Tool tracking calibration

The purpose of this guide is to offer a step-by-step process on how to calibrate the laparoscopic instrument tracking system for its use in KTS - The Alchemist serious game.

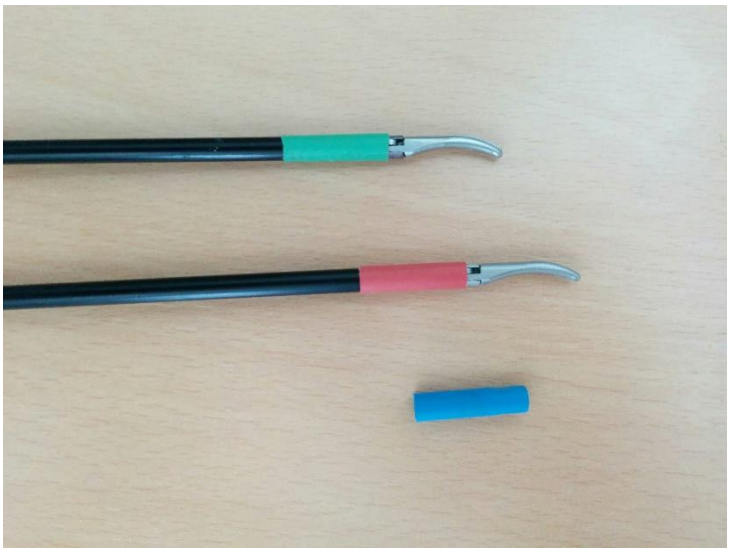
NOTE: You may need to first install in the computer the Visual C++ Redistributable 2012. You can download the version required for your computer from:

https://www.microsoft.com/en-us/download/details.aspx?id=30679

Setting up of the laparoscopic instruments

Laparoscopic instruments should be of a standard black colour in the shaft of the instrument. In order to track the instruments, colour markers will be required. Colour markers should be placed just above the distal end of the shaft (i.e.: the instrument per se).

There are several ways that the markers can be fashioned from: colour duct tape, thermo-shrinking tubing, etc. Markers Current tested colours include green, red, blue and yellow, preferably in a matte tonality. Other colours may work, but have not been currently tested. Length of the markers should be of 2cm.

