# Fine-Tuning Kinematic Skeleton with the Vive   Sep 2018

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Using a Vive & SynDash skeleton editor to fine-tune a Synertial skeleton file (.sk file)

System requirements: a Synertial Mocapsuit, a Vive system running on the same PC as Synertial HW & SynDash skeleton editor.

(Fig-1) The Vive needs to be at least in this state before starting SynDash or SynShow. Feel free to restart the hardware for whatever reason in middle of this process (no need to restart SW)..
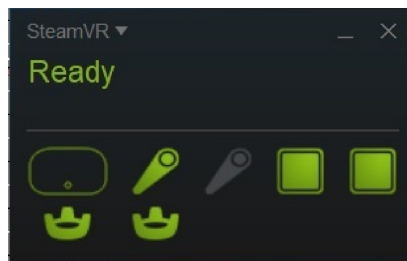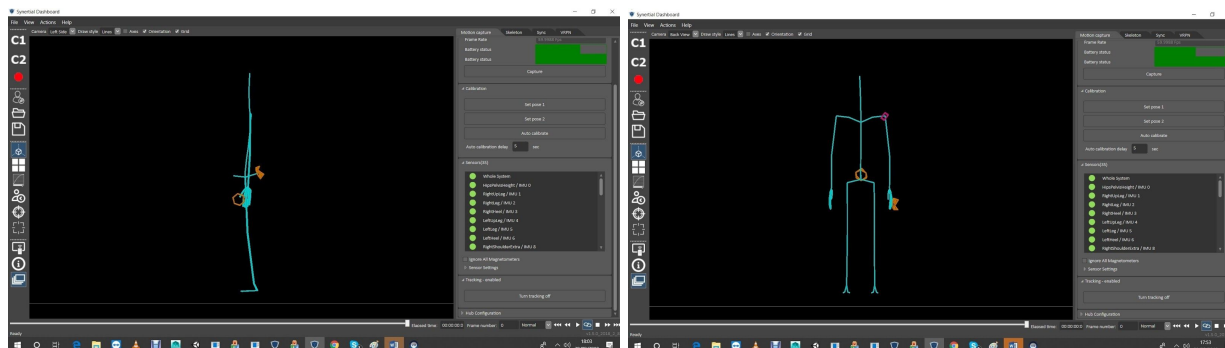

Fundamentals:

1- Calibrate suit for every step of this process. Do *a pose-1/pose-2 before each check below.*
------Understand how to calibrate: *GO TO Cobra 4G Calibration Document*
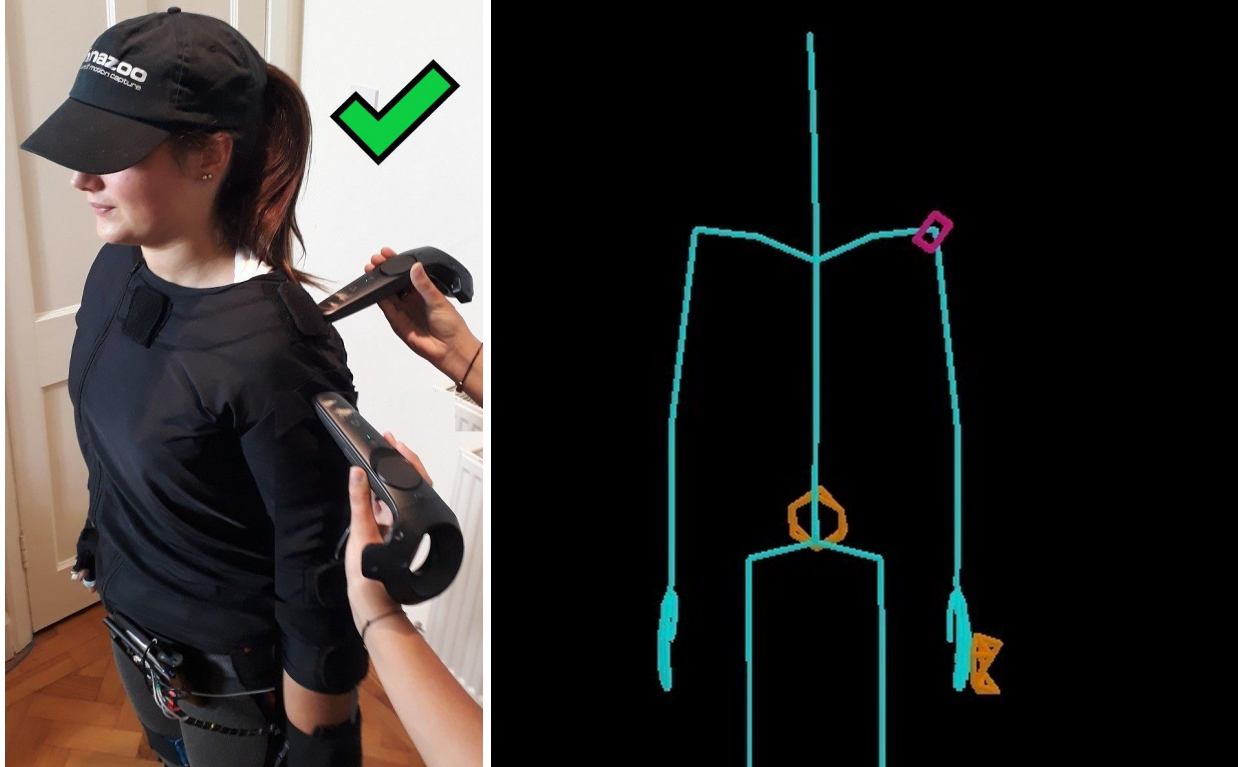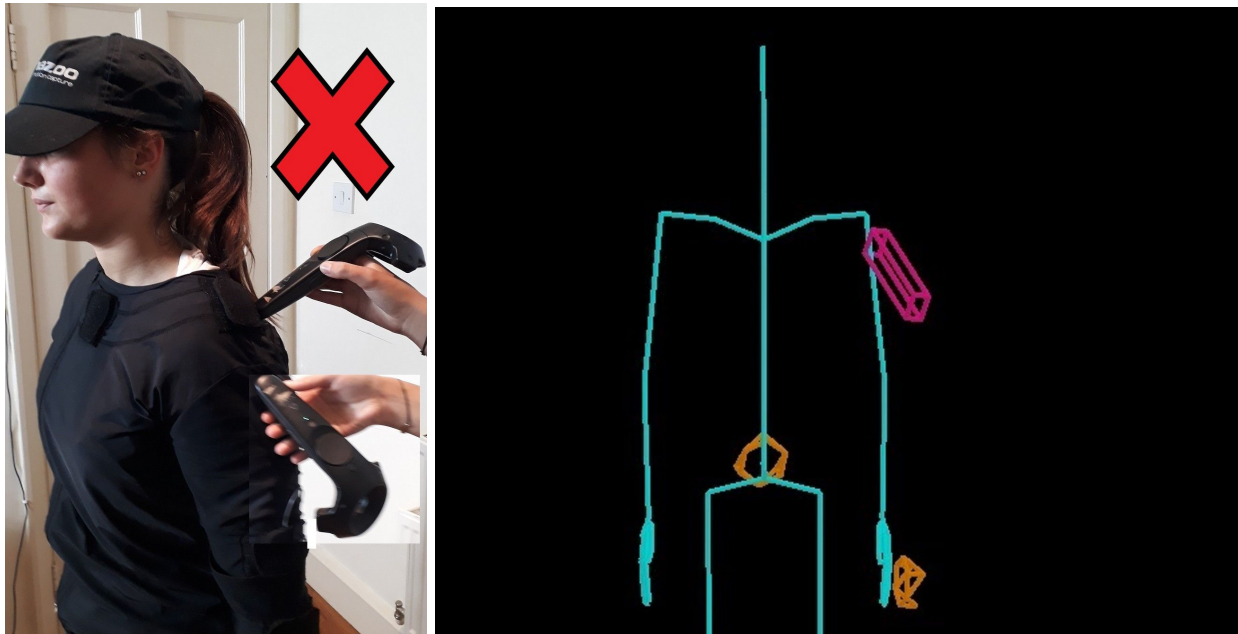
2- Use 'Left Side' and 'Back View' to review.

