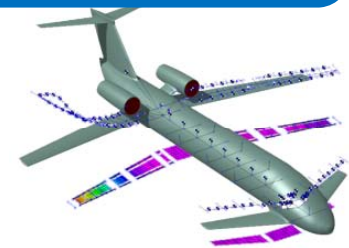
The user provides the file where the trim data are saved.



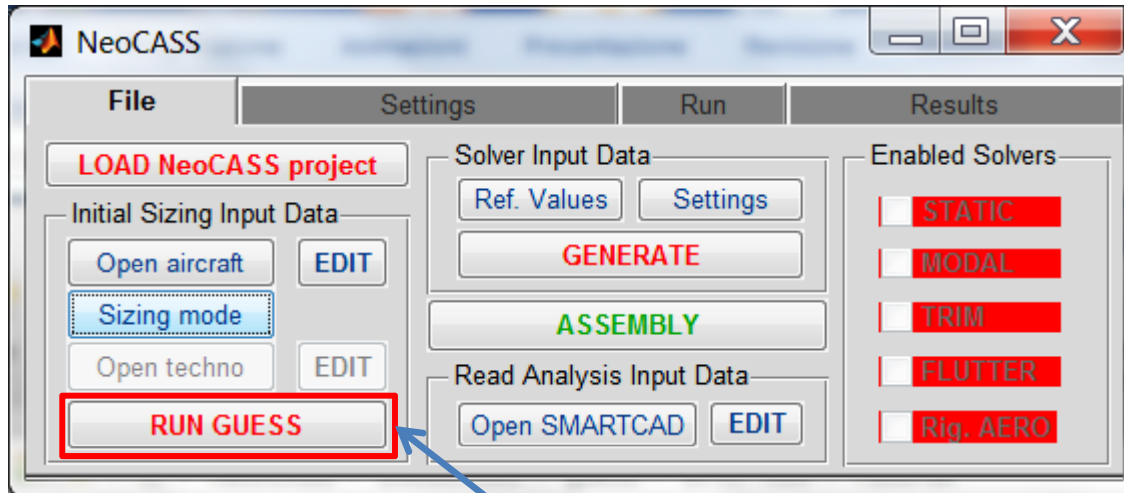
# Selecting the sizing mode



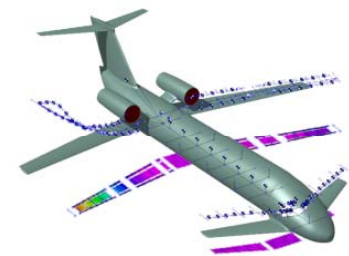
**Two solution modes** are available: force method (*Rigid Aircraft*) and displacement method (*Elastic Aircraft*). The second option is compulsory in case of non-conventional configurations and multiple mass configurations. After this choice, press *OK* button.



# Running GUESS



Press *RUN GUESS* button to run Guess module



# Running GUESS

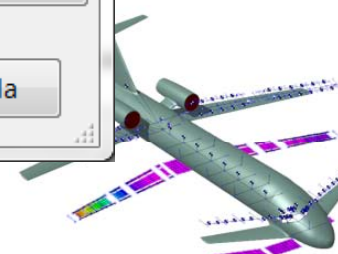


Nome	Ultima modifica	Tipo
pullup.inc	31/05/2016 08:31	File INC

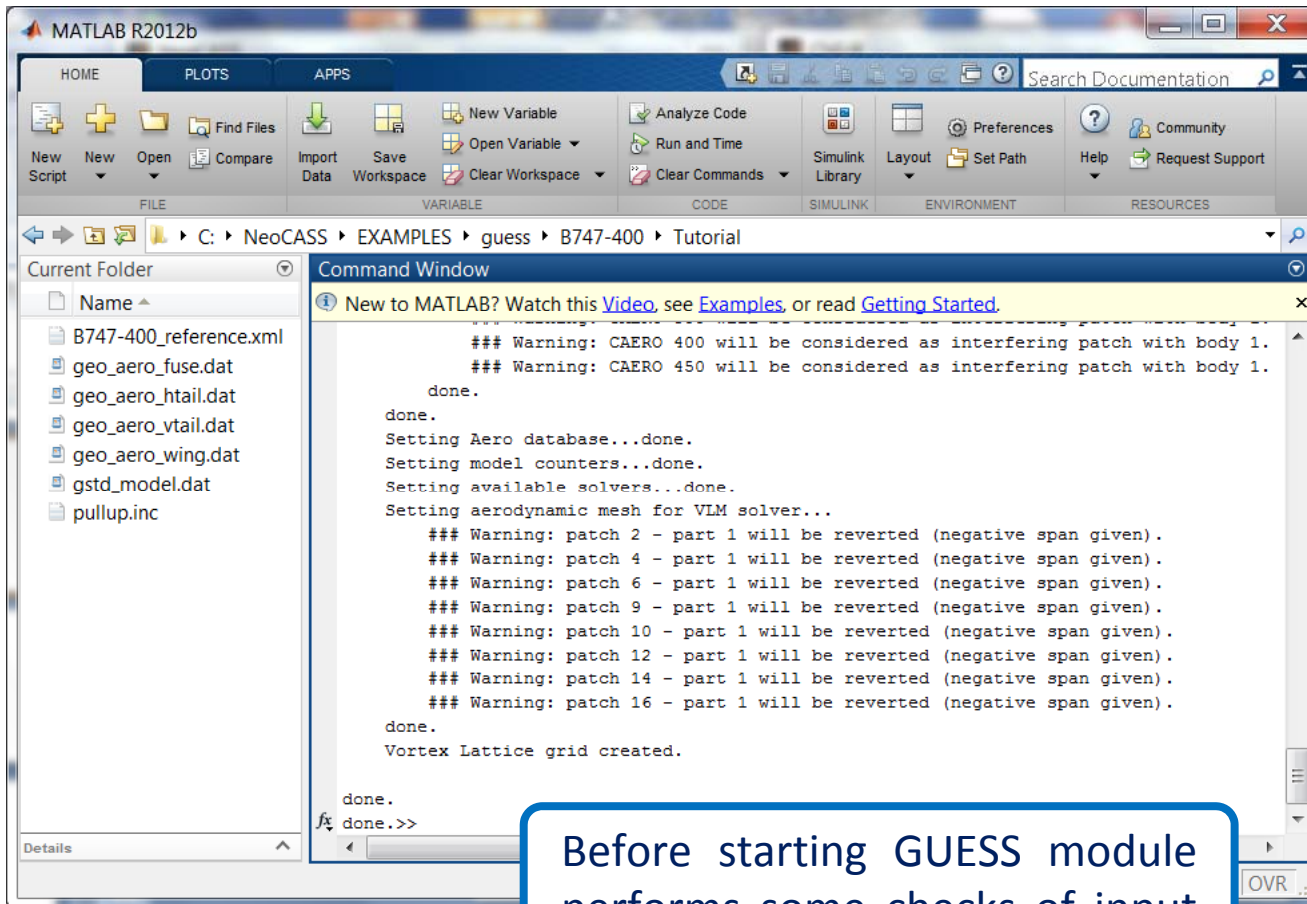
Nome file:

Salva come:

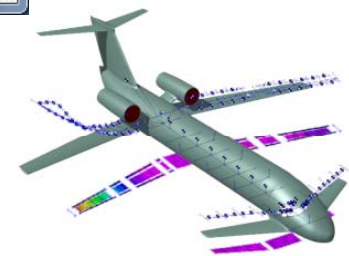
Salva Annulla



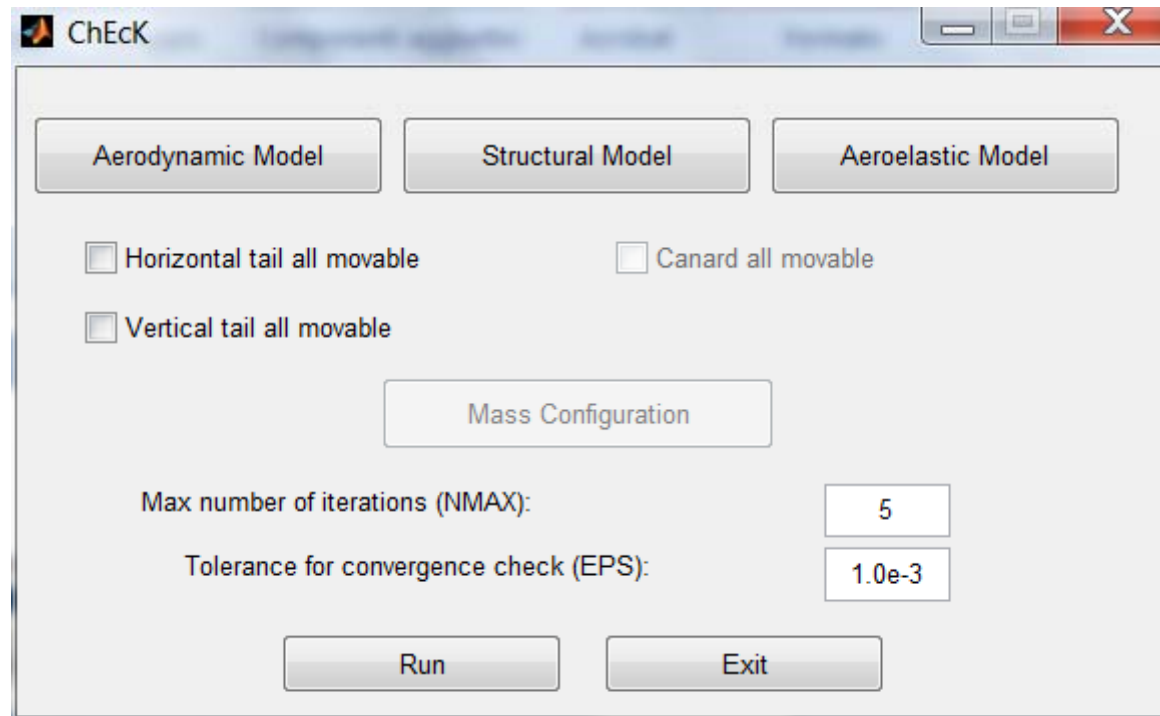
# Running GUESS



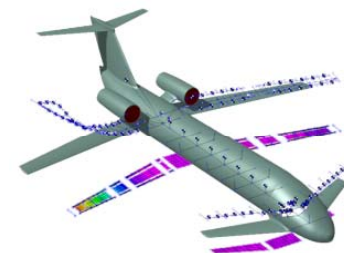
Before starting GUESS module performs some checks of input data consistency



