# A.L.I.A.S.: A Lovely Indentation Analysis System – Viscoelasticity

The code have been built in python environment and language. Therefore it is necessary to download Python (https://www.python.org/) and Pycharm (<https://www.jetbrains.com/pycharm/download/?section=windows>) on the computer where the data analysis will be performed.

The code is structured in a series of functions and it allows the processing of different data (Dynamical Mechanical Analysis and Force-relaxation) and by using different fitting models.

In particular, it allows the processing of Dynamical Mechanical Analysis or Simple Indentation (force-relaxation) data acquired with FT-MTA03 nano/microindenter from FemtoTools.

For force-relaxation analyses it is possible to alternatively choose between:

* **Generalized Maxwell Model with fixed relaxation times**
* **Generalized Maxwell Model** with all the fitting parameters left free (**E∞, E1, E3, E3, τ1, τ2, τ3**). This code uses also the Fourier Transform for obtaining the complex modulus
* **Poroelastic Model**

It is recommended to save data from FemtoTool software by using the “Space delimited” type of formatted text and by naming the file as “data”.

## Experimental and fitting parameters:

When running the code a user-friendly interface appears. The first upper part is relative to probe and sample information. In addition, it allows also to adjust values (baseline and contact point threshold) for helping the code to catch the correct baseline and contact point. The default values had been tested from soft sample (500 Pa) to stiffer ones (100 kPa) with good performances.

## Data processing:

**Extract data** allows to extract “data” txt file saved with the FemtoTools software form its own folder and creating a backup folder with original data.

**Divide data** allows to divide the “data” txt file, which contains all the measurements performed, in single txt files for each experiments. In case of single indentations, these are used by **Analyse individual measurement** button for processing single force-relaxation curves, or by **Run DMA Analysis** for DMA measurements.

**Divide array data** converts each curve of the array in a csv file which is used by **Analyse array measurement** for the processing of force-relaxation arrays.

## Force relaxation analysis:

**Select fitting model** allows to alternatively choose between the three implemented models.

**Correct Drift** can be helpful for correcting potential force drift during measurement.

**Apply RCF** is required for correcting the loading ramp when it is not instantaneous.

**Show Location** allows the visualization of indenting positions represented as circles on the output viscoelastic maps.

**Analyse individual measurement** is the button for processing single curve.

**Analyse array measurement** is the button for processing single array.

**Get array coordinates** allows to obtain the X-Y coordinates of the array by placing the first point as the origin (0, 0). It needs the Fitting Results Summary csv file generated at the end of **Analyse array measurement** function.

## DMA analysis:

It is necessary to start the recording of the channels before the approach to the sample during the measurement with the dedicated button “Record Data” available in the measurement window of the Femtotool software suite. This one is required for the evaluation of the indentation depth during data analysis with ALIAS-Viscoelastic.

**Determine Depth** allows to load the recording of channels. Once calculated the indentation depth, the value will be visualize on the Dialog Window. This value must be inserted in the **Indentation Depth (um)** box. Then, with **Run DMA Analysis** itis possible to process the measurement by selecting the“data” txt file.

An example dataset is provided. It contains two folders:

* Processed data 🡪 here the **Generalized Maxwell Model** has been used for force-relaxation analysis.
* Unprocessed data 🡪 it contains original data as they have been saved with the FemtoTool software.