(Fig-2) Left side and Back View screens

3- Aim controller at right angles into the subject body, to best match the SynDash viewer 'Left Side' and 'Back View'. You will know it is at a right angle when the pink controller in the scene is reduce to a small traingle.
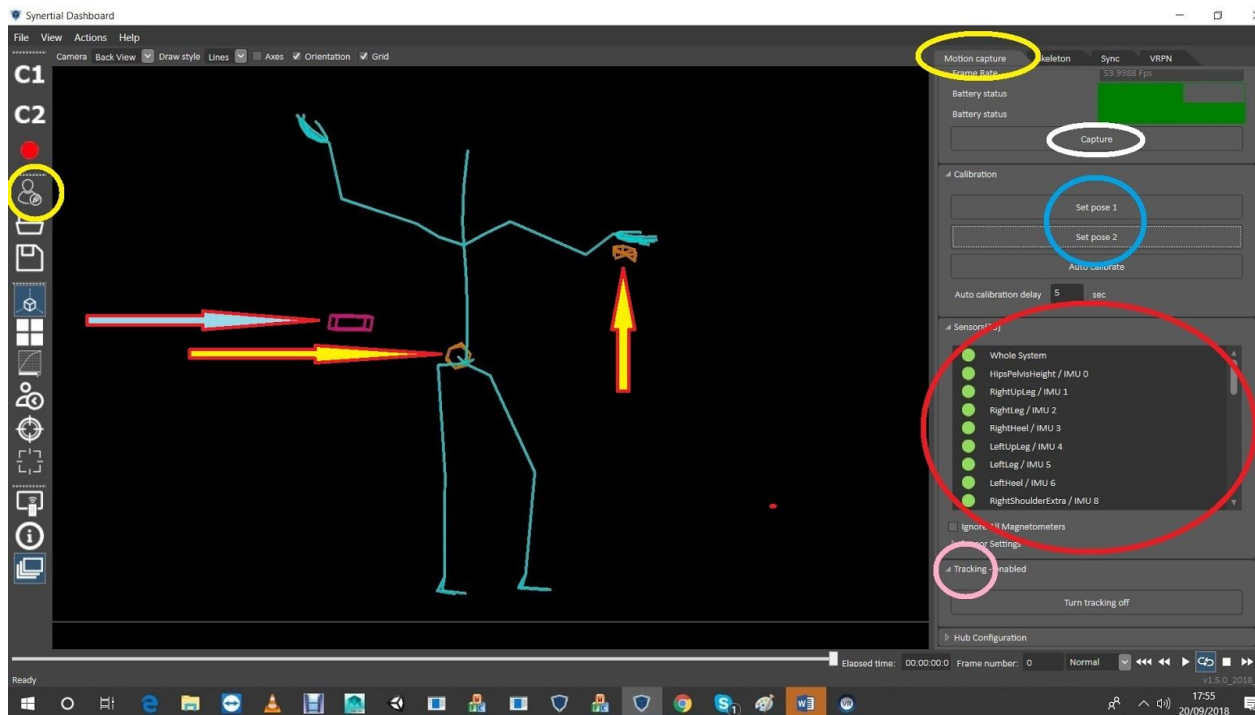
(Fig-3) Aiming Square