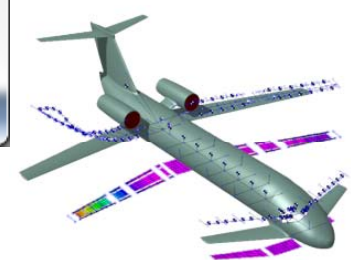
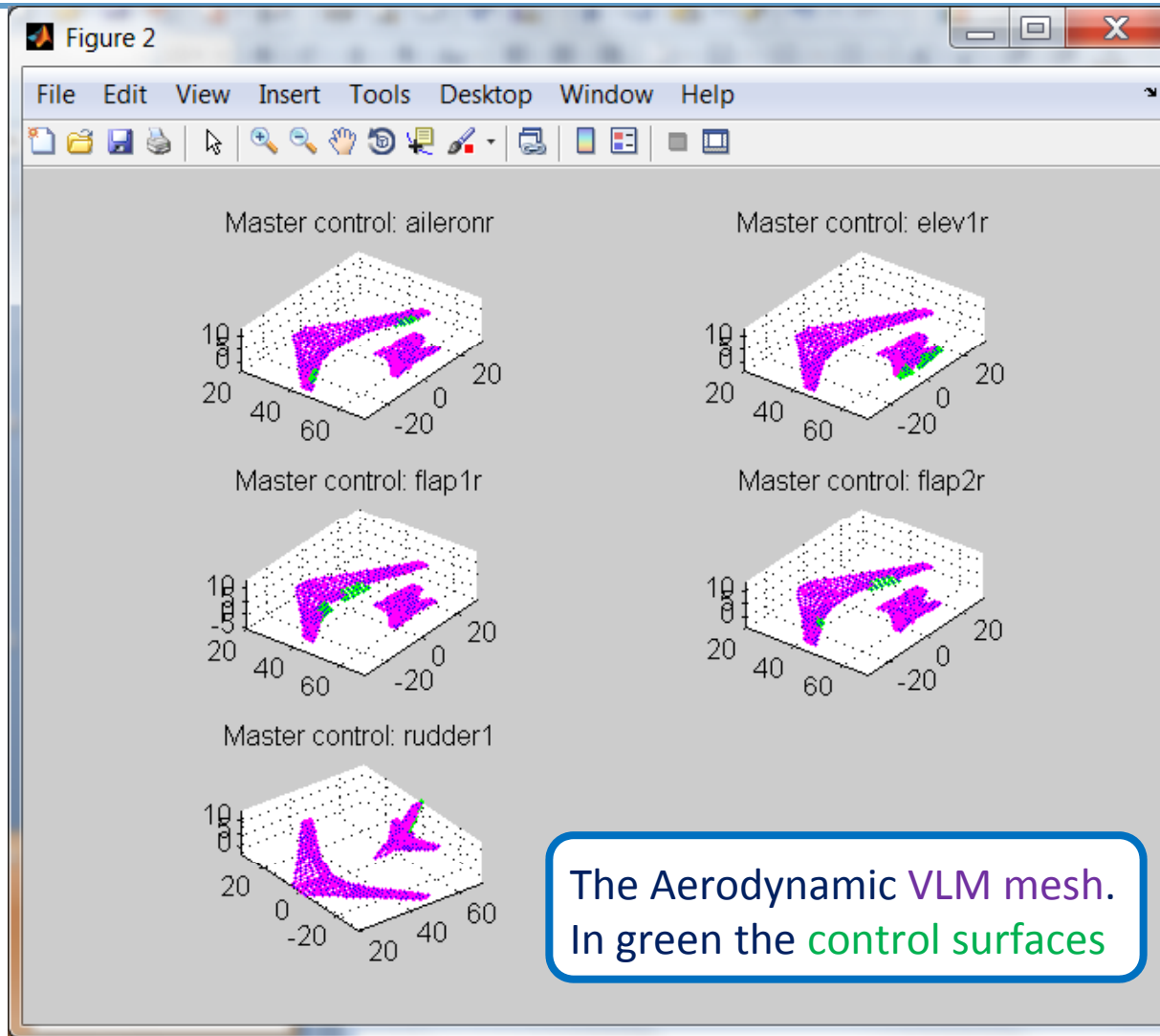
# Running GUESS: the ChEcK window



The **ChEcK** window allows the user to check the structural, aerodynamic and aeroelastic meshes, as well the selection of different mass configurations (Elastic Aircraft only)

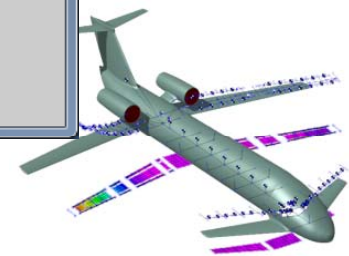
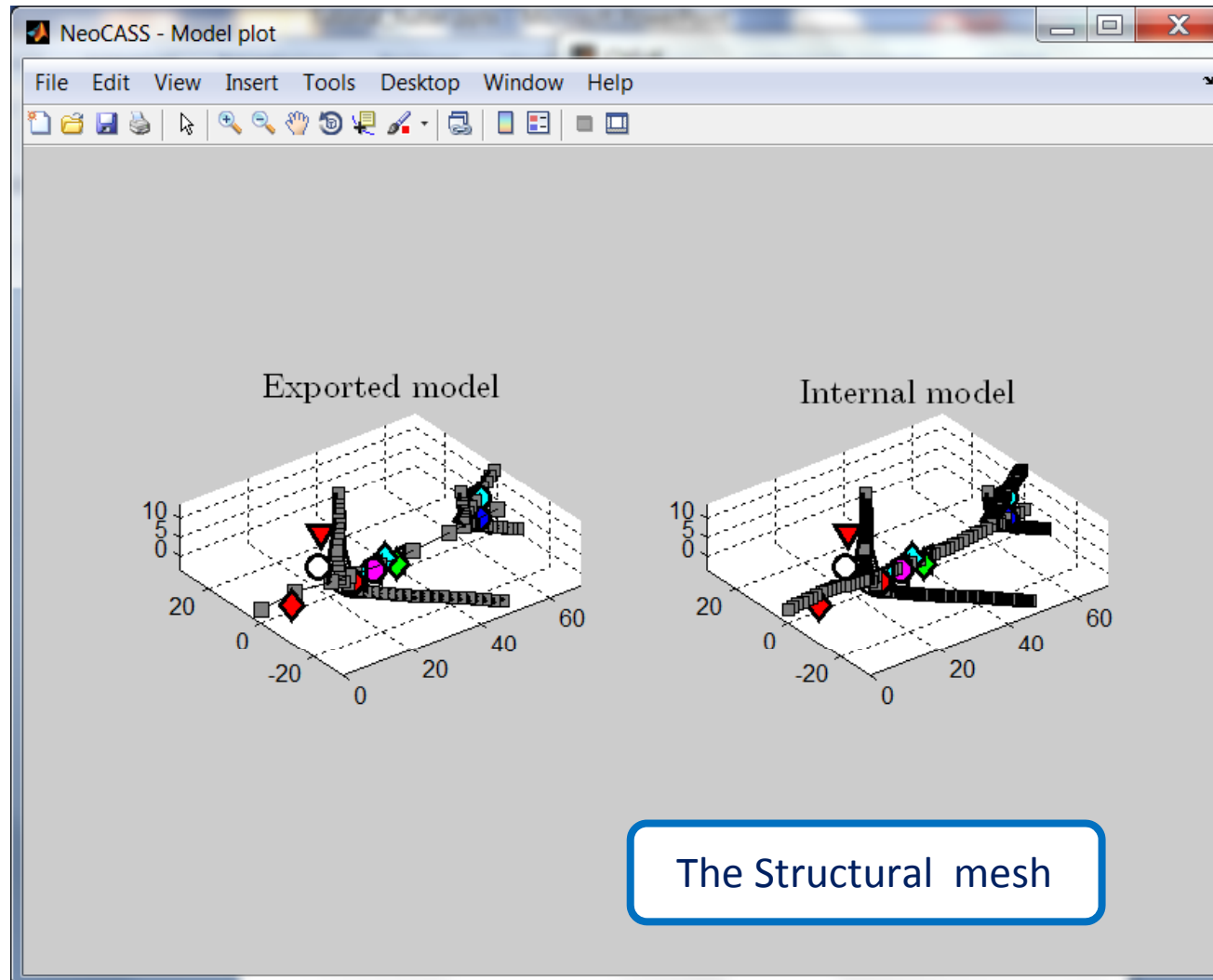


# Running GUESS: the ChEck window

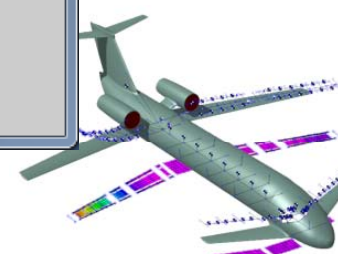
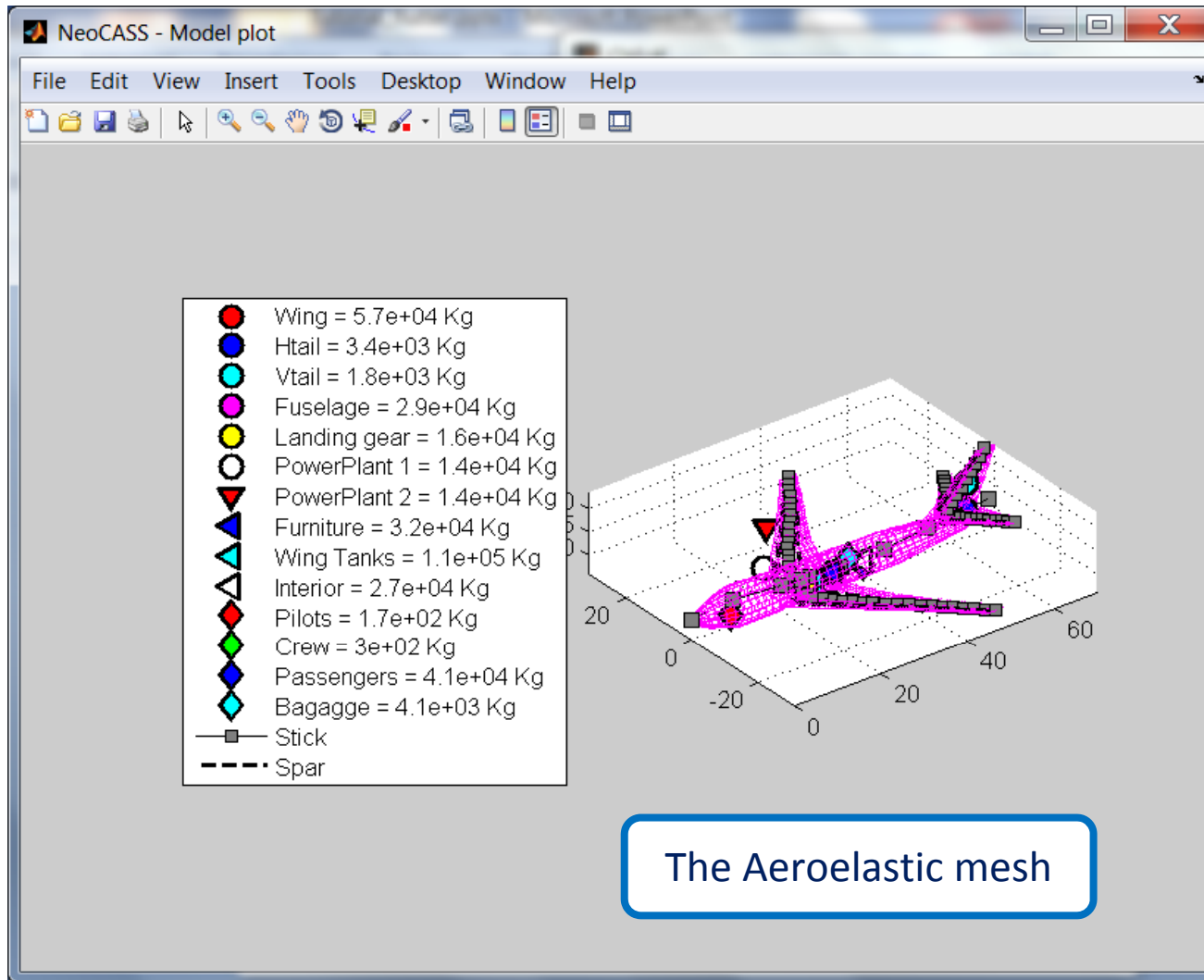