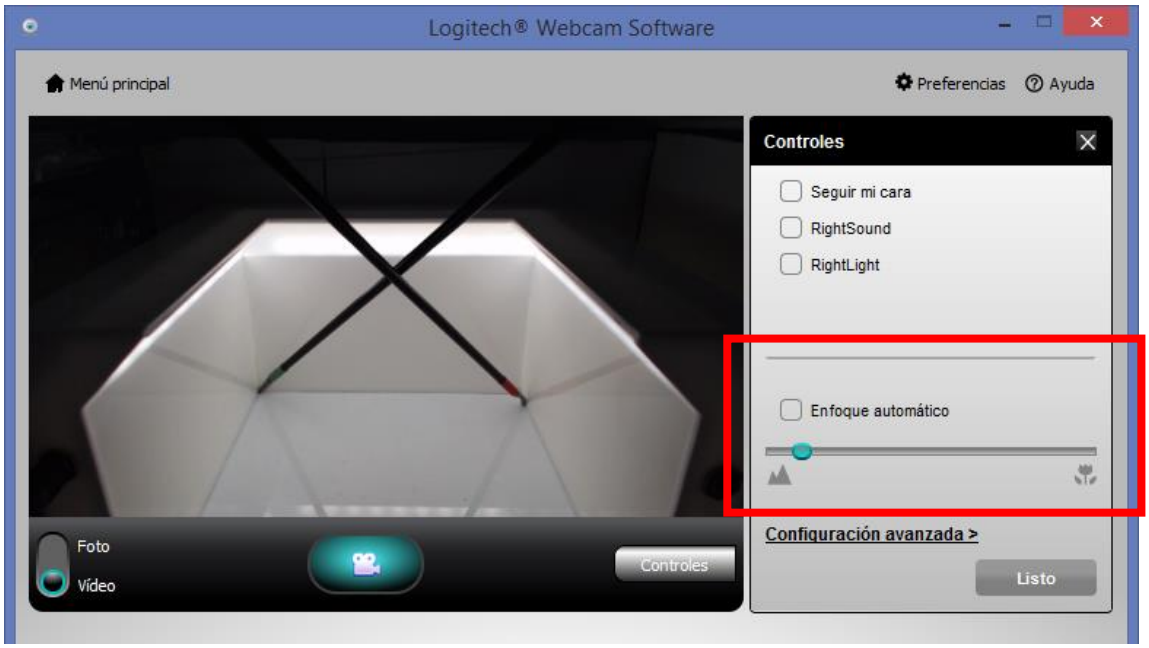


Setting up the camera

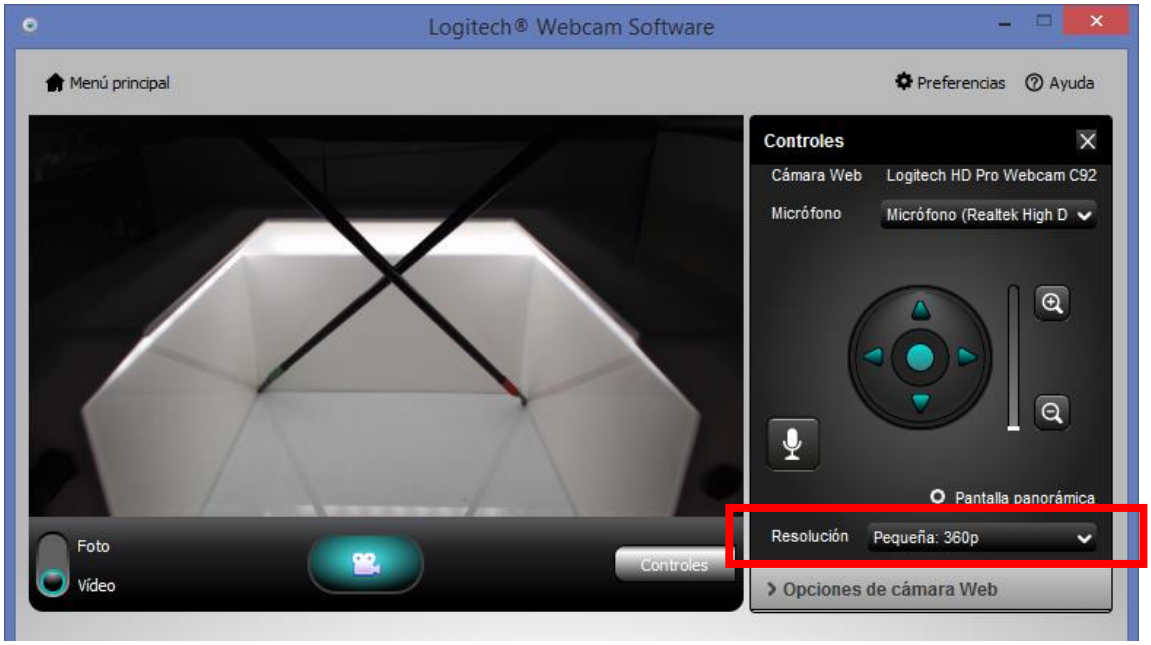
In order to prepare the camera from tracking, the Logitech drivers should be installed. They will be provided along with the game and the tracking tool. They can also be downloaded from http://support.logitech.com/product/hd-pro-webcam-c920#download.

Once you have them installed, run the Logitech Webcam Software from your computer and change the following settings:

- Turn autofocus off, then move the focus slide bar until the image shown in the camera is sharp and clear.



- Set the resolution at 360p Small.



- In the advanced configuration menu, turn Right Light off, then configure Brightness, Contrast and Colour Intensity as follows:

Once you have completed these tasks, save and quit the Logitech Webcam Software. Bear in mind that this settings tend to reset sometimes, so if at any moment you find that the tracking system is not performing correctly, check these parameters again.