(Fig-4) Not aiming square

4- Change values in the 'Editor' mode and check the results in the 'Live' mode:

Fig-5) **Live mode**

- Yellow circle: Toggle button to go between 'Live' and 'Edit' modes.
- Yellow arrows: Vive pucks on coccyx and left hand
- Blue arrow: Vive' Controller'
- Yellow oval: 'Motion Capture' tab manages the HW and the 'Live' mode
- White oval: Start and Stop capturing the live feed
- Blue circle: Pose-1/Pose-2 calibration commands
- Red circle: the 'State' of sensors (green, yellow, red, grey: good to go, almost good, not good, and 'unreliable'). Every sensor has own reporting, including the Vive sensors (scroll to the bottom)
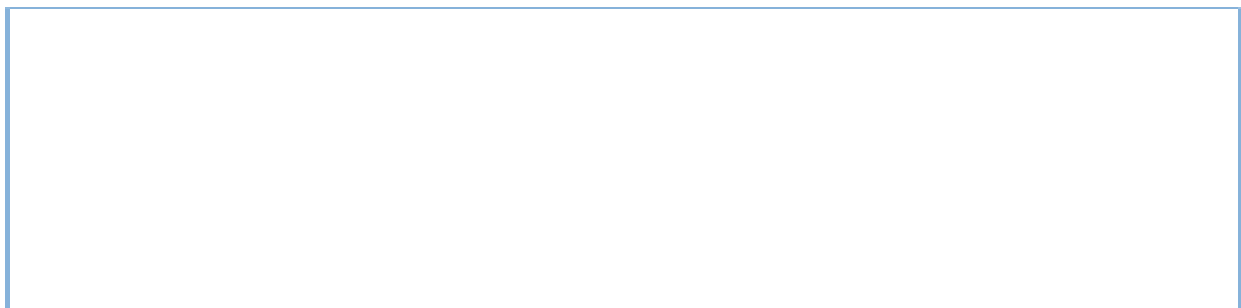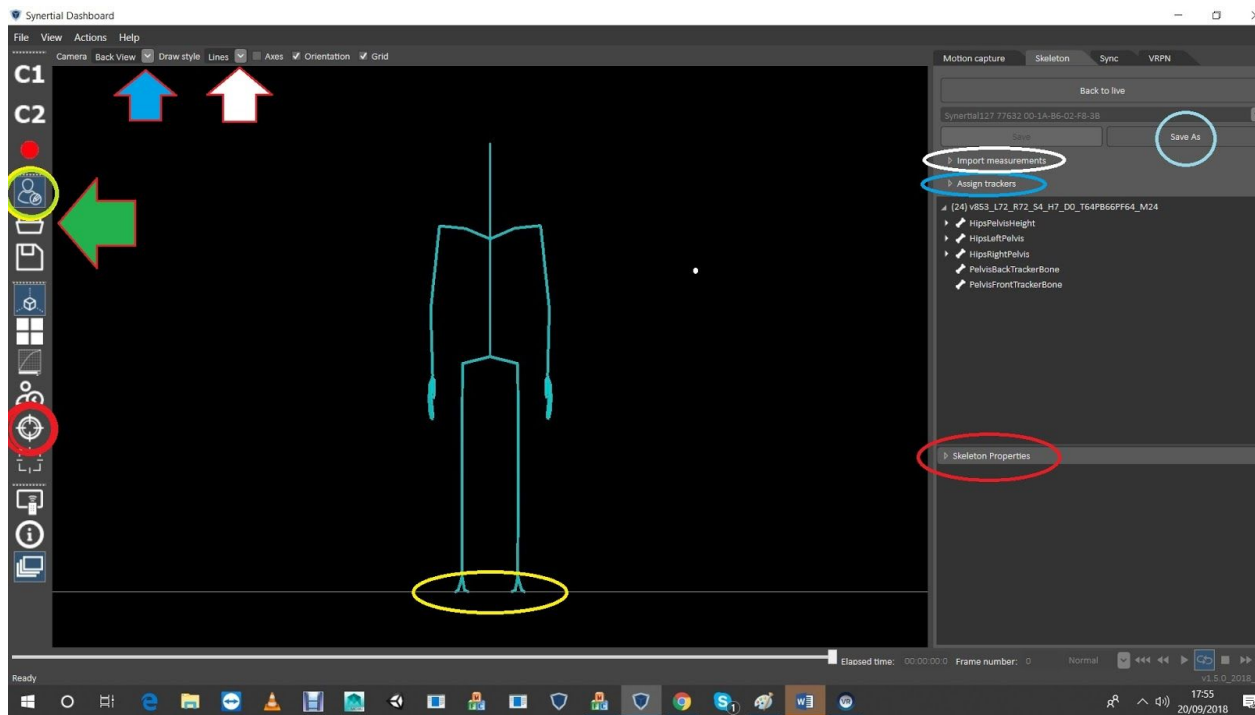-Pink circle: 'Enable' or 'Disable' the Vive live data