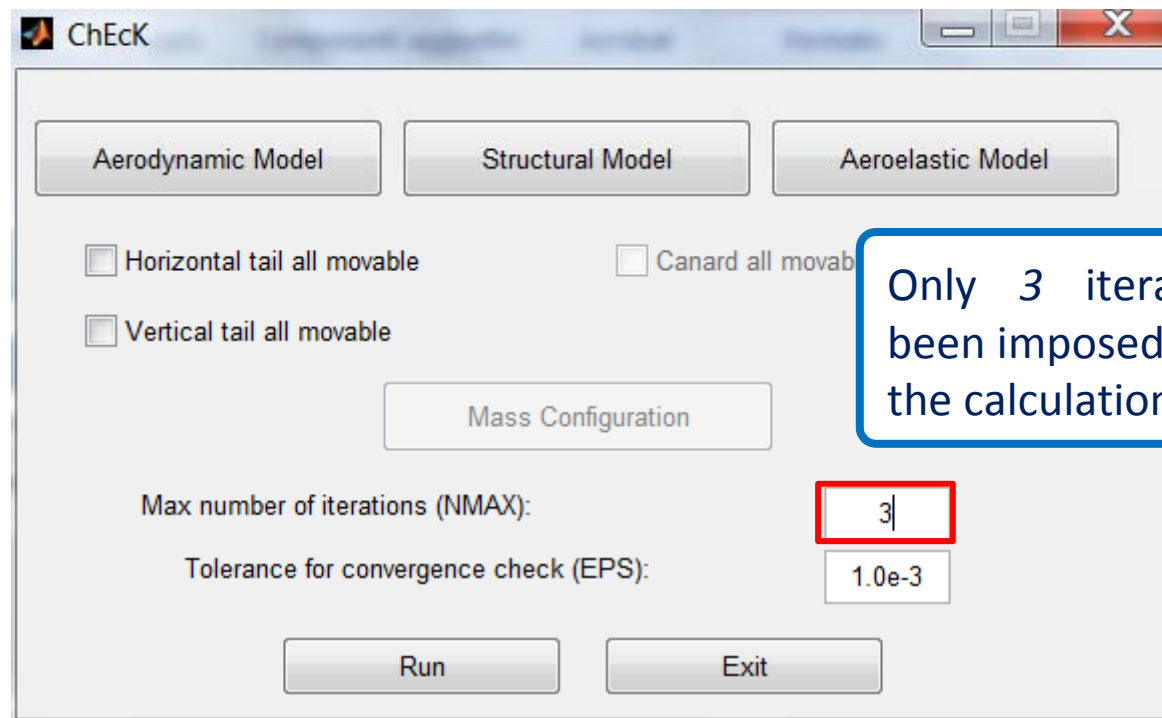
# Running GUESS: the ChEcK window



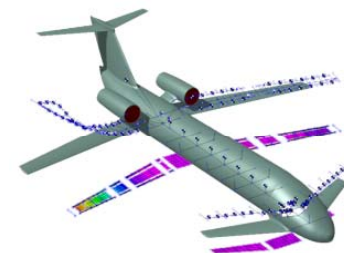
# Running GUESS: the ChEcK window



# Running GUESS: the ChEck window



Only 3 iterations have been imposed to speed up the calculation.



# Running GUESS



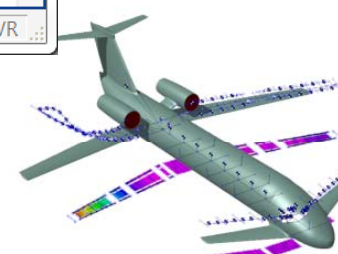
----- Aircraft MAC [m] -----  
Wing mean aerodynamic chord MAC 10.61  
Wing mean aerodynamic chord a

----- Aircraft Balan

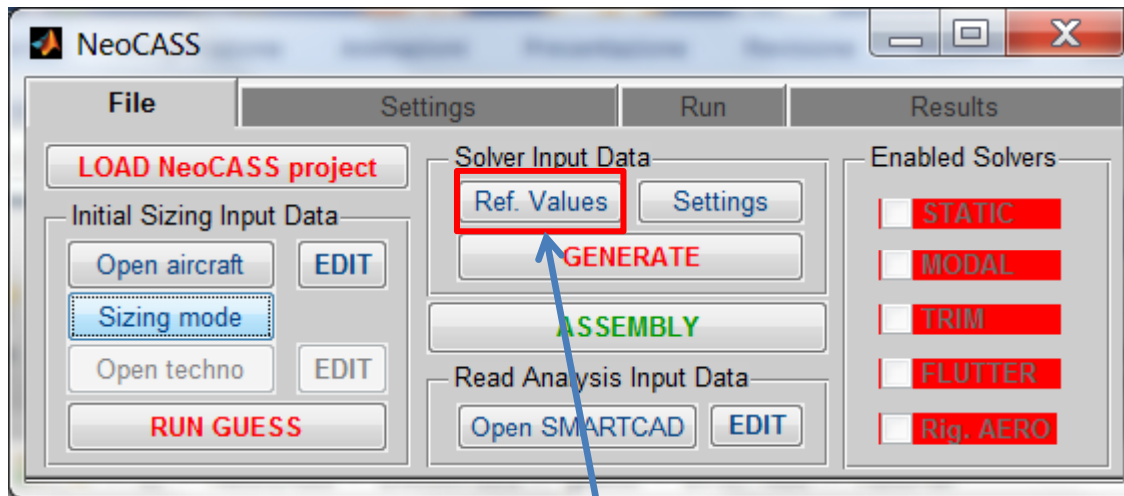
Longitudinal Operative Empty  
Longitudinal Max Zero Fuel W  
Longitudinal Maximum Take Of

-----  
- Refinement loop history:  
Iter 1: Total structural mass: 112041 Kg. Tolerance: 2.960e-02.  
Iter 2: Total structural mass: 111028 Kg. Tolerance: 8.774e-03.

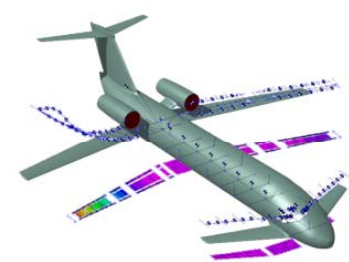
- GUESS model saved in C:\NeoCASS\EXAMPLES\guess\B747-400\Tutorial\geo\_guess.mat file.  
- GUESS summary saved in C:\NeoCASS\EXAMPLES\guess\B747-400\Tutorial\geo\_guess.txt file.  
- SMARTCAD main file with OEW configuration saved in C:\NeoCASS\EXAMPLES\guess\B747-400\Tutorial\geo.inc.  
- SMARTCAD configuration file saved in C:\NeoCASS\EXAMPLES\guess\B747-400\Tutorial\geoCONM\_CONF1.inc file.



# Definition of the REFERENCE quantities



Press the *Ref. Values* button to define the reference quantities used for the calculation of many aeroelastic quantities.



# Definition of the REFERENCE quantities



REFERENCE\_Settings

Reference values

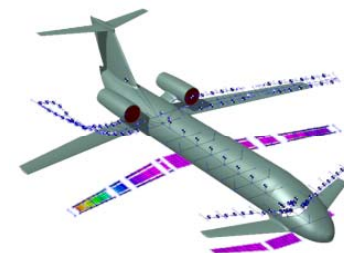
Ref. Chord  Ref. Span  Ref. Surface

Aerodynamic settings

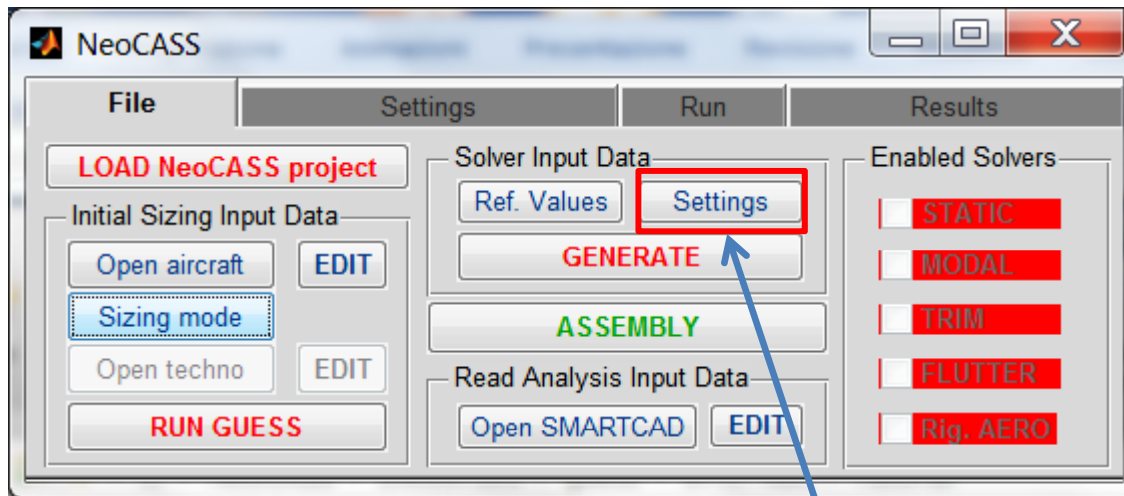
Vertical simmetry  Horizontal simmetry  Height  Kernel order

Ok Apply Cancel

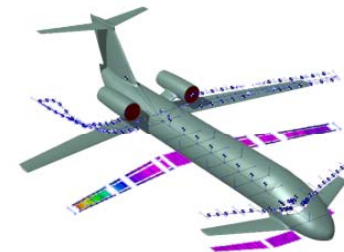
Only *Chord*, *Span* and *Surface* have to be defined. The other quantities assume the default values.



# Definition of the Analysis problem



Press the *Settings* button to start the definition of the analysis problem.



# ANALYSIS Settings definition: MODAL ANALYSIS



ANALYSIS\_Settings

Trim conditions

Static Aeroelastic Analysis

Number of flight conditions:

Modal Analysis

Normalization  ID  DOF

Number of Mode Shapes  From  To

Flutter Analysis

Number of reduced frequencies (max 12)

Modal Base [Qhh]

Mode Tracking

V-g plot

Max speed V-g

Max V step

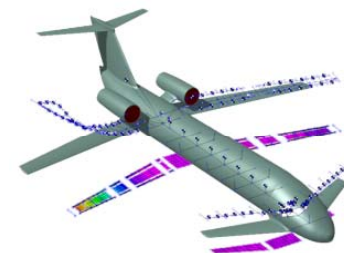
Density

Mach number

Flutter Envelope

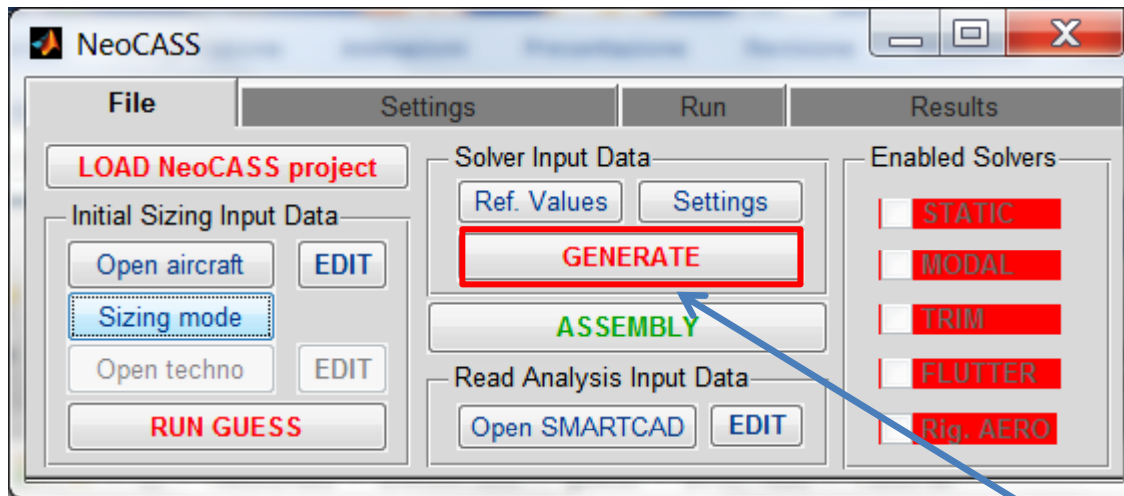
N.Mach numbers

This panel allows the user to define the analysis problem to be solved.  
To run the Flutter analysis at first a MODAL analysis has to be performed.





# Definition of the MODAL analysis problem



Press the *GENERATE* button to save the input data for modal analysis.