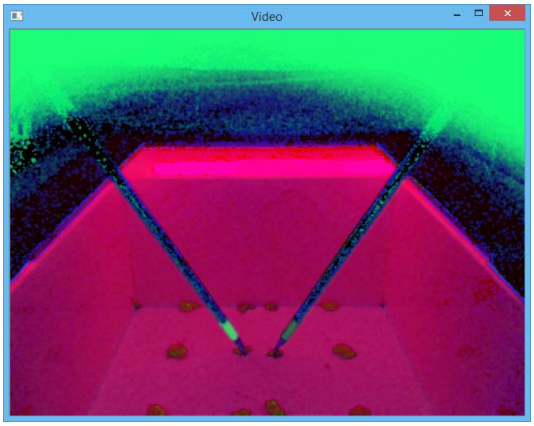
Calibrating the tracking system

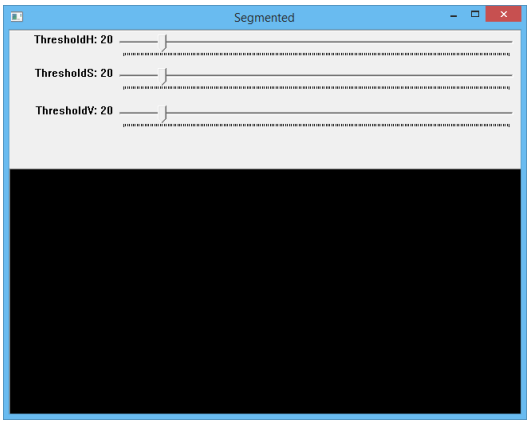
Calibration of the tracking system is carried out running the **calibration.exe** application in the main folder. The calibration process follows three steps:

- Calibration of the right instrument marker
- Calibration of the left instrument marker
- Calibration of the instrument shafts

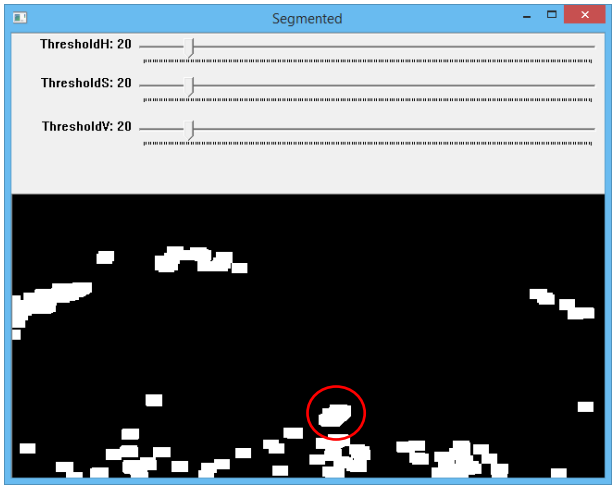
Calibration of the right marker

Once the calibration software is running, two windows will be shown: Video and Segmented:

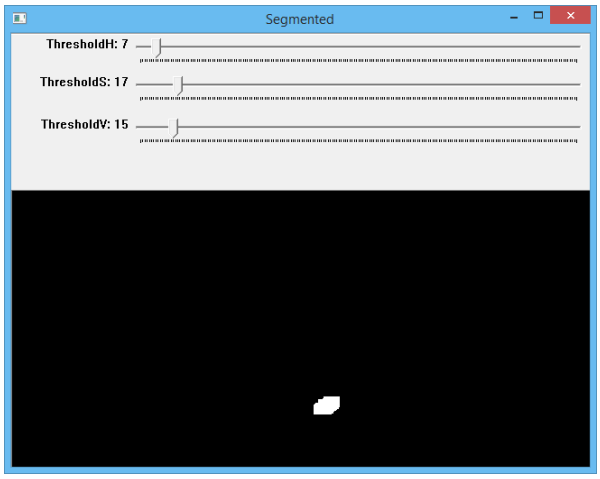




The application will prompt you to click on the instrument marker in the Video window. This will result in a semiautomatic segmentation of the marker (in a red circumference in the following figure), visible in the Segmented Window.



In order to achieve a full segmentation, adjust the three slide bars ThresholdH, ThresholdS and Threshold V until only the marker is visible. You should move the instrument around the box to see if segmentation is ok on different positions.



