# Trifilar Pendulum User manual

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Version 0.1 first draft

A picture containing indoor, wall, design

Description automatically generated

This user manual assumes that the user has already assembled the pendulum structure (optional) and platform. It also assumes that the user has a camera selected to perform the measurement.

## Perform a measurement:

Place the object under test on the platform such that the centre of mass of the object coincides with the centre of the platform and the axis around which the mass moment of inertia is going to be measured coincides with the Z-axis of the platform.

Hold the edge of the plate with both hands and give it a slight rotation (+/- 5 degrees).

Start the camera and call out the test configuration (this will later be helpful to identify the test if for instance a GoPro or any other stand-alone camera is used).

Download or save the movie to an appropriate folder.

## From movie to MoI

Download the Software from (link to the online repository) onto a Windows computer with Python 3.

Install the following libraries using Pip install [check this by downloading the sw onto a different machine, or running from the command line]

* Tinker
* MoviePy
* OpenCV (cv2)
* Csv
* Numpy
* Math
* Mathplotlib

The easiest way to run the software is to use Visual Studio Code. If everything is setup run:

Moi\_calculation\_automatic\_v2.py

A GUI will appear as illustrated in Figure 1, the user is required to select the video and an output folder, and the software will automatically copy this folder and add the date and time to the copy. This will give the user the opportunity to easily run multiple tests without having to create multiple folders to save the data manually. The user is furthermore required to enter the Mass (this is the combined mass of the platform and the test object). The other pre-filled fields can be changed to to accommodate the user's specific build. This includes camera setting, and frames per second. Length of the wires, and the markers sizes used in the build of the platform.

If the user is happy with the variables entered in the GUI, the process button can be clicked. 

The software will go through the steps visualized in Figure 2. There are two parts of the analysis, the first part can be seen in the top three yellow hexagons, where the video analysis takes place, the output of the video analysis is a video that has no audio and two .csv files, one that captures the location of the centre of the platform per frame and one .csv file that describes the location of an outlying dot per frame. These files can be used by the user to do additional analysis or can be used to produce plots for presentation purposes. While this part of the software is running a pop-out screen shows the video and the tracking markers. The next part of the analysis is illustrated in the orange hexagons, here the .csv files will be combined into a data frame and several steps will be undertaken to extract the period of oscillation and the MoI.

When the Software is done with the analysis the MoI, period and plot will be shown on the right-hand side of the GUI.

## From MoI to PoI and full Inertia Tensor

Often a case knowing the MoI about one principle axis is insufficient. The entire Mass Moment of inertia tensor needs to be known. Using the orientations in Figure 3 as a guide the Mass moment of inertia around the various axis can be measured and the Products of inertia can be calculated. (add required equations etc. )

