Progetto Speciale RS11 "Trattamento
delle incertezze nella valutazione degli edifici
esistenti"
UR: UNINA
Graphical User Interface Manual
"ROBUST FRAGILITY TOOL"

ROBUST FRAGILITY TOOL
Ver. 1.0

ReLUIS 2014 – 2018
Progetto Speciale RS11 "Trattamento
delle incertezze nella valutazione degli edifici
esistenti"
UR: UNINA

Fatemeh Jalayer and Raffaele De Risi
Department of Structures for Engineering and Architecture
University of Naples Federico II

Progetto Speciale RS11 "Trattamento
delle incertezze nella valutazione degli edifici
esistenti"
UR: UNINA
Graphical User Interface Manual
"ROBUST FRAGILITY TOOL"
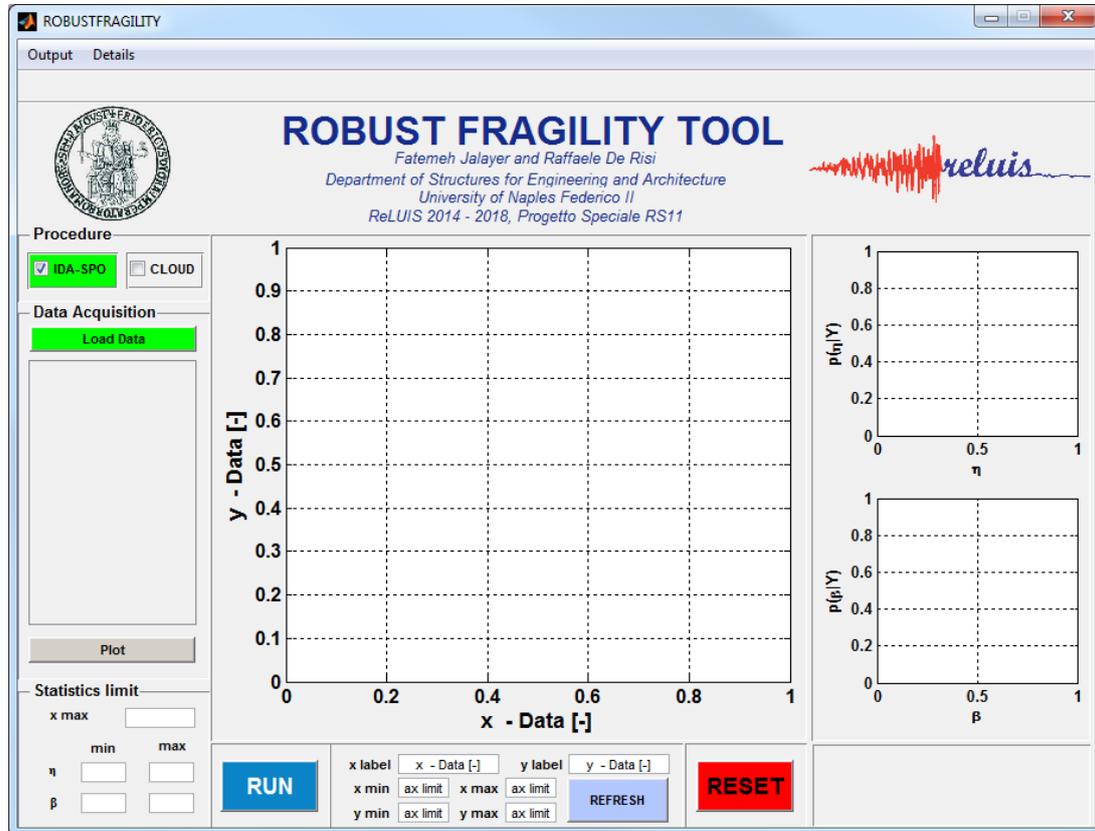
For the correct functioning of the software, verify the MATLAB Compiler Runtime (MCR) is installed and ensure you have installed version 8.3 (R2014a). Such version of MCR can be downloaded at:
http://uk.mathworks.com/products/compiler/mcr/

DISCLAIMER

ROBUST FRAGILITY TOOL may be used and distributed for free while their modification and commercialization are not authorized. The authors have made every effort in order to ensure the accurate working of the software; however, any responsibility is declined for wrong results

LICENSE

ROBUST FRAGILITY TOOL by Fatemeh Jalayer and Raffaele De Risi is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License. Permissions beyond the scope of this license may be available at fatemeh.jalayer@unina.it.