Fig-6) **Editor Mode**

- Yellow circle: Toggle button to go between 'Live' and 'Edit' modes.
- Green arrow: Load SK (skeleton) file
- Blue arrow: viewer's modes (for this exercise) are 'Left Side' and 'Back View'
- White arrow: thickness of bones
- Yellow oval: when in 'Edit' mode, feet will always be on the ground. In 'Live' mode, the puck dictates how far off the ground the feet are
- Blue circle: save the skeleton often
- White oval: import Kinexact or AutoCal (hand & body) data
- Blue oval: 'Assign Tracker' button to change the ID number on Vive puck & controllers
- Red oval: click the dropdown to see 'Skeleton Properties':
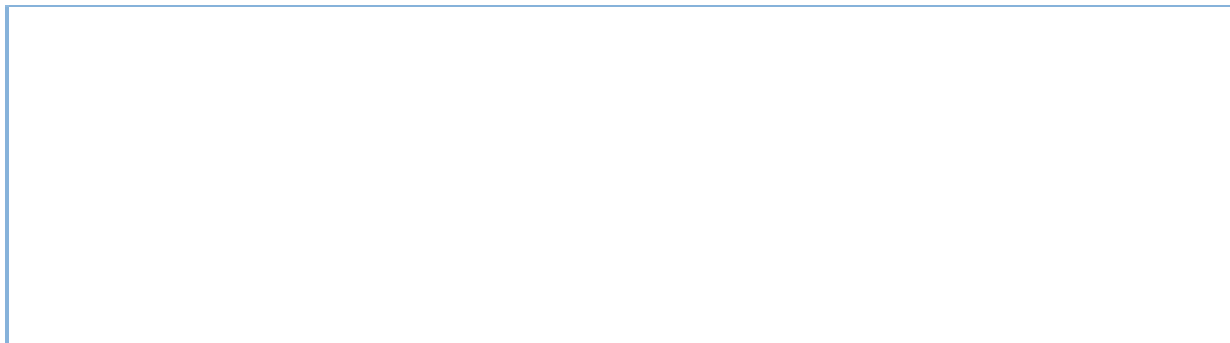
5- Change calibration parameters (settings for Pose-1/Pose-2 process)

Fig-7) Editor Mode / Skeleton Properties
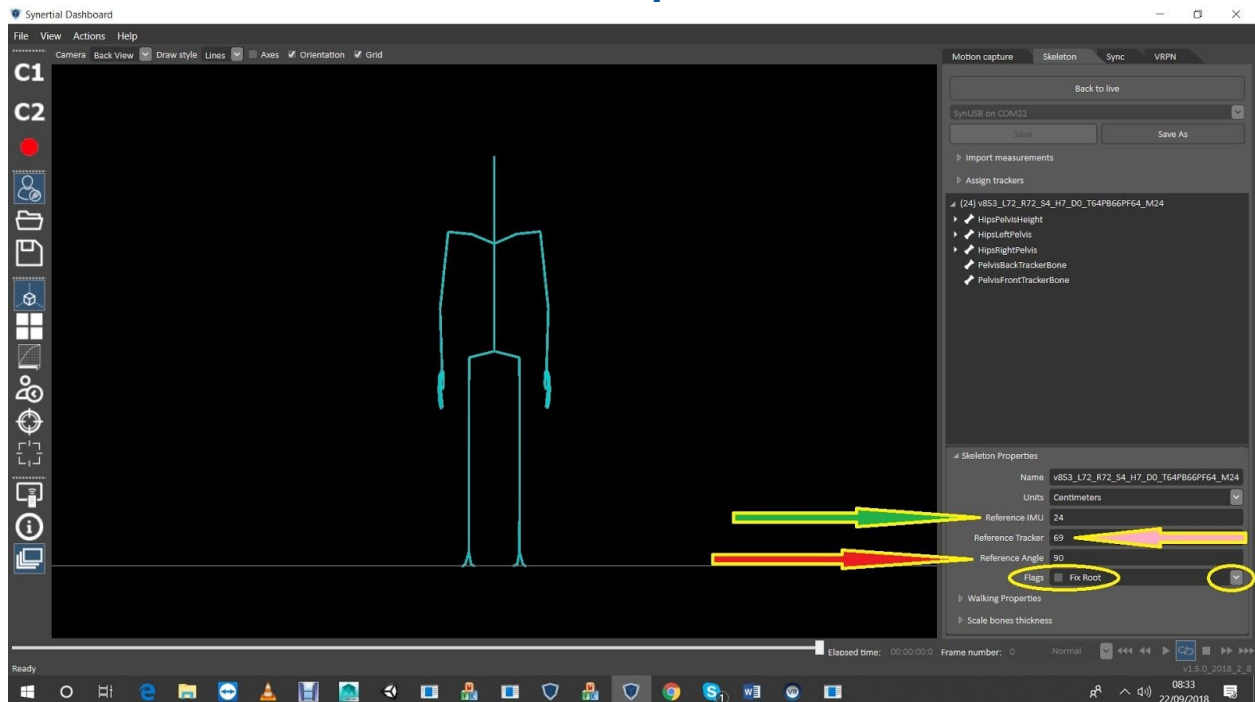
- Green arrow: 'Reference IMU' is the sensor used by Pose-1/Pose-2 process to calibrate. Find sensor numbers using Synshow if not certain of the sensor numbers.