# ANALYSIS Settings definition: MODAL ANALYSIS



Generate Solver input data file

« EXAMPLES ▶ guess ▶ B747-400 ▶ Tutorial

Cerca Tutorial

Organizza Nuova cartella

Nome	Ultima modifica	Tipo
geo.inc	31/05/2016 10:44	File INC
geoCONM_CONF1.inc	31/05/2016 10:44	File INC
pullup.inc	31/05/2016 08:31	File INC

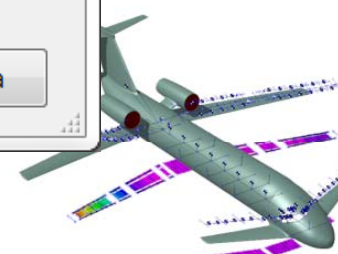
As usual, the user must provide the name of the file where the cards for modal analysis will be saved:

***modal.inc***

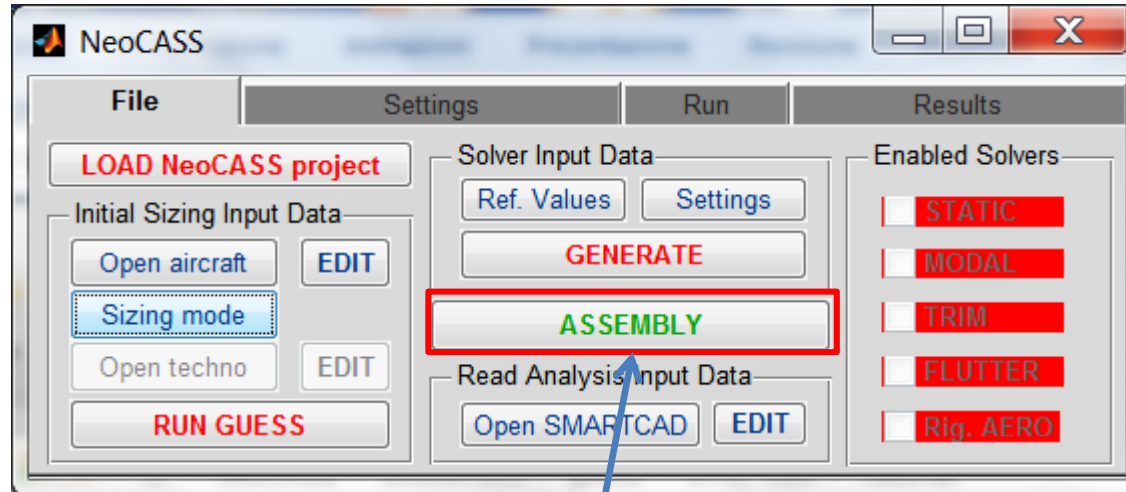
Nome file: modal.inc

Salva come: Solver input data file (\*.inc)

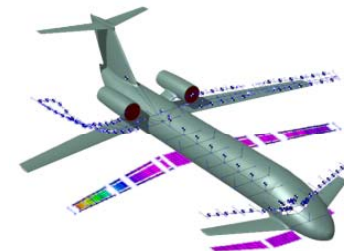
Salva Annulla



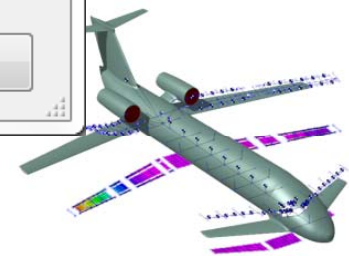
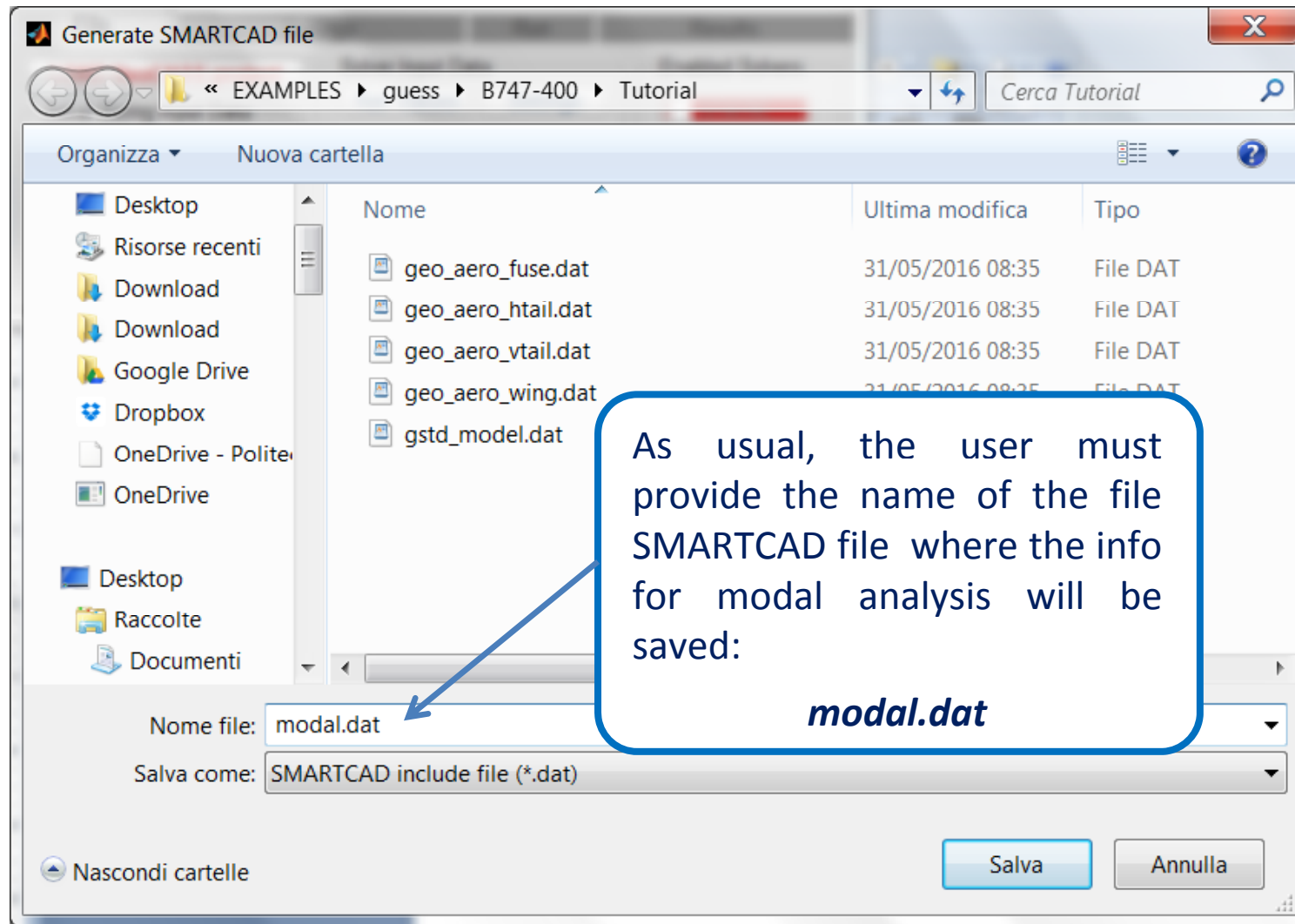
# Generation of SMARTCAD input file for MODAL analysis



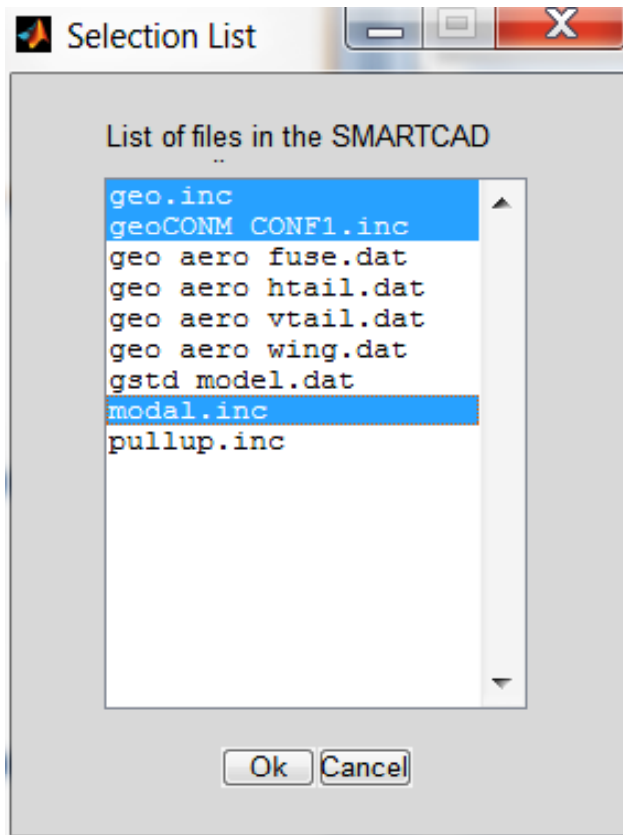
By pressing the *ASSEMBLY* button it is possible to **merge** the different files (.inc) already prepared **into an unique SMARTCAD analysis file** (.dat)



# Generation of SMARTCAD input file for MODAL analysis



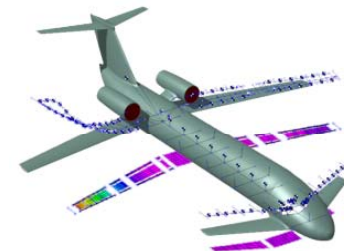
# Generation of SMARTCAD input file for MODAL analysis



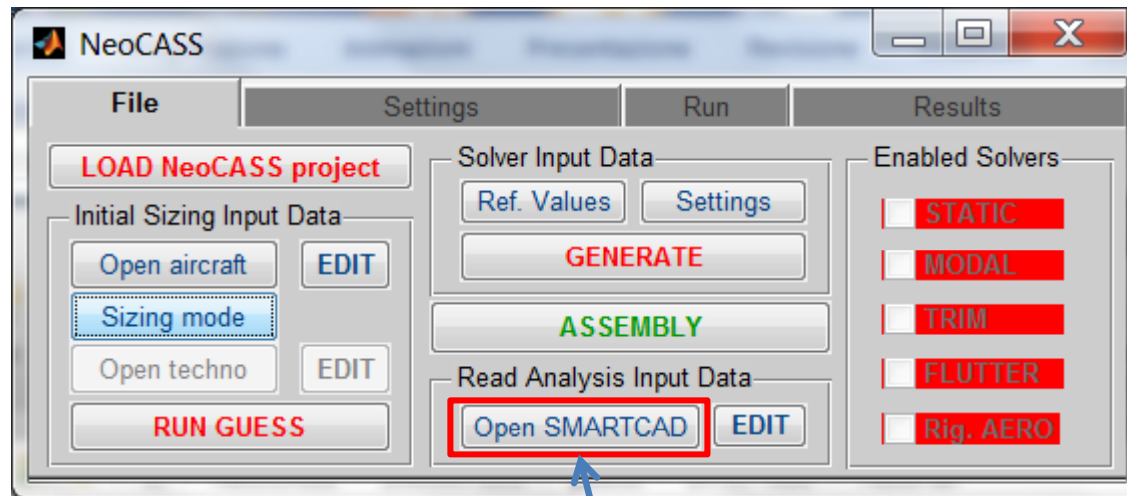
To define a SMARTCAD file usually it is necessary to include:

- The **mesh** model created by GUESS
- The **MASS** file including the non structural masses
- The **analysis file** including the cards requested for a specific analysis

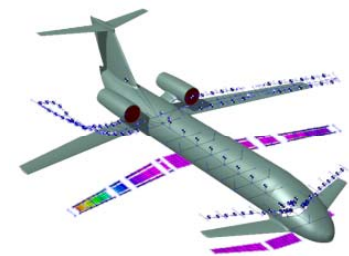
The Popup window shows all the files available in the current folder and the selection can be done in an usual Windows style using the left mouse button + SHIFT or CTRL button.