Progetto Speciale RS11 "Trattamento
delle incertezze nella valutazione degli edifici
esistenti"
UR: UNINA
Graphical User Interface Manual
"ROBUST FRAGILITY TOOL"

INDICE

Progetto Speciale RS11 "Trattamento
delle incertezze nella valutazione degli edifici
esistenti"
UR: UNINA
Graphical User Interface Manual
"ROBUST FRAGILITY TOOL"

Introdution

The present document is the descriptive manual of the Matlab-based Graphical User Interface (GUI) named "Robust Fragility Tool". This GUI facilitates the application of the methodologies explained in the following papers:

- Jalayer, F., De Risi, R., & Manfredi, G. (2014). Bayesian Cloud Analysis: efficient structural fragility assessment using linear regression. Bulletin of Earthquake Engineering, 1-21.

- Jalayer, F., Elefante, L., De Risi, R., Manfredi, G. (2013). Cloud analysis revisited: efficient fragility calculation and uncertainty propagation using simple linear regression. 10th U.S. National Conference on Earthquake Engineering. 21-25 July, Anchorage, Alaka.

- Jalayer, F., De Risi, E., Elefante, L., Manfredi, G. (2013). Robust fragility assessment using Bayesian parameter estimation. Vienna Congress on Recent Advances in Earthquake Engineering and Structural Dynamics, VEESD. 28-30 August 2013, Vienna, Austria.

Only four steps are required:
a) Acquire the input from an external file and check visually the preliminary results;
b) Choose the desired analysis option and run the analysis;
c) Increase the accuracy of the results and representation, changing the related interval limits;
d) Save the results.

Progetto Speciale RS11 "Trattamento
delle incertezze nella valutazione degli edifici
esistenti"
UR: UNINA
Graphical User Interface Manual
"ROBUST FRAGILITY TOOL"

1   The Graphical User Interface

Figure 1 shows the screenshot of the GUI. The panel is composed by five main parts. In the left column is allowed the acquisition of the data and the definition of the calculation options. In the central part is displayed the fragility curve after that it is calculated. In the bottom part there are the plot options and the two buttons that allow to perform the analysis or to clean the workspace. Finally in the left column in the upper part there are the two plots related to the distributions of the regression parameters and in the bottom part there is a waiting bar that indicate the waiting time. In the top part there is also a toolbar that allows getting the results (Output button) and have info on the related papers to the GUI (Info button). In the following, the main parts of the GUI will be explained in detail.
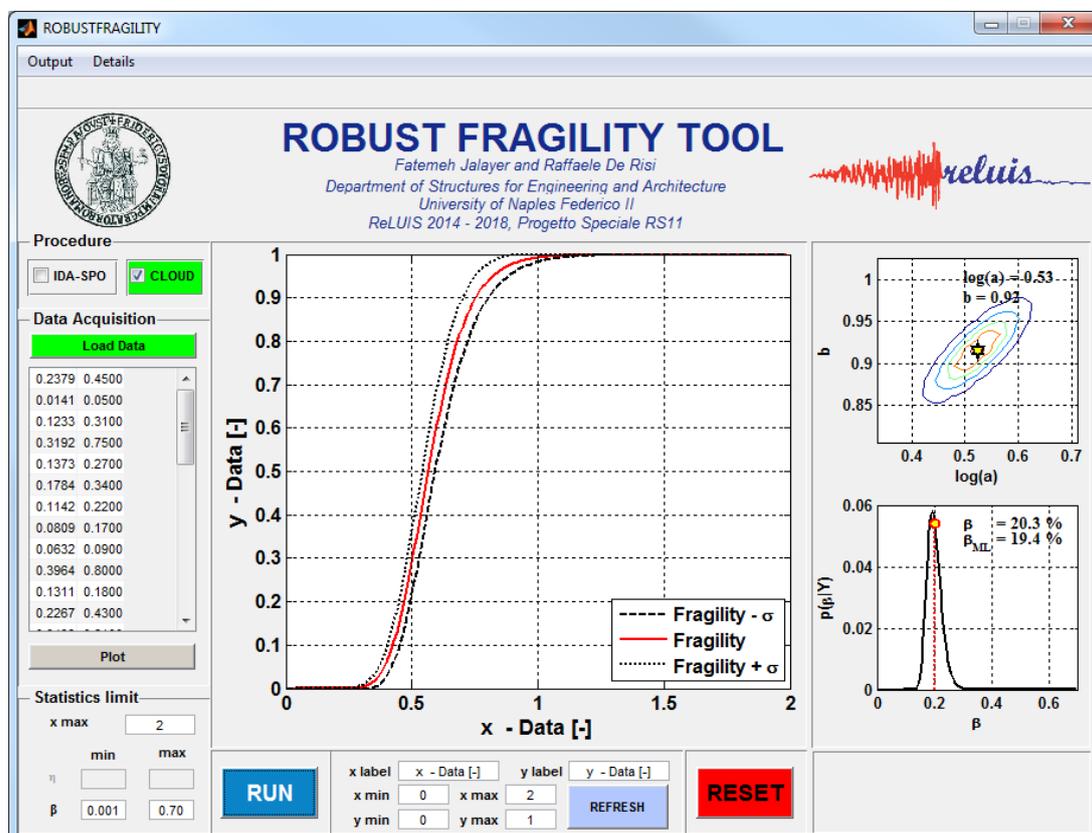
Figure 1 - The screenshot of the GUI