- Pink arrow: 'Reference Tracker' is the Vive Tracker used to fuse the root of the suit/skeleton into the Vive space (through the same Pose-1/Pose-2 procedure used to calibrate the suit with the 'reference IMU', simultaneously)

- Red arrow: 'Reference Angle' is the axis and direction of Pose-1/Pose-2 angular transition:

     - 0 & 180 are in 'X' (in either direction)
     - 90 & 270 are in 'Y'

- Yellow ovals: drop-down the 'Flags' to define the relationship between the suit root (and its walking method which uses the Lowest Point Algorithm, LPA) and trackers for the global coordinates: how much of each? Or if one without the other?
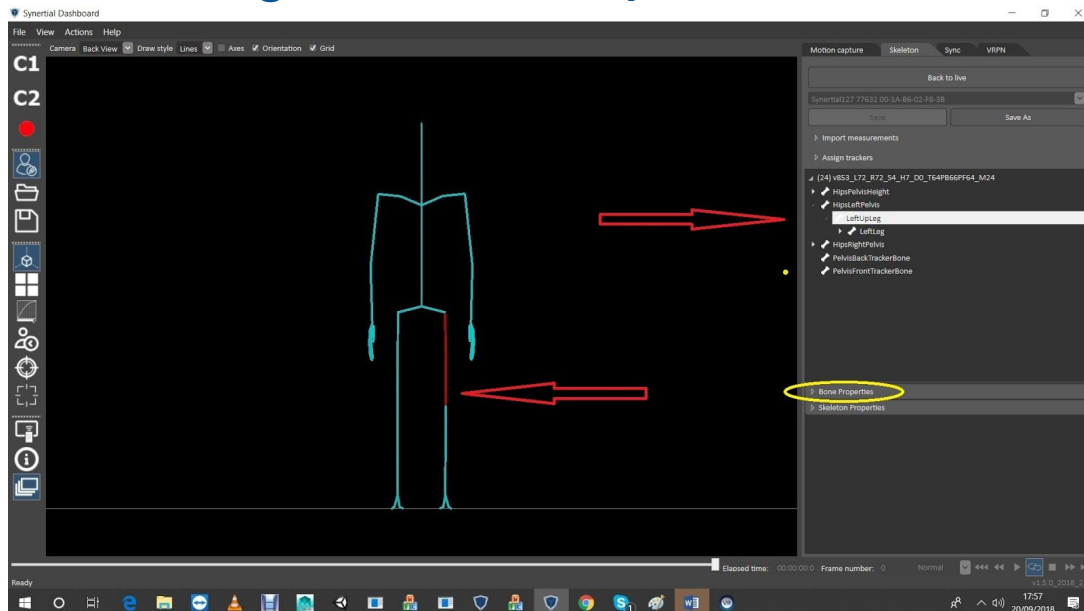
Fig-8) **Editor Mode / Skeleton Properties / Flags**
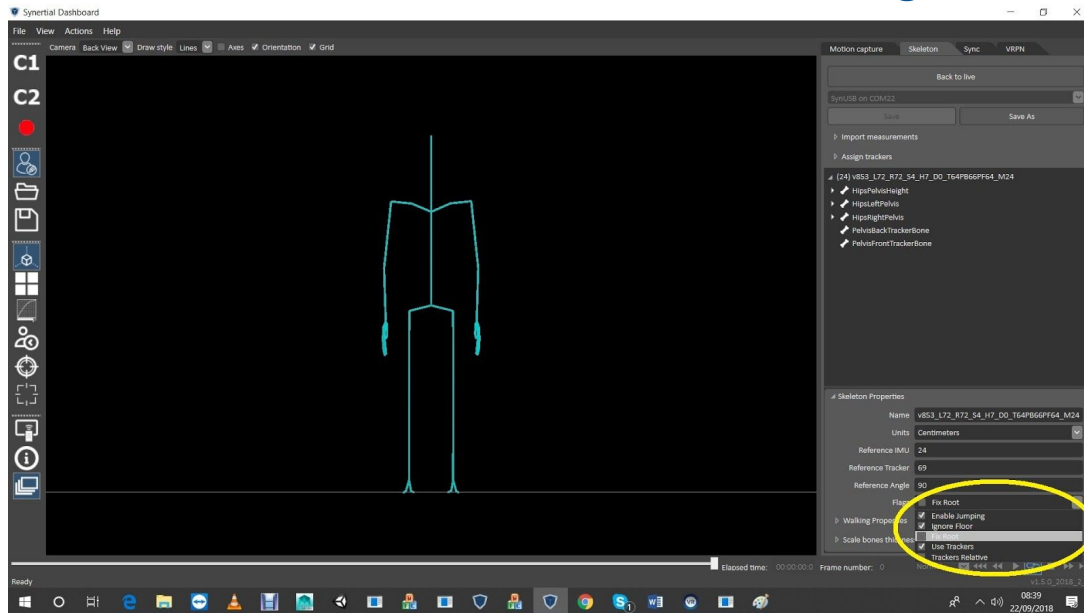
-   In this exercise, the trackers need to be 100% and no LPA throughout the process.

6- To modify the length or orientation of any bone, highlight it in the Editor Mode.