Once the marker is perfectly segmented, press Space to continue.

Tips:

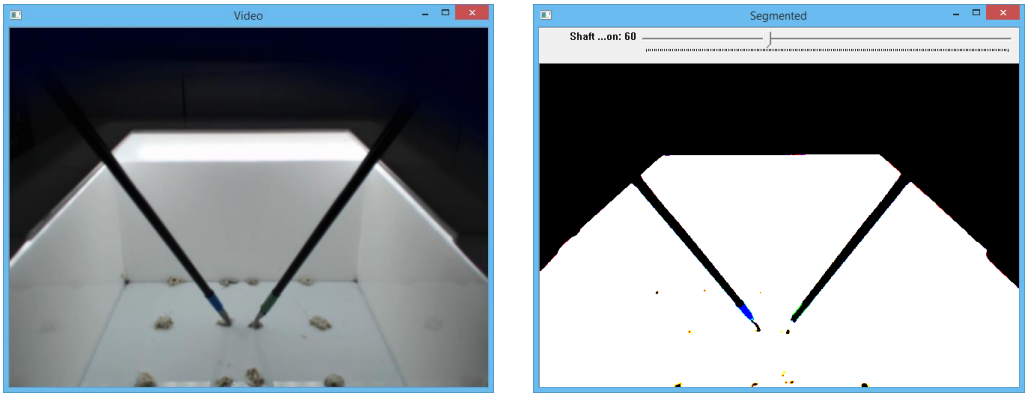
- **Sometimes clicking on a marker will result in a very noisy image difficult to correct with the bars. In this case, clicking again the marker may yield a better result.**
- **In order to maximise the effect of the segmentation, make sure the instrument is placed around the centre of the box when clicking on the marker.**
- **Adjustments to the tolerance bars should usually be small**
- **Recent tests have yielded that blue and yellow markers are a good selection of markers. Green and red also provide good results.**
- **Always carry the segmentation process with both instruments inside the box trainer. This way you can see whether the current segmentation values are also causing the other marker to show simultaneously. This should be avoided at all costs.**

Calibration of the left marker

In order to calibrate the left marker, follow the same steps as with the right one. Press Space when you are finished.

Calibration of the instrument shafts

In this case, the Video and Segmentation windows will show the following information:



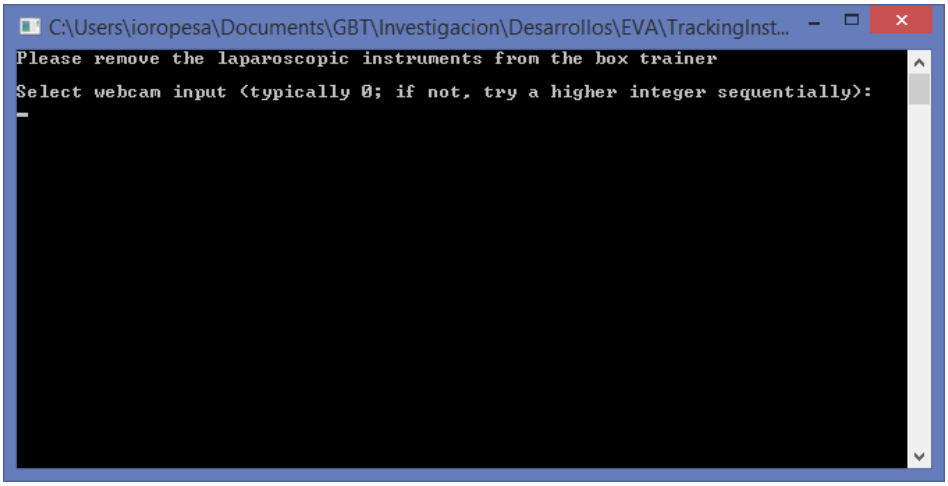
The goal is to adjust the Shaft Tolerance slide bar (in the Segmented Window) until the shafts match those on the Video Window, especially where width is concerned. Once you are satisfied, press Space. This will end the calibration process.