Progetto Speciale RS11 "Trattamento
delle incertezze nella valutazione degli edifici
esistenti"
UR: UNINA
Graphical User Interface Manual
"ROBUST FRAGILITY TOOL"

1.1 Procedure

In the Procedure panel the user can choose the type of structural analysis that has
been carried out and consequently the type of results that are going to be uploaded.
According with the reference papers there are two possible options:

- IDA-SPO: marking this checkbox, the user is going to upload results related to
  Incremental Dynamic Analysis or Static Pushover results. The results of this
  type of analysis must to be composed by the Intensity Measures (IM) values
  that bring to reach or to overcoming the generic limit state under
  consideration. In case of IDA these results are obtained generally intersecting
  the IDA curves with a predefined EDP threshold. In case of Pushover
  Analysis the results are obtained by means a N2 approach or similar
  approaches.

- CLOUD: marking this checkbox the user is going to upload results related to a
  Cloud analysis. The results of this type of analysis must to be composed by
  two columns: the first column reporting the values of IM representative of
  the ground motions used for the analysis, and the second column reporting
  the values of the associated EDPs.

1.2 Data Acquisition

In the Data Acquisition panel, once that the Procedure is chosen, it will be possible
to upload the data from an external text file (*.txt). The format of the data reflects
the typology of analysis procedure employed. If IDA-SPO is chosen, the text file
will be composed by a single column of data. Conversely if CLOUD is selected, the
text file will be composed by two columns, one for the IMs and the other for the
related resulting EDPs. If the format of data is different from the previous standards,
the system returns an error.

Each time that the data are acquired, they will be immediately reported in the table
below the Load Data button and will be represented together a preliminary
elaboration.

In case of IDA, the empirical CDF and the related log-normal fitting together with
the statistics are represented.

In case of Clod analysis, the linear regression and the related error are plotted, and
the regression parameters and the error associated to the regression are reported.

Progetto Speciale RS11 "Trattamento
delle incertezze nella valutazione degli edifici
esistenti"
UR: UNINA
Graphical User Interface Manual
"ROBUST FRAGILITY TOOL"

Once that the user close the output figure, can represent again the results using the Plot button under the table.

1.3 Statistics limits

In Statistics limit panel, the limits of the investigated statistics of the regression have to be defined. This definition change according to the type of analysis procedure used.

- x max: this number is the maximum value of IM for which the fragility is computed. When the user loads the data, this number is automatically set to the double of the maximum value of IM of the uploaded dataset. Each time that the user change it, also the x max number in the plot options changes.

- In case of IDA, the user have to define the median (η) and logarithmic standard deviation (β). When the data are uploaded, the statistics are determined automatically by the system. After the first run, the user can change the limits according to the representations reported in the right panel of the GUI.

- In case of CLOUD, the user have to define only the range of the error associated to the linear regression (β). When the data are uploaded, the statistics are determined automatically by the system. After the first run, the user can change the limits according to the representations reported in the right column of the GUI. There are no options for the joint distribution of the regression parameters (i.e. log(a) and b), since the limitations and the representation are automatically managed by the system.

1.4 RUN and RESET

Two are the main command buttons: RUN and RESET. The first one starts the analysis, the second clear completely the framework.

1.5 Central plot and plot panel

The main plot area is used to show the robust fragility curves at the end of the analysis. In particular, the output is composed by the mean fragility curve and the fragilities corresponding to minus/plus standard deviation (as illustrated in the legend that appear on the plot).

In the plot option panel (the panel between the button RUN and RESET) there are all the details that can be changed in the main plot. In particular:

Progetto Speciale RS11 "Trattamento
delle incertezze nella valutazione degli edifici
esistenti"
UR: UNINA
Graphical User Interface Manual
"ROBUST FRAGILITY TOOL"

- x label and y label: writing in the two text box is possible to change the label to the axes.

- x min and x max: this two values define the minimum and maximum values of the x axis.

- y min and y max: this two values define the minimum and maximum values of the y axis.

Each time that one of these parameters is changed, the user has to push on Refresh button to obtain the desired effect on the plot. The output plots will maintain the option defined in this panel.