Fig-9) **Selecting a bone to modify**

– Red arrows: highlight a bone by directly double clicking on the stickfigure or use the tree on the upper right (triangles on the left of titles can further expand the tree)..
– Yellow oval: drop down to modify the particular bone (segment)

Fig-10) Editor Mode / Bone Properties
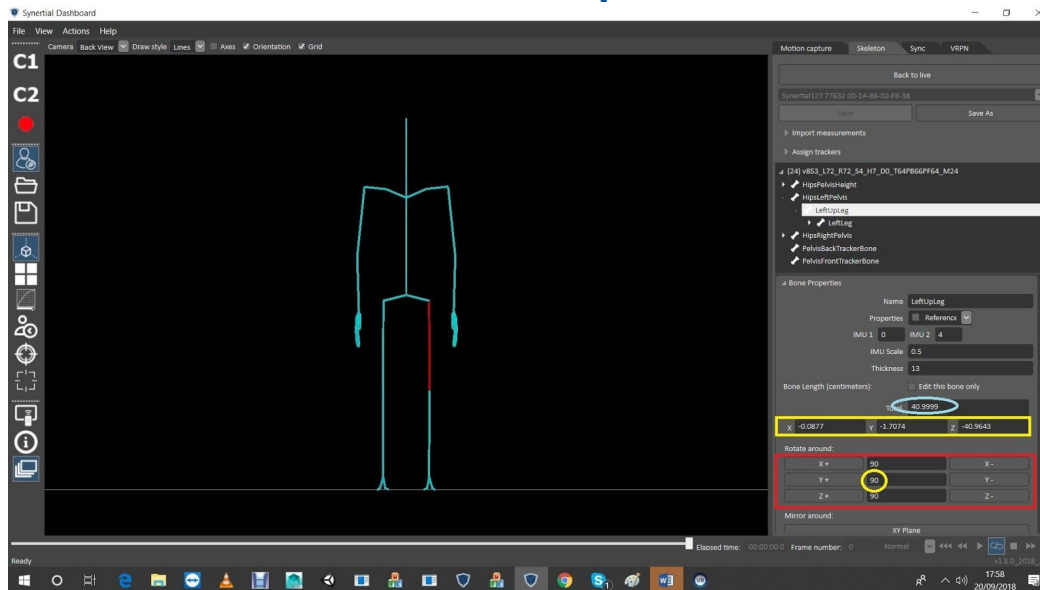
- Blue oval: the 'Total' length of that segment, from it's 'Parent Node' to its 'Child Node'
- Yellow rectangle: distance of a Child Node from its Parent Node in each global axes
- Red rectangle: where the orientation of the blue oval ('Total' above) can be modified
- Yellow circle: increment in degrees by which clicks on either side rotate the segment. Modifying the orientation of the segment using the red rectangle will change the values in the yellow rectangle automatically.

Fig-11) Editor Mode / Bone Properties / Sole-Segment
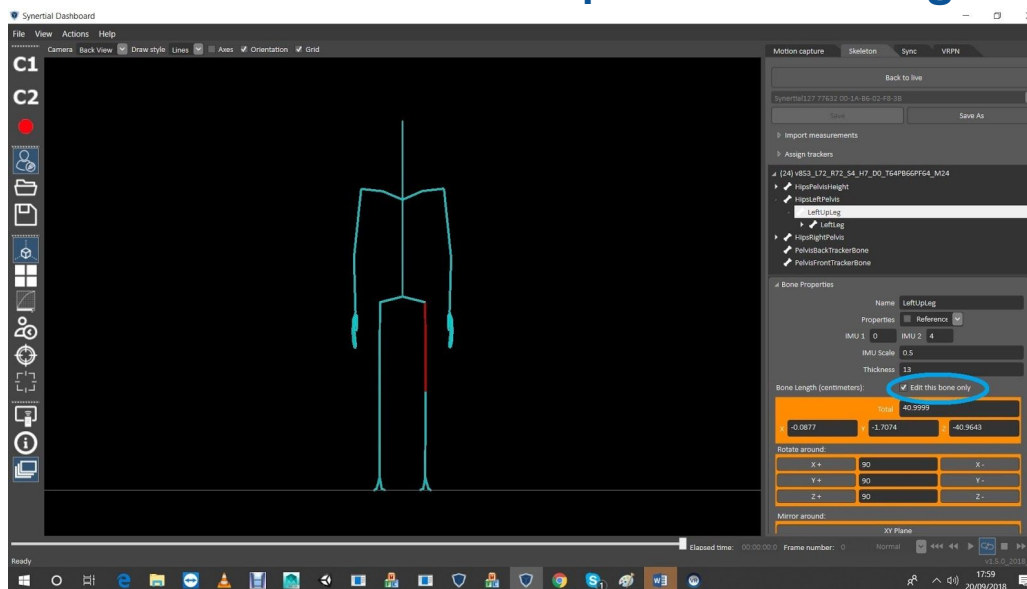
- Blue oval: when 'Edit this bone only' feature is checked, segment edits are contained and will not alter the parameters of the Child segments thereafter. Useful for example, when you want to only modify the length of the upper leg without changing the distance between the root and floor.