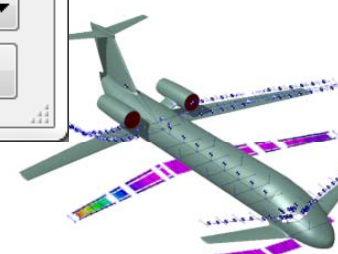
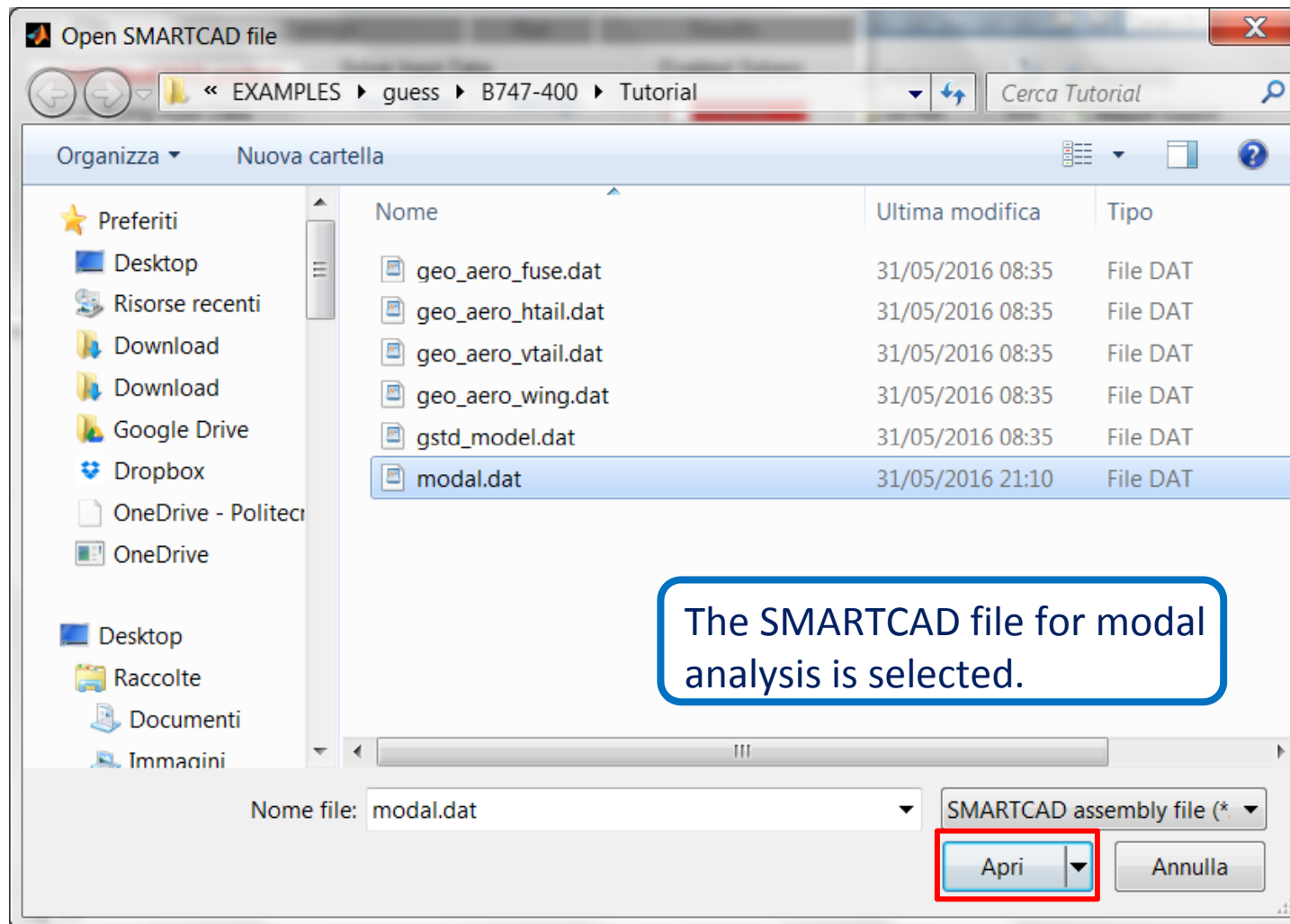
# Running SMARTCAD



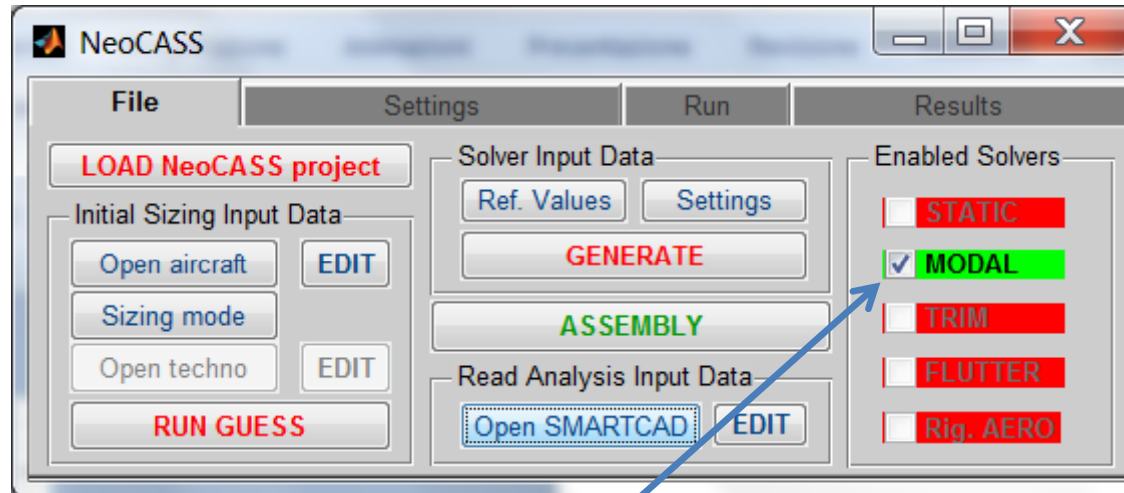
To run a SMARTCAD analysis it is necessary to open the corresponding analysis file (*modal.dat*)



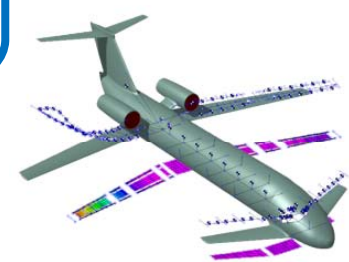
# Running SMARTCAD



# Running SMARTCAD

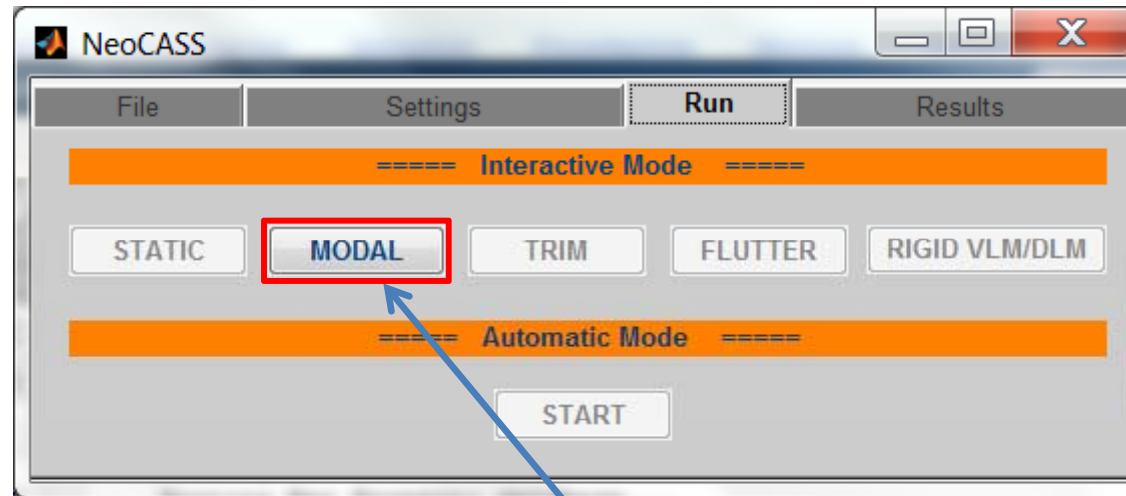


NeoCASS processes the provided SMARTCAD file and on the basis of the included cards shows which kind of analysis can be carried out (green message).  
In the case of modal file, only modal analysis can be performed.

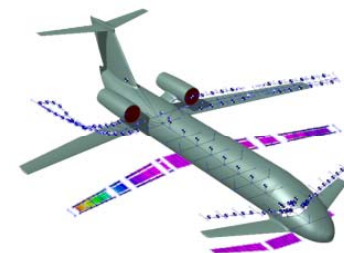




# Running SMARTCAD



Pressing the RUN Tab, it is possible to see that only the MODAL analysis button is now active. Press the button to run the analysis



# Running SMARTCAD



Command Window

```
New to MATLAB? Watch this Video, see Examples, or read Getting Started.
```

7	1.721617
8	1.58962
9	2.31216
10	2.84613
11	3.20901
12	3.54786
13	4.02107
14	4.50505
15	4.78526
16	5.31704
17	6.39707
18	6.47784

Normalization: unity generalized mass.

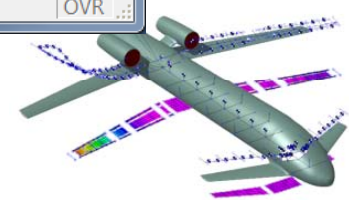
completed.

- Storing analysis results..done.
- SUPPORT required: 6 rigid body modes overwritten.done.
- Updating modal shapes for slave nodes...done.

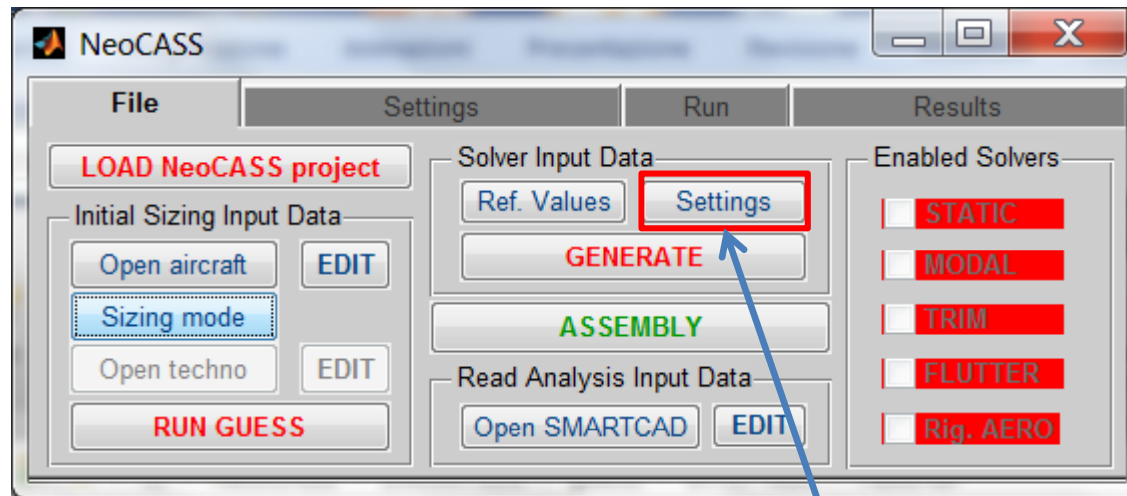
done.

fx >>

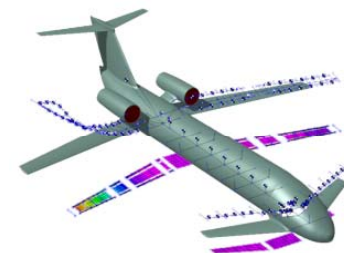
The *eigenfrequencies* are printed out in the *Command Window* and saved into the matlab database.



# Definition of the FLUTTER problem



Press the *Settings* button to start the definition of the flutter problem.