1.6 Right column plot panel

In addition to the robust fragility plot, in the central plot panel, the GUI returns other two graphical outputs presented in the right column panel. These plots change with respect to the typology of structural analysis procedure carried out. In particular:

- In case of IDA, the plot in upper part represents the distribution of the median and the plot in the bottom part the distribution of the logarithmic standard deviation of the data. In each plot are also reported a couple of values. The first is the value related to the mean robust fragility curve (indicated with a red circle filled with yellow) meanwhile the second is the maximum likelihood value according to the distribution.

- In case of Cloud, the plot in upper part represents the joint distribution of the regression parameters (i.e. log(a) and b) and the plot in the bottom part represents the distribution of the error associated to the linear regression. In the first plot are reported the values of log(a) and b corresponding to the maximum likelihood. In the second are reported two values: the first is the product of the logarithmic dispersion of the mean robust fragility curve for the maximum likelihood b value (indicated with a red circle filled with yellow), the second is the maximum likelihood according to the distribution.

Progetto Speciale RS11 "Trattamento
delle incertezze nella valutazione degli edifici
esistenti"
UR: UNINA
Graphical User Interface Manual
"ROBUST FRAGILITY TOOL"

2   Output

The output, at the end of the analysis, can be obtained clicking on the Output
command bar. Choosing the option Get results it will be possible to save all the
outputs in a specific predefined folder. The output is composed by 5 files:

a) the robust fragility curves;

b) the distribution of the median (for the IDA) or the joint distribution of the
   regression parameters (for the CLOUD);

c) the distribution of the logarithmic standard deviation (for the IDA) or the
   distribution of the error associated to the regression (for the CLOUD);

d) the plot of empirical CDF and classical lognormal fitting (in case of IDA) or the
   points IM-EDP and the linear regression (in case of CLOUD);

f) the text file with the median and logarithmic standard deviation of the three
   fragility curves.

Progetto Speciale RS11 "Trattamento
delle incertezze nella valutazione degli edifici
esistenti"
UR: UNINA
Graphical User Interface Manual
"ROBUST FRAGILITY TOOL"

Tutorial 1: fragility based on IDA results.

Suppose that an IDA has been carried out using 20 ground-motions. It is reported below the typical result in terms of IDA curves. As EDP has been considered the critical demand over capacity ratio (indicated with Y), therefore the values of $Sa(T_1)$ corresponding to Y=1 represent the output dataset of the analysis on which is possible to built a fragility curve.
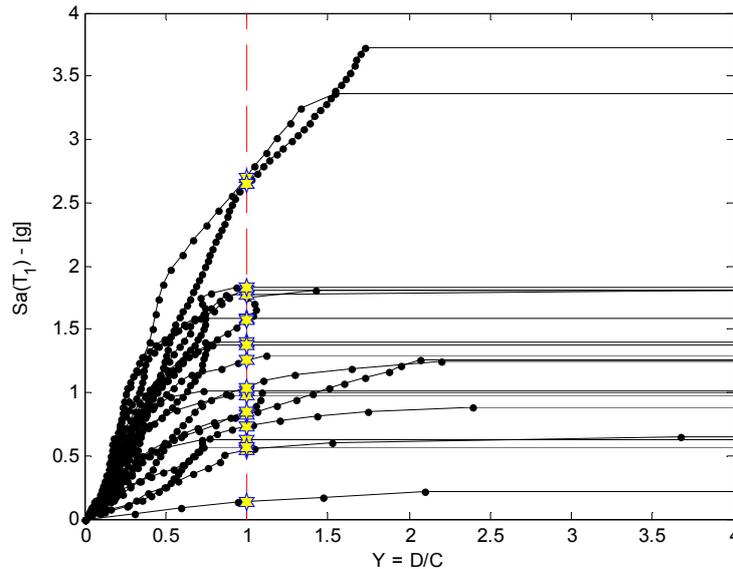
The text file that the generic user will prepare has to look like in the figure below.