7- Change Draw style from Bones to Lines and back
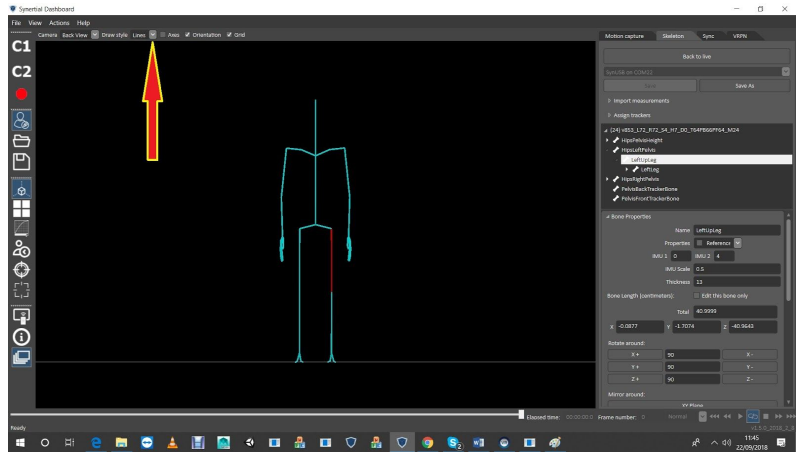
(*Fig-12)*
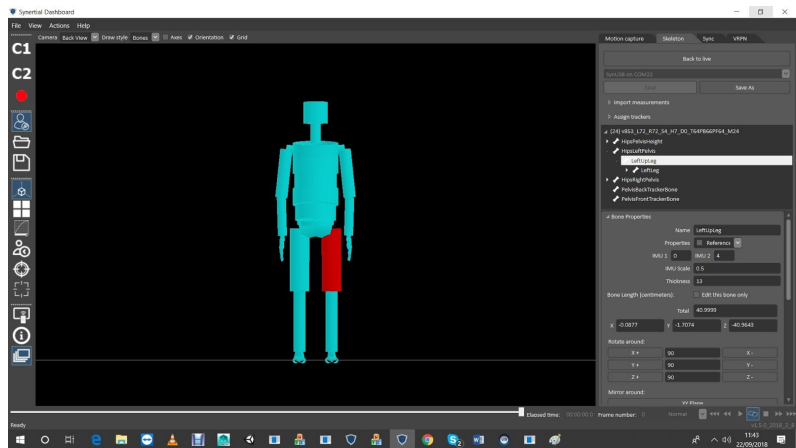
(*Fig-13)*

8- OK when sensor 'State' lights go yellow during this process
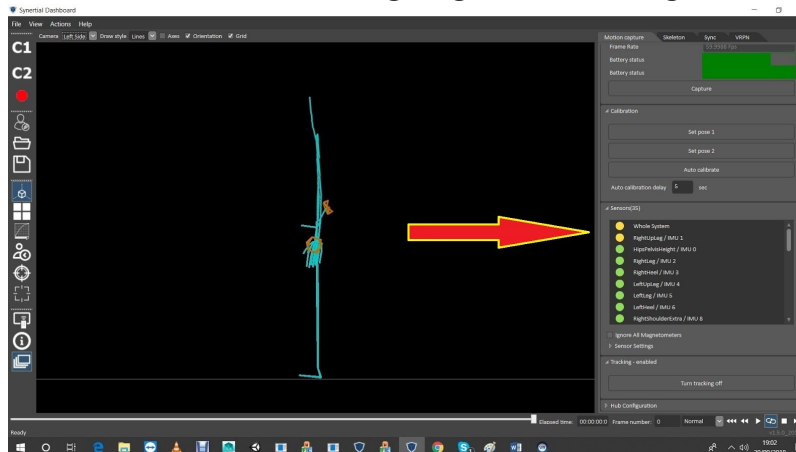
(*Fig-14)*

-The yellow circles indicate which sensors(segments) will 'stay' uncalibrated after pose-1/pose-2 refresh. This is OK during this exercise.

9- Commands for capture and replaying recordings

(*Fig-15*) Live device
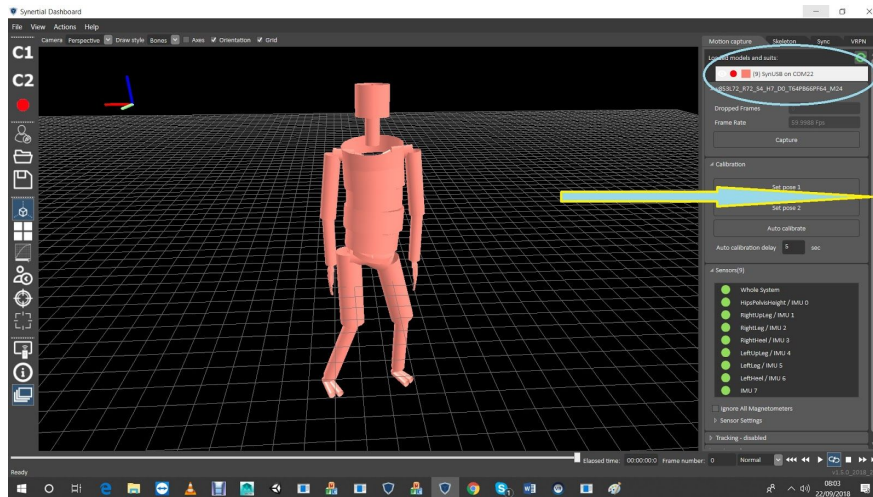
– Blue arrow shows the scroll bar for the whole right column.
– Blue oval shows there is one 'live' device present,
– You can change the color by left clicking on the sqare on the left of the name,
– You can click the red circle to start recording and the new button appearing then to stop recording
– To the left of the red recording button there is an 'eye' icon that will make things visiable and not