# Definition of the flutter problem



ANALYSIS\_Settings

Trim conditions

Static Aeroelastic Analysis

Set Control Surfaces

Number of flight conditions: 0

SELECT Values

Modal Analysis

Normalization: 1 MASS

ID: ID

DOF: 1

Number of Mode Shapes: 18

From: 0

To: 60

Flutter Analysis

Number of reduced frequencies (max 12): N.Freq

INSERT Values

Modal Base [Qhh]: MSELECT

Mode Tracking: FMODES

V-g plot

Max speed V-g: 340.3

Max V step: 50

Density: 1.225

Mach number: 0.5

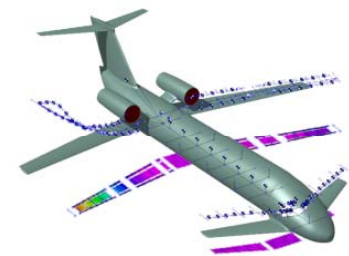
Flutter Envelope

N.Mach numbers: N.Mach

INSERT Values

Ok Apply Cancel

The standard *V-g plot* option is selected. The analysis parameters are usually correct for any kind of test case, otherwise have to be updated



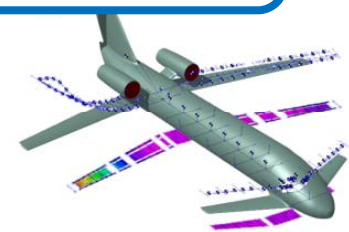
# Definition of the flutter problem



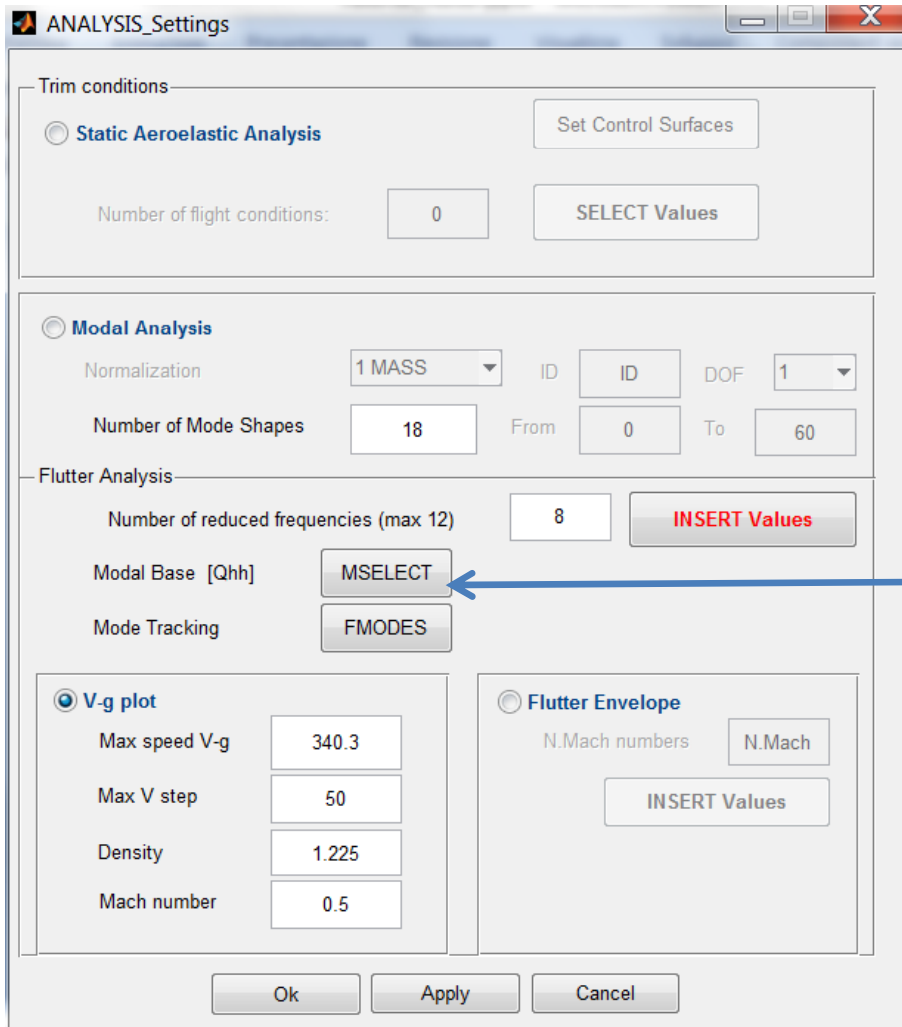
The screenshot shows the ANALYSIS\_Settings dialog box with the Modal Analysis section selected. The 'Number of reduced frequencies (max 12)' is set to 8. A pop-up menu titled 'Input Reduced Frequencies' is open, showing a table of values for k1 through k8. A blue arrow points from the text box to the '8' in the 'Number of reduced frequencies' field.

k1	k2	k3	k4	k5	k6	k7	k8
0.001	0.005	0.01	0.05	0.1	0.25	0.5	1

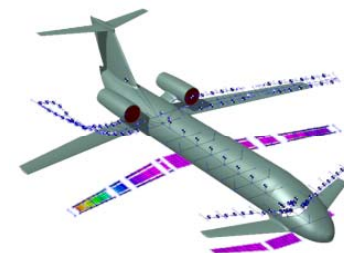
First of all, the number of reduced frequencies have to be imposed. A pop up menu allows the user to input the right values



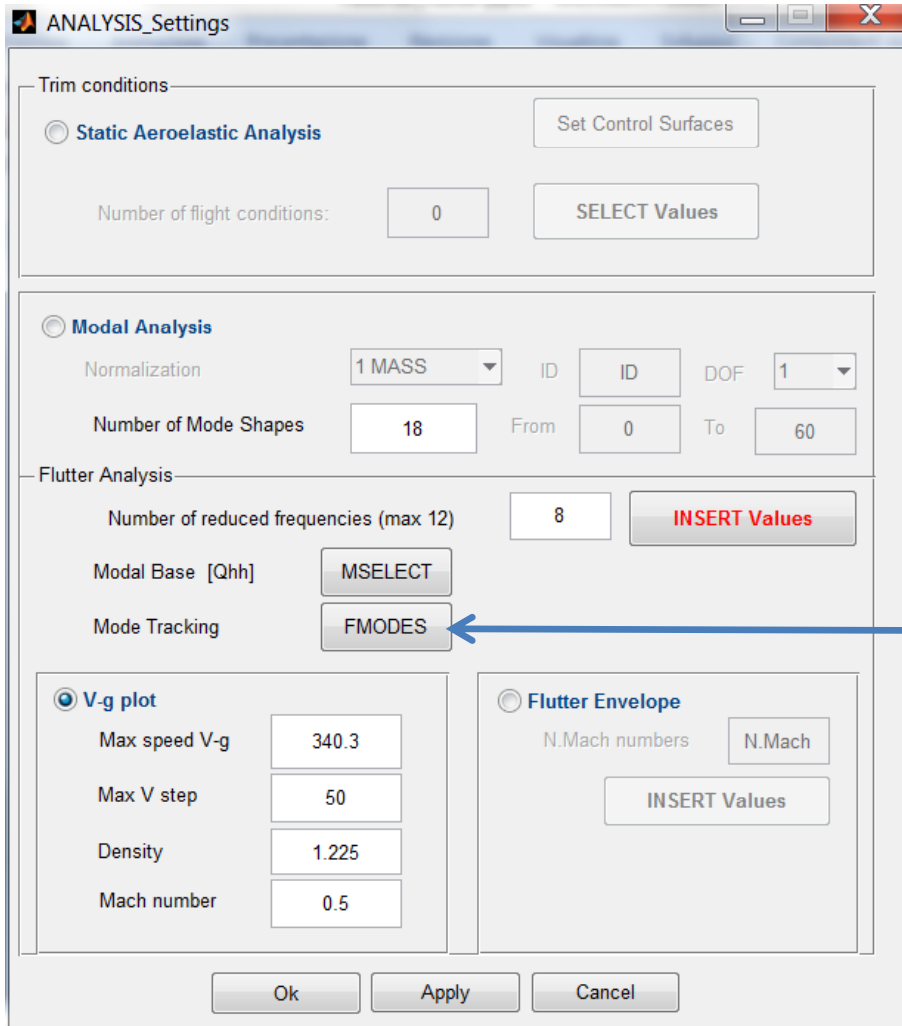
# Definition of the flutter problem



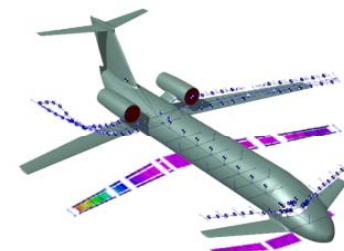
*MSELECT* Button is used to select the the modes that have to be included into the aeroelastic system.



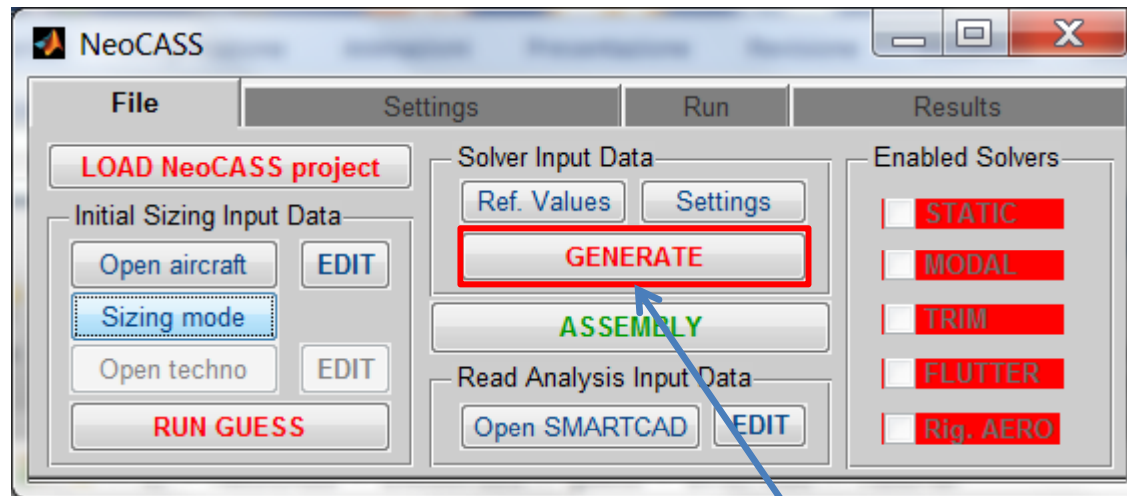
# Definition of the flutter problem



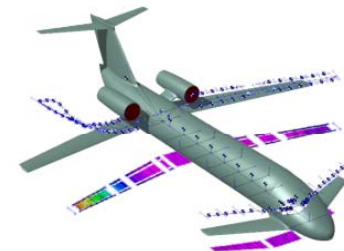
*FMODES* Button is used to select the modes that must be tracked in the V-g plot.  
**IMPORTANT:** the rigid modes cannot be included!