Progetto Speciale RS11 "Trattamento
delle incertezze nella valutazione degli edifici
esistenti"
UR: UNINA
Graphical User Interface Manual
"ROBUST FRAGILITY TOOL"
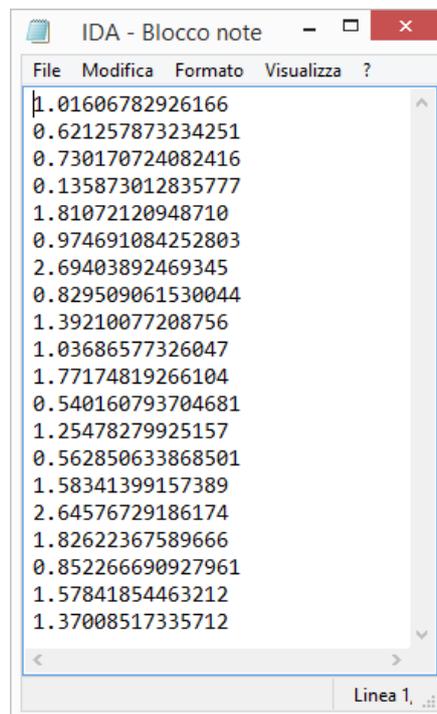
The first step is save this file in a predefined directory. Therefore the user has to start the GUI from Matlab, has to select the IDA procedure and pushing on Load data could acquire the data from the previous text file. Immediately the system returns the represetnation of the data (empirical CDF) and the lognormal fitting with the representation of median and logarithmic standard deviation as well. The charged data will appear in the table below the Load data button.
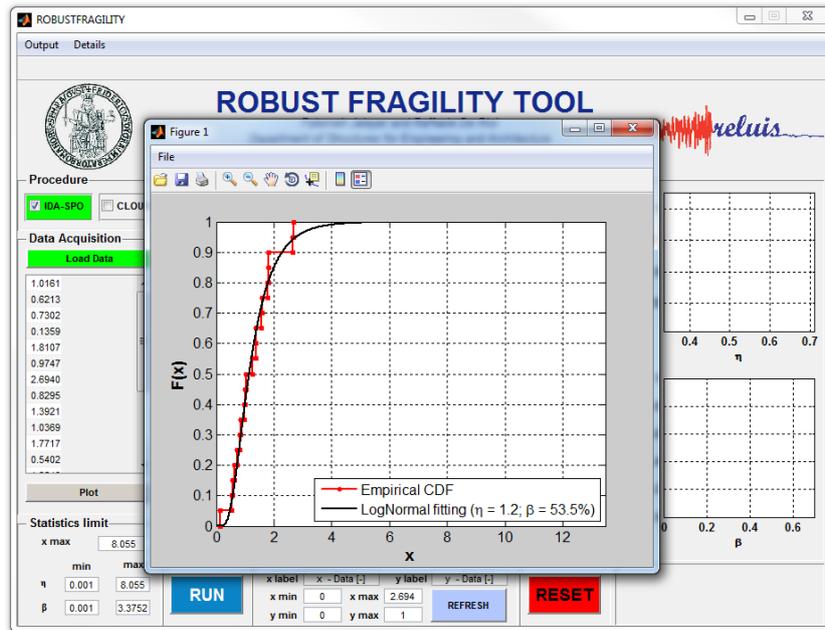
Once that the data have been acquired, and after closing the first plot, pushing the button RUN, will be possible to obtain the first results, as shown in figure below.

Progetto Speciale RS11 "Trattamento
delle incertezze nella valutazione degli edifici
esistenti"
UR: UNINA
Graphical User Interface Manual
"ROBUST FRAGILITY TOOL"
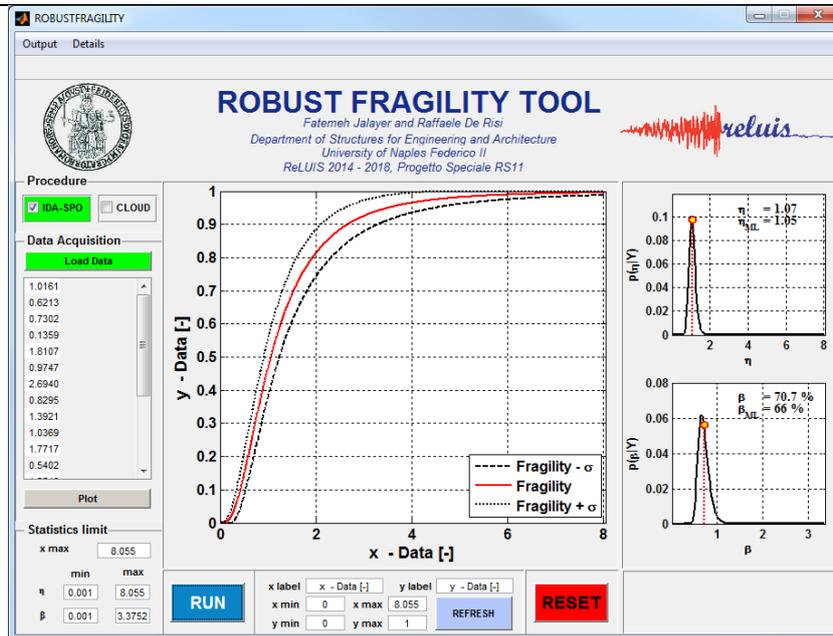
From the plots on right column it is possible to observe that the maximum value for the median can be limited to 3 and the maximum value for the logharitmic standard deviation can be limited to 2. Setting this value in the Statistics limit analysis and repeating the analysis (RUN again), it will be possible to obtain results more accurate repsect to the previous case. Below the new results.