Tips:

- **Always make sure that no additional noise enters the image when moving the slidebar. Only the shafts should be visible in the white region of the image.**
- **If you are not sure about what values to provide, values between 60-100 should provide a good segmentation.**

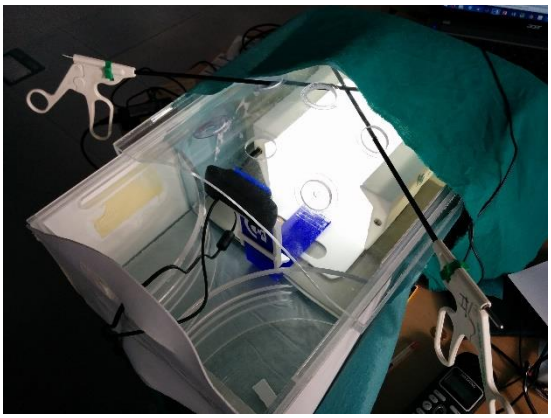
Starting the tracking application

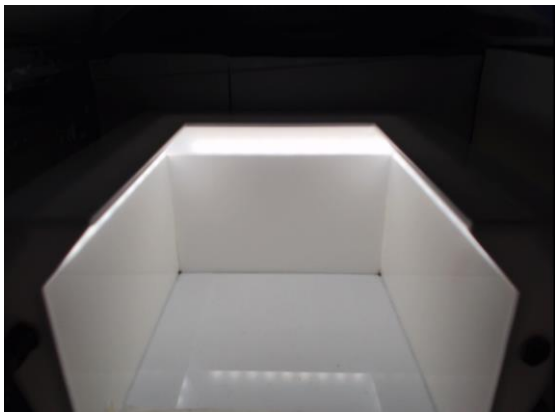
Every time the tracking application is started[1], the following screen will be shown:



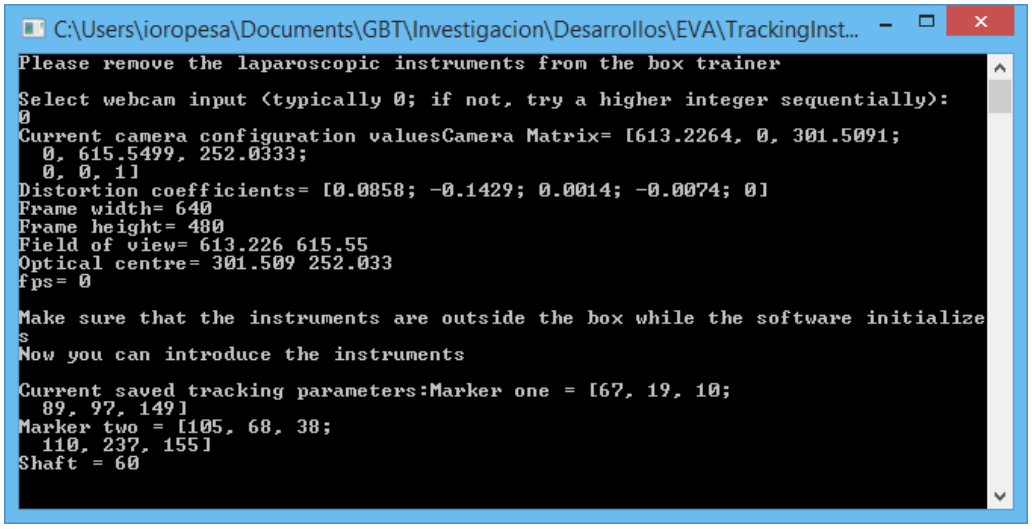
[1] In order for the tracking application to work, The Alchemist game should already be running in the background.

As an initial internal calibration will always be done, the application requires that the laparoscopic instruments are not in the camera field of view during this phase of setting up. ***Always remove the laparoscopic instruments from the simulator when starting the application.***





At this point, the application prompts you to select the camera that will be used to track the laparoscopic instrument. Typically, the input required will be 0; however, should there be additional cameras connected, the number could be 1+. Once you have introduced the correct camera number, press Enter. The following screen will be shown after 2 seconds:



After this time, the application will start tracking. ***Place the instruments now inside the box. You can now play The Alchemist.***