# Generation of the input file for flutter problem

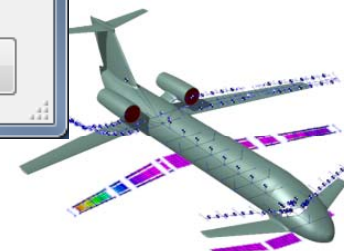
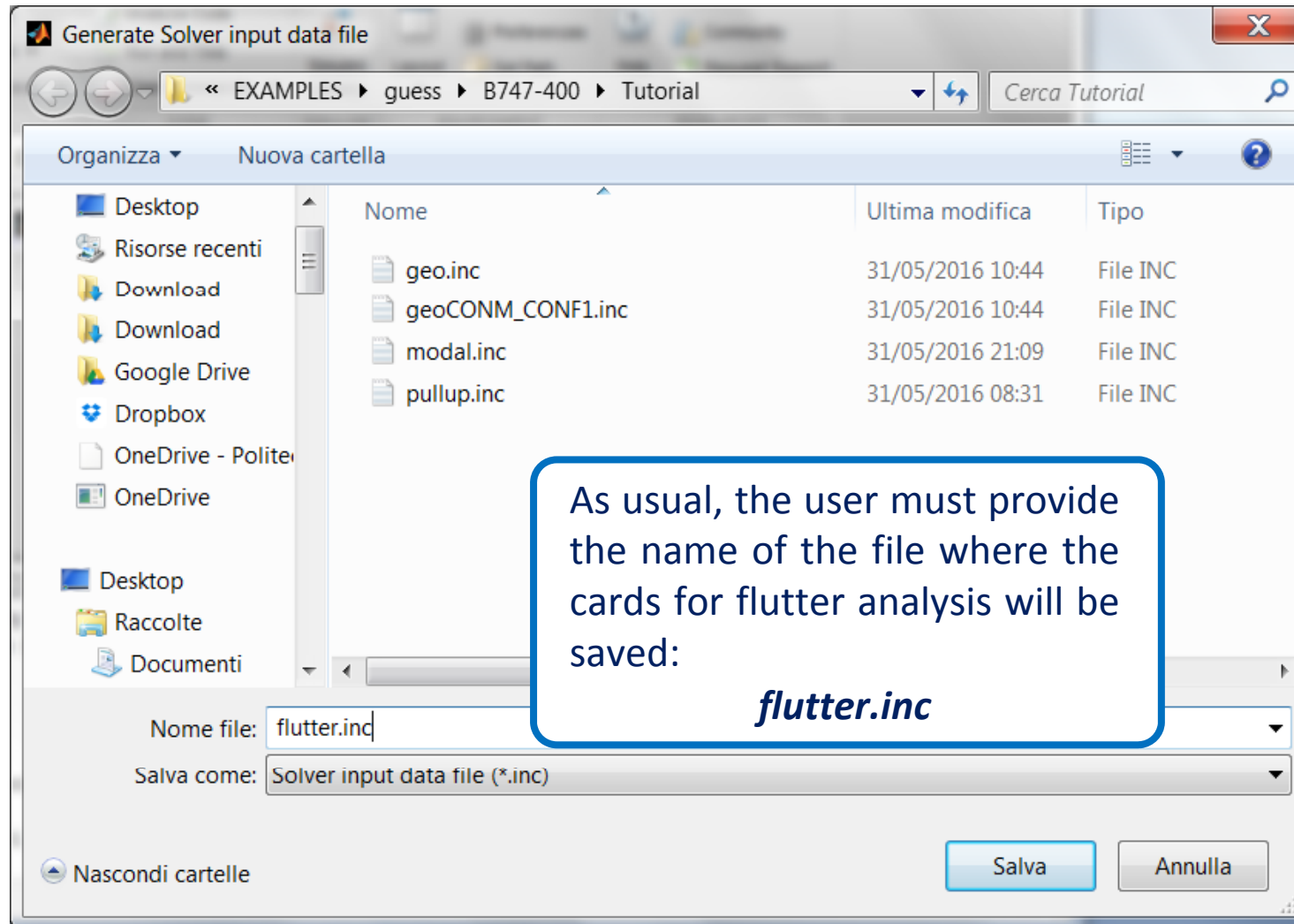


Press the GENERATE button to save the input data for flutter analysis.

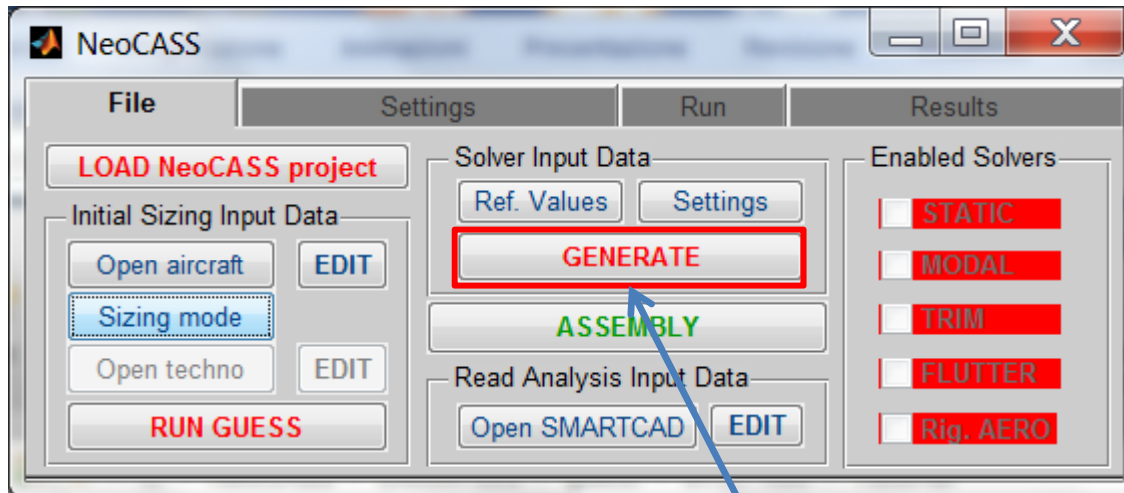




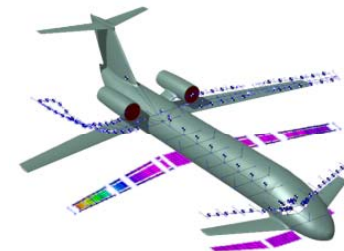
# Generation of the input file for flutter problem



# Generation of FLUTTER analysis SMARTCAD file



By pressing the *ASSEMBLY* button it is possible to merge the different files (.inc) already prepared into an unique SMARTCAD analysis file (.dat)



# Generation of FLUTTER analysis SMARTCAD file



Generate SMARTCAD file

« EXAMPLES ▶ guess ▶ B747-400 ▶ Tutorial

Cerca Tutorial

Organizza Nuova cartella

Nome	Ultima modifica	Tipo
geo_aero_fuse.dat	31/05/2016 08:35	File DAT
geo_aero_htail.dat	31/05/2016 08:35	File DAT
geo_aero_vtail.dat	31/05/2016 08:35	File DAT
geo_aero_wing.dat	31/05/2016 08:35	File DAT
gstd_model.dat	31/05/2016 08:35	File DAT
modal.dat		

Nome file: flutter.dat

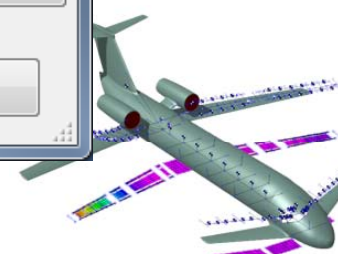
Salva come: SMARTCAD include file (\*.dat)

Salva Annulla

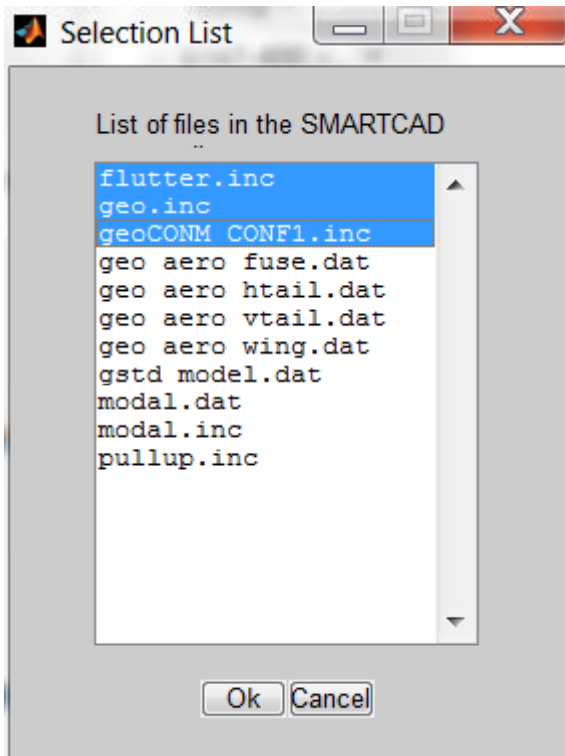
Nascondi cartelle

As usual, the user must provide the name of the SMARTCAD file where the info for flutter analysis will be saved:

***flutter.dat***



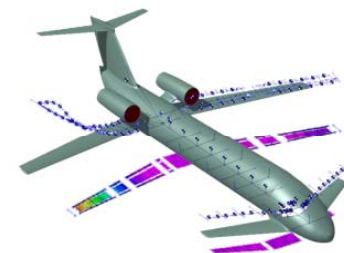
# Generation of FLUTTER analysis SMARTCAD file



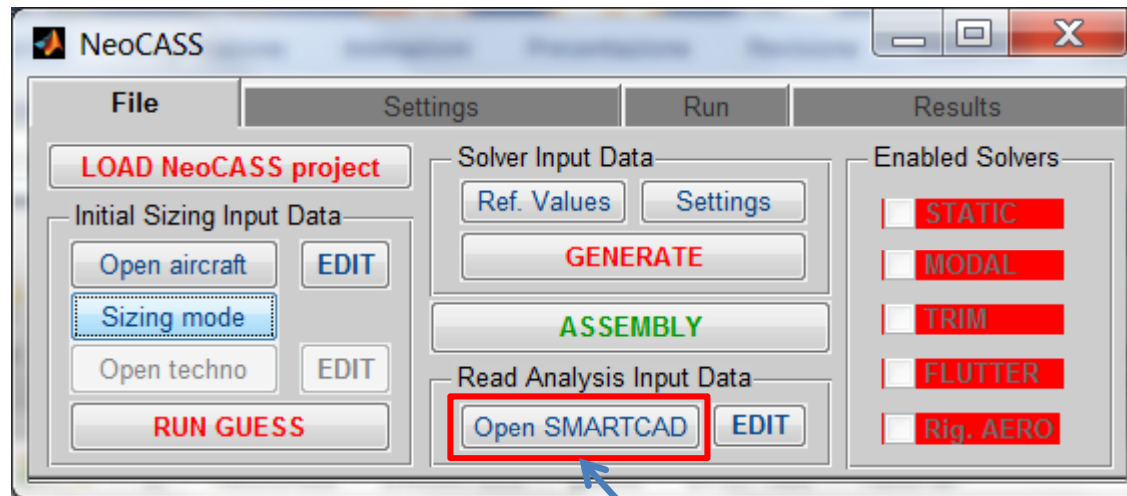
To define a SMARTCAD file usually it is necessary to include:

- The **mesh** model created by GUESS
- The **MASS** file including the non structural masses
- The **analysis file** including the cards requested for a specific analysis

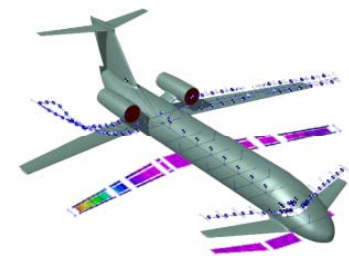
The Popup window shows all the files available in the current folder and the selection can be done in an usual Windows style using the left mouse button + SHIFT or CTRL button.