Progetto Speciale RS11 "Trattamento
delle incertezze nella valutazione degli edifici
esistenti"
UR: UNINA
Graphical User Interface Manual
"ROBUST FRAGILITY TOOL"
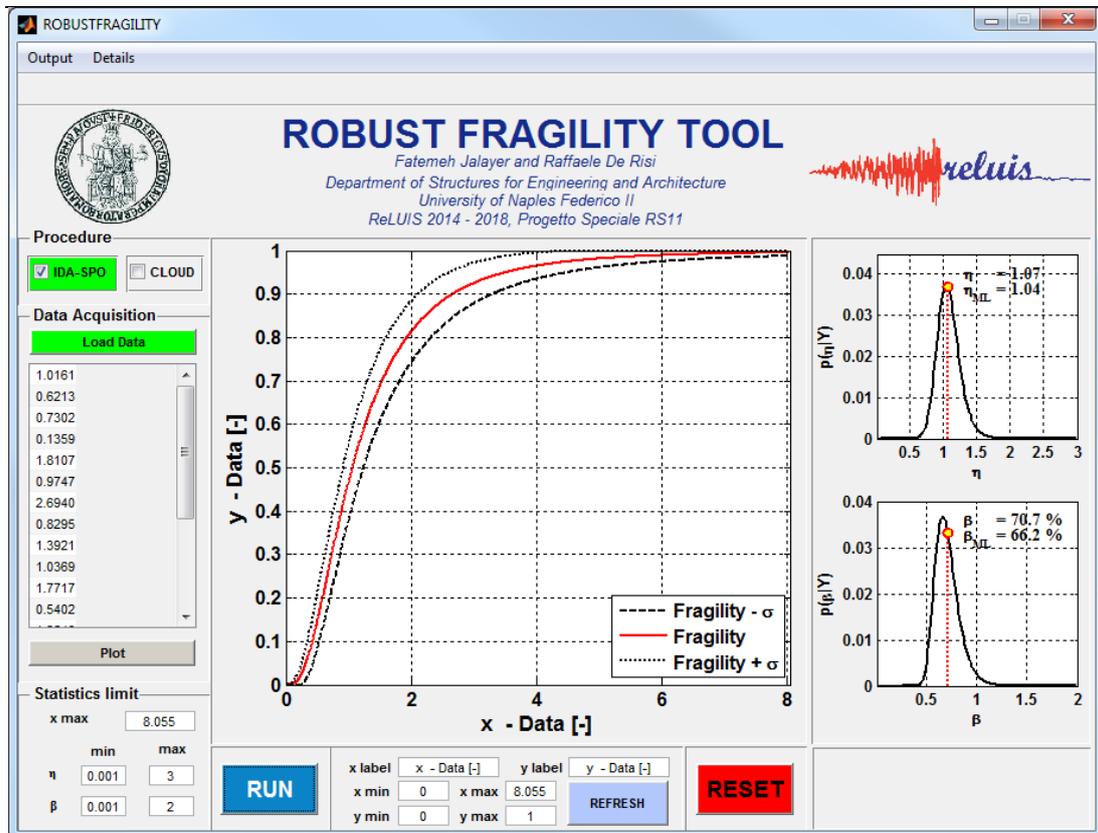
Using the Output command in the command bar, it will be possible to save all the outputs in a predefined folder. The output in this case is composed by the three main plots presented in the GUI, the plot of the data (ECDF) and lognormal fitting presented above, and a text file with the statistics of the thre fragility curves presented in the main plot panel.

Progetto Speciale RS11 "Trattamento
delle incertezze nella valutazione degli edifici
esistenti"
UR: UNINA
Graphical User Interface Manual
"ROBUST FRAGILITY TOOL"

Tutorial 2: fragility based on Cloud results

Suppose that a Cloud has been performed using 20 accelerograms. Is reported below the typical result in terms of EDP-IM points. As EDP has been considered the critical demand over capacity ratio (indicated with Y). The points represented in figure below represents exactly the dataset from which calculate the fragility curve.
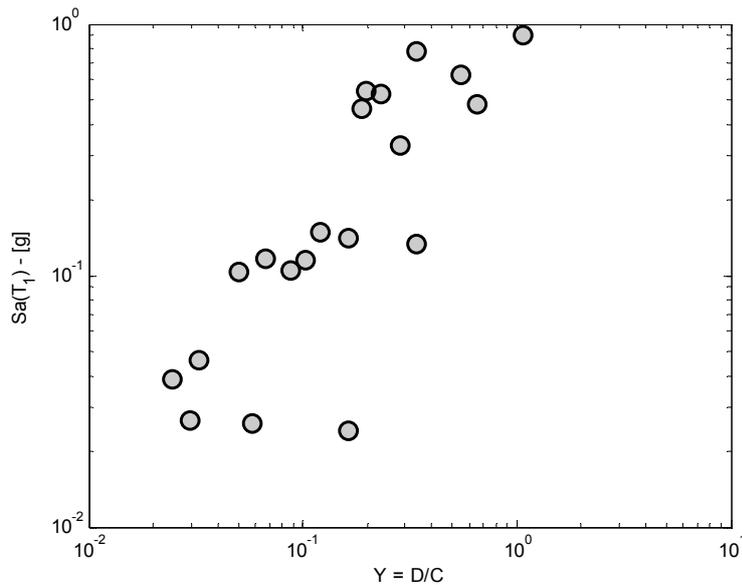
The text file that the generic user will prepare, has to look like in the figure below.

Progetto Speciale RS11 "Trattamento
delle incertezze nella valutazione degli edifici
esistenti"
UR: UNINA
Graphical User Interface Manual
"ROBUST FRAGILITY TOOL"
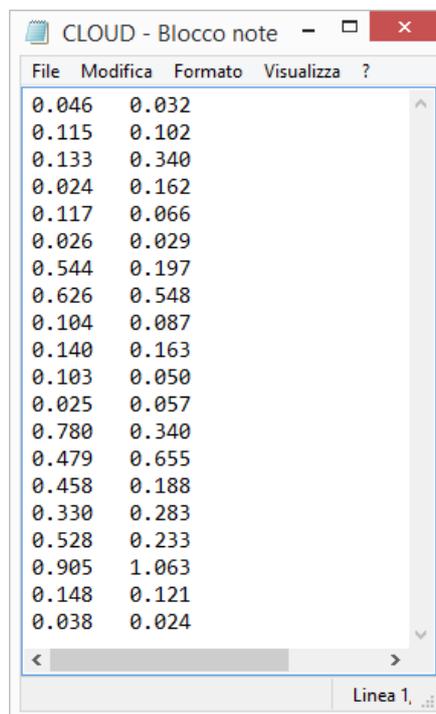
The first step is save this file in a predefined directory. Therefore the user has to start the GUI from Matlab, has to select the Cloud procedure and pushing on Load data could acquire the data from the previous text file. Immediately the system returns the represetnation of the data (Points representative off the couples IM-EDP) and the linear regression. The charged data will appear in the table below the Load data button.
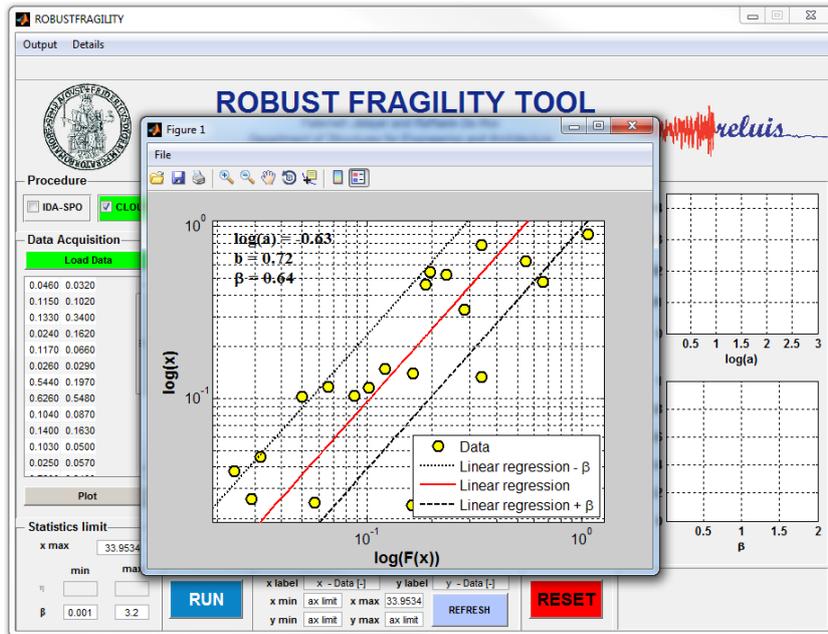
Once acquired the data, and after closing the first plot, pushing the button RUN, will be possible to obtain the first results, as shown in figure below.