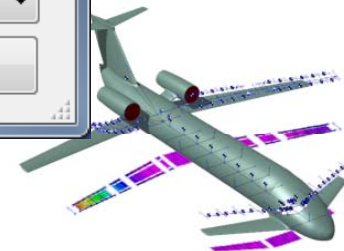
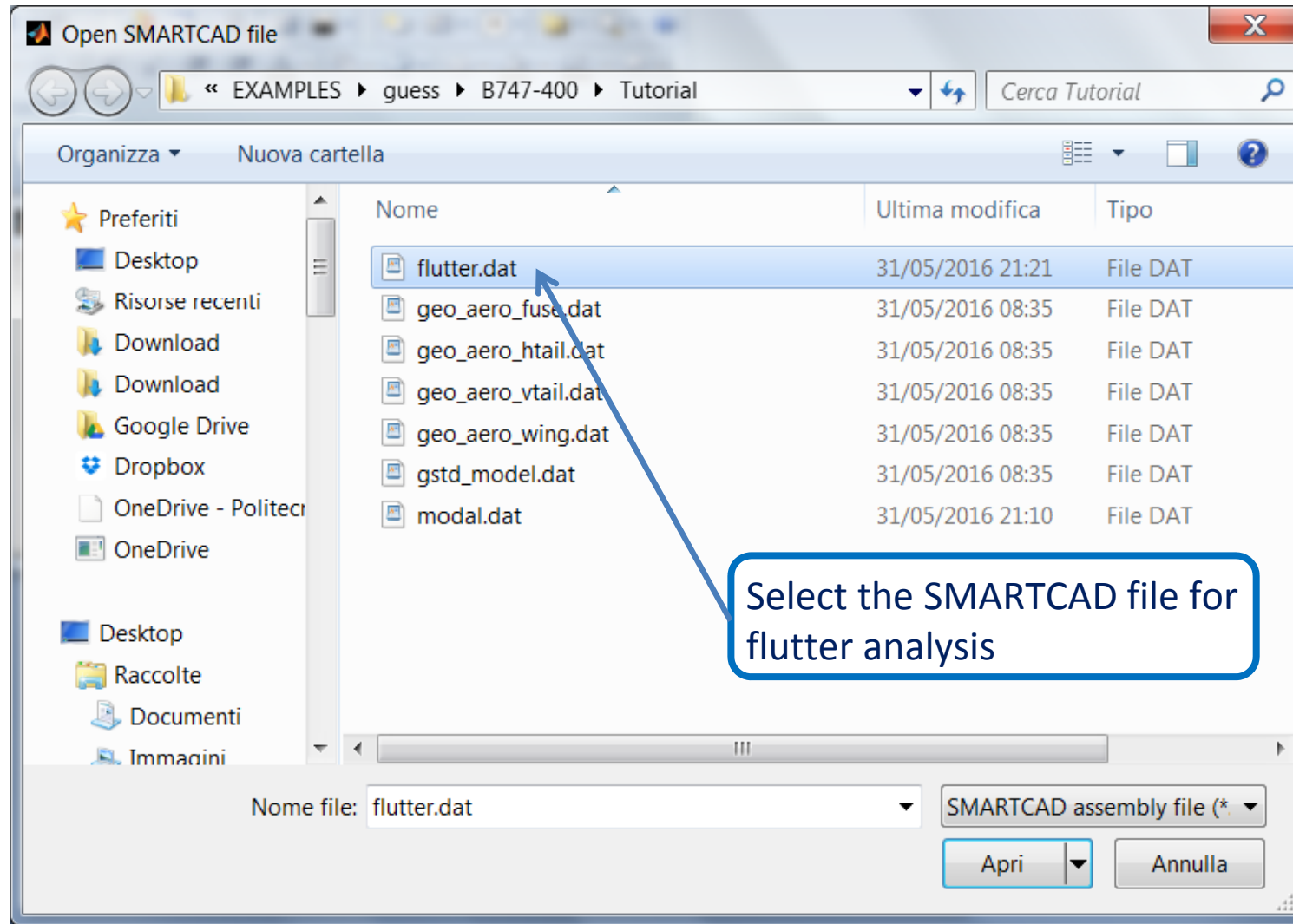
# Running flutter in SMARTCAD



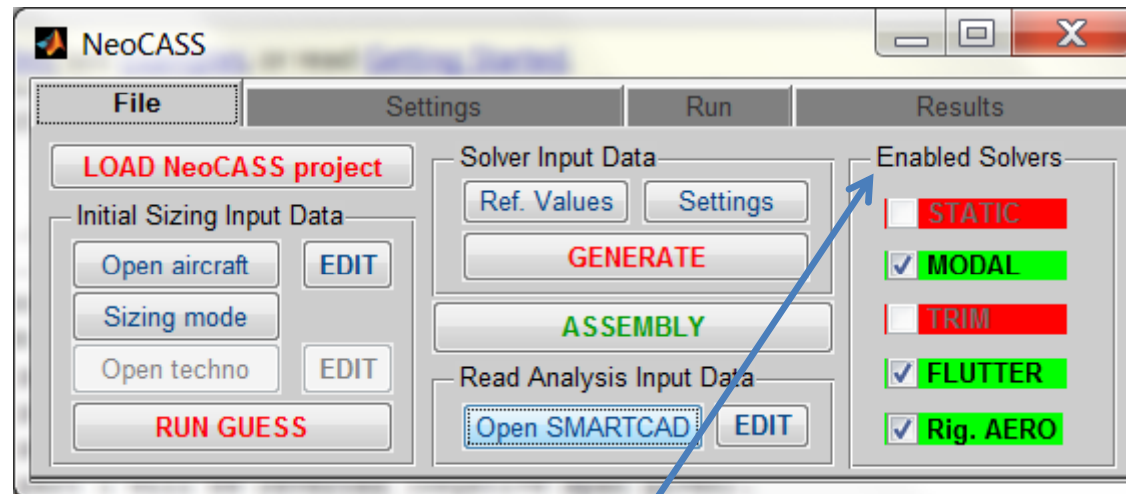
To run a SMARTCAD analysis it is necessary to open the corresponding analysis file (.dat)



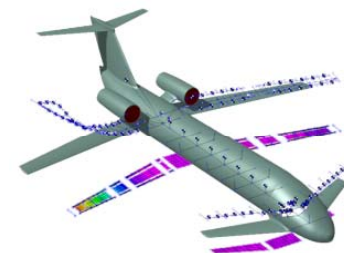
# Running flutter in SMARTCAD



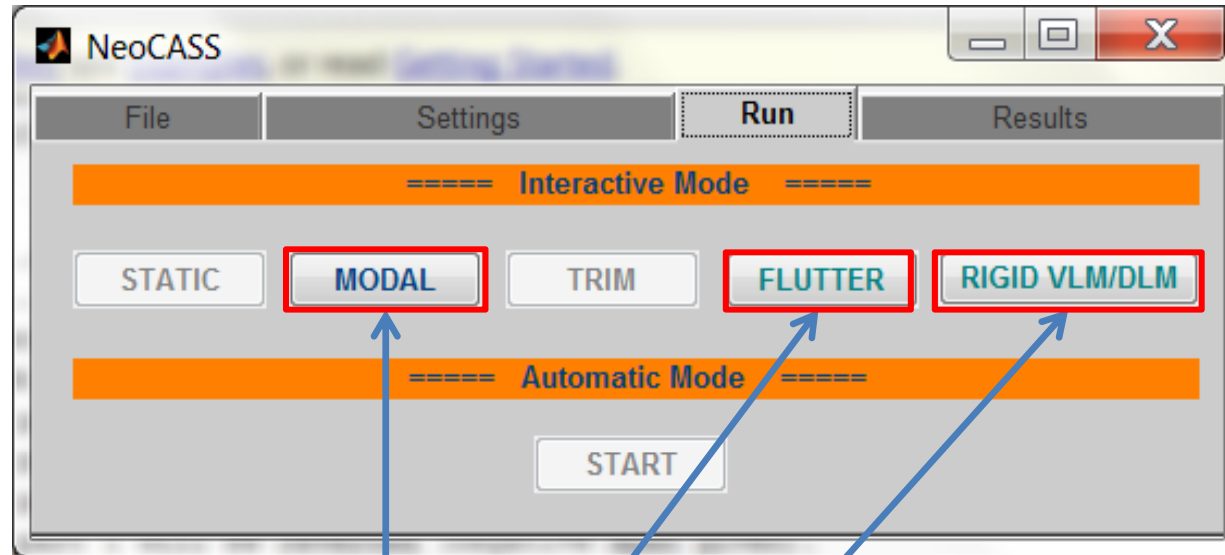
# Running flutter in SMARTCAD



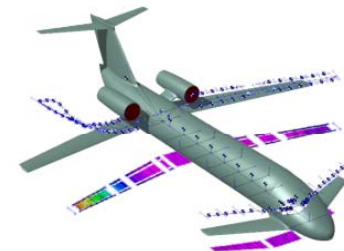
NeoCASS processes the provided SMARTCAD file and on the basis of the included cards shows what kind of analysis can be carried out (green messages). In the case of flutter different analyses can be executed with the same cards.



# Running flutter in SMARTCAD

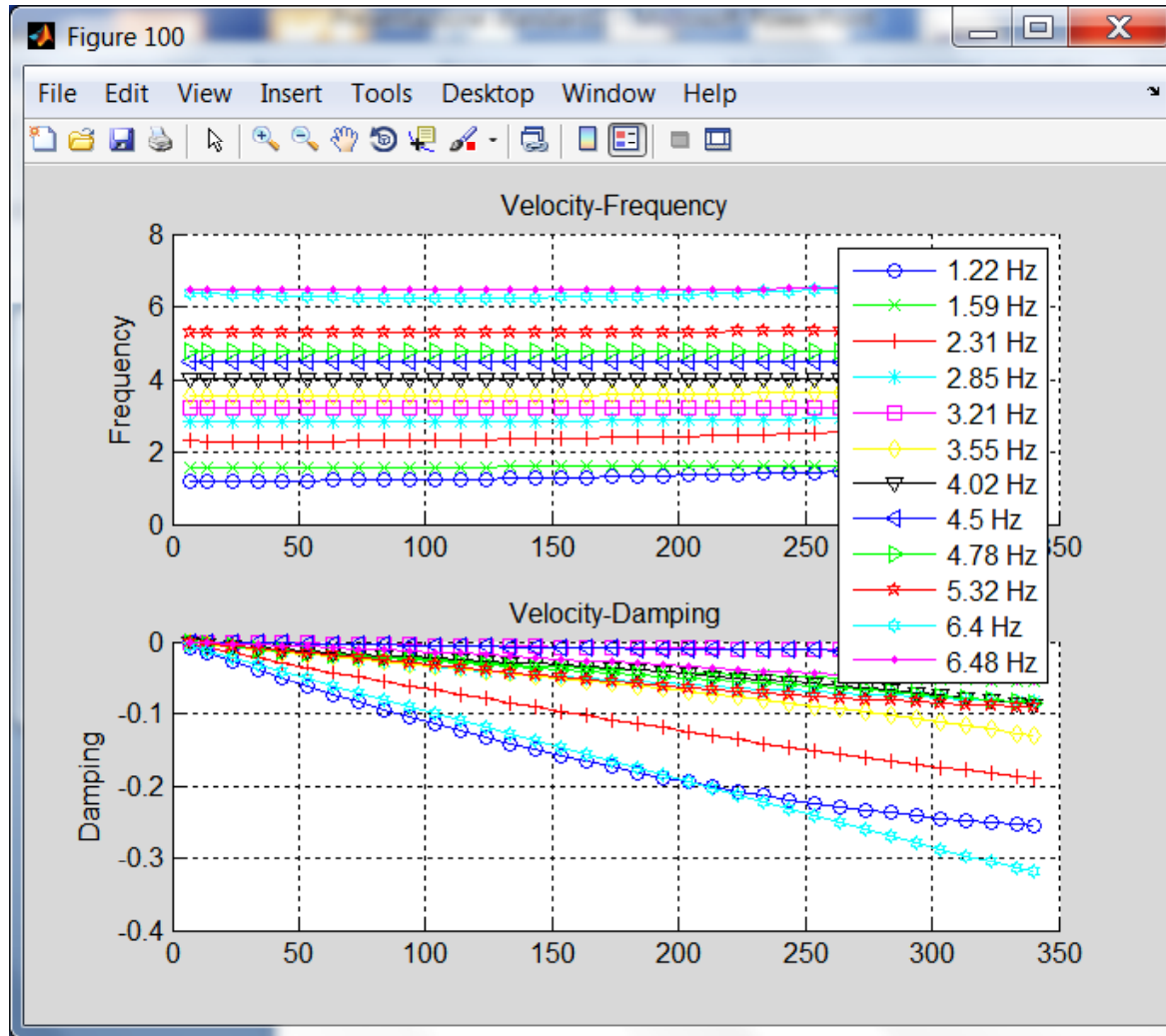


Pressing the *RUN* tab, it is possible to see that three run buttons are now active. Press the *FLUTTER* button to run the flutter analysis.





# Running flutter in SMARTCAD



After the due time, the final **V-g plot** appears on the screen.

In the present case, *no flutter is found*