Progetto Speciale RS11 "Trattamento
delle incertezze nella valutazione degli edifici
esistenti"
UR: UNINA
Graphical User Interface Manual
"ROBUST FRAGILITY TOOL"
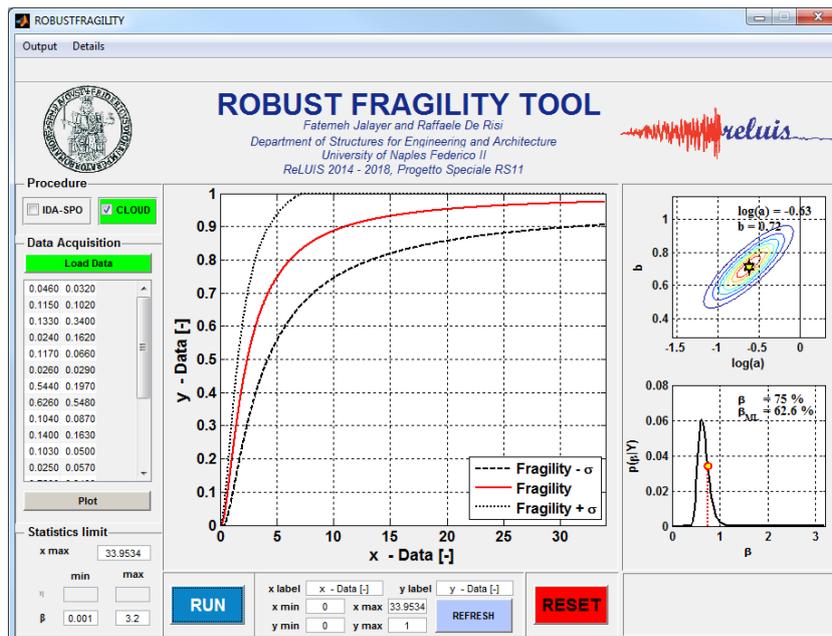
From the plots on right column it is possible to observe that the maximum value for the linear regression error can be limited to 1.5. Setting this value in the Statistics limit analysis and repeating the analysis (RUN again), it will be possible to obtain results more accurate repsect to the previous case. Below the new results.
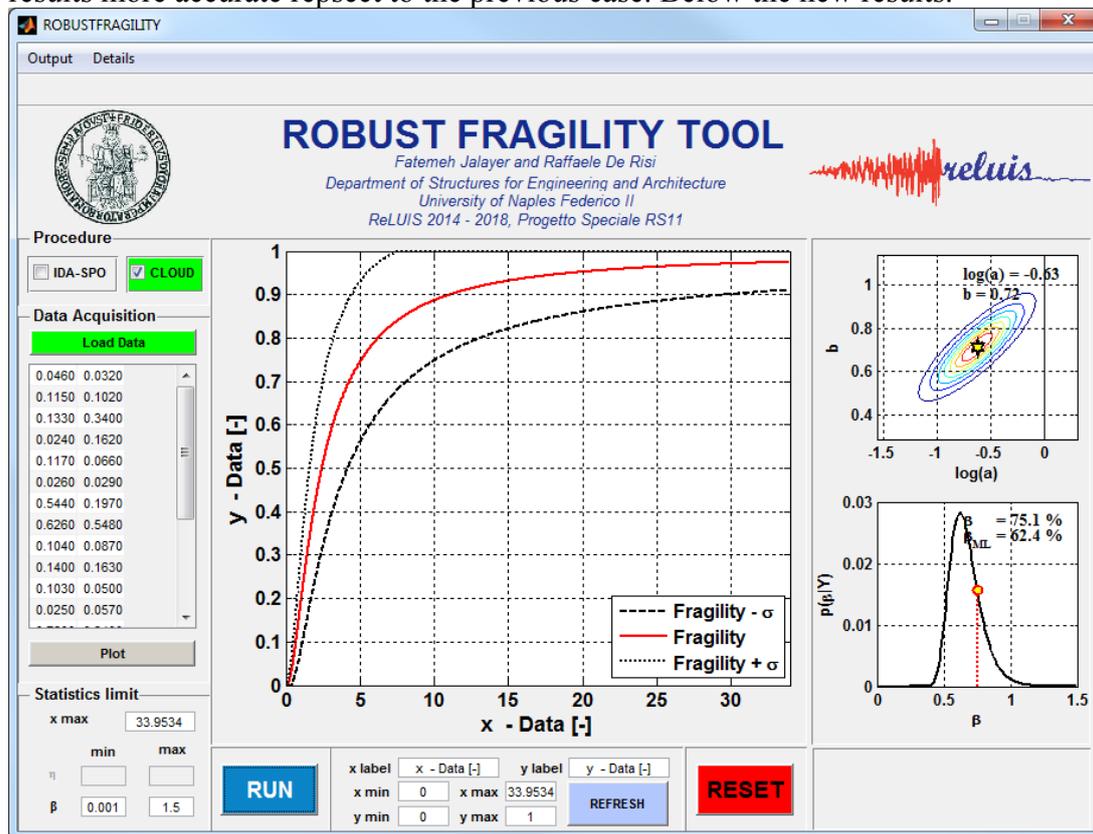
Using the Output command in the command bar, it will be possible to save all the outputs in a predefined folder. The output in this case is composed by the three main plots presented in the GUI, the plot of the data (points IM-EDP) and linear regression presented above, and a text file with the statistics of the thre fragility curves presented in the main plot panel.