(*Fig-16*) Recording playback
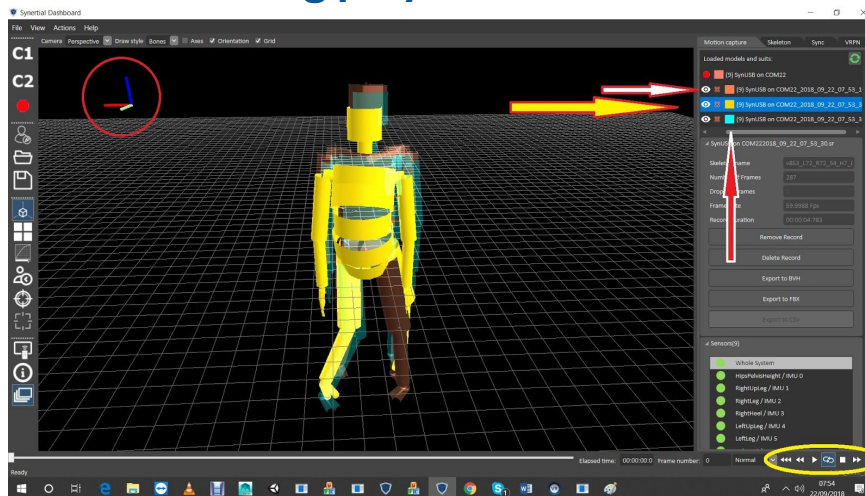
– Arrows showing 3 separate recordings (right click on the name to see where the data is automatically stored)
– Yellow oval showing the playback controls (for the highlighted recording)
– Can change color and visibility of each recorded skeleton

End of 'Fundumentals'

Follow these steps in progression to fine tune an sk file.

This exercise wants the subject to 'freeze' (no motions) in pose-2 after calibration, so that the joint centers of its 'Live' stickfigure, as pinpointed by the Vive controller, can be compared with the joint centers created by the SK file, and parameters altered if necessary.

STEP 1 **Puck** *height* **to** *a flat* ***upper leg:*** *(*Puck needs to be on the coccyx, centered, and not loose) Run controller along the flat upper leg.

(Fig-17)

- Establish a ***line*** between the femur and the knee joint and see how it looks on SynDash:

- If SynDash shows it like this, above the upper leg segment, *(Fig-18)*
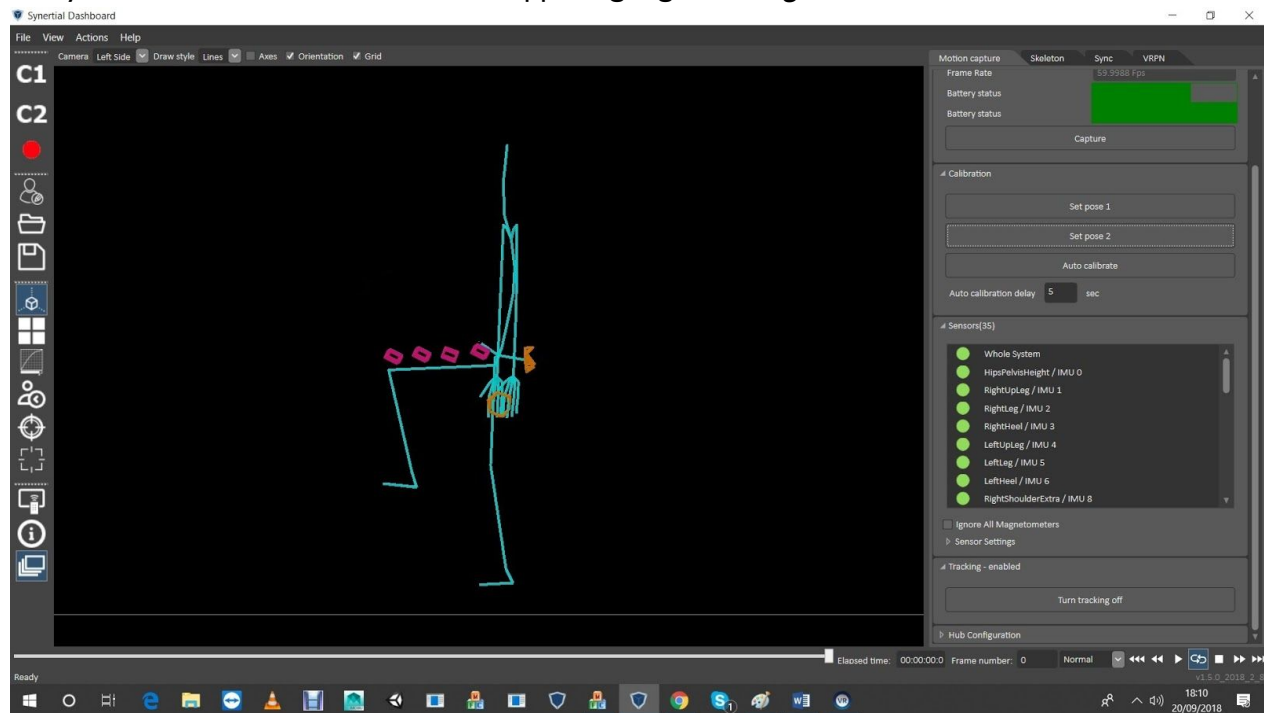
- Then go to the Editor and highlight the **'PelvisBackTrackerBone'** *(Fig-19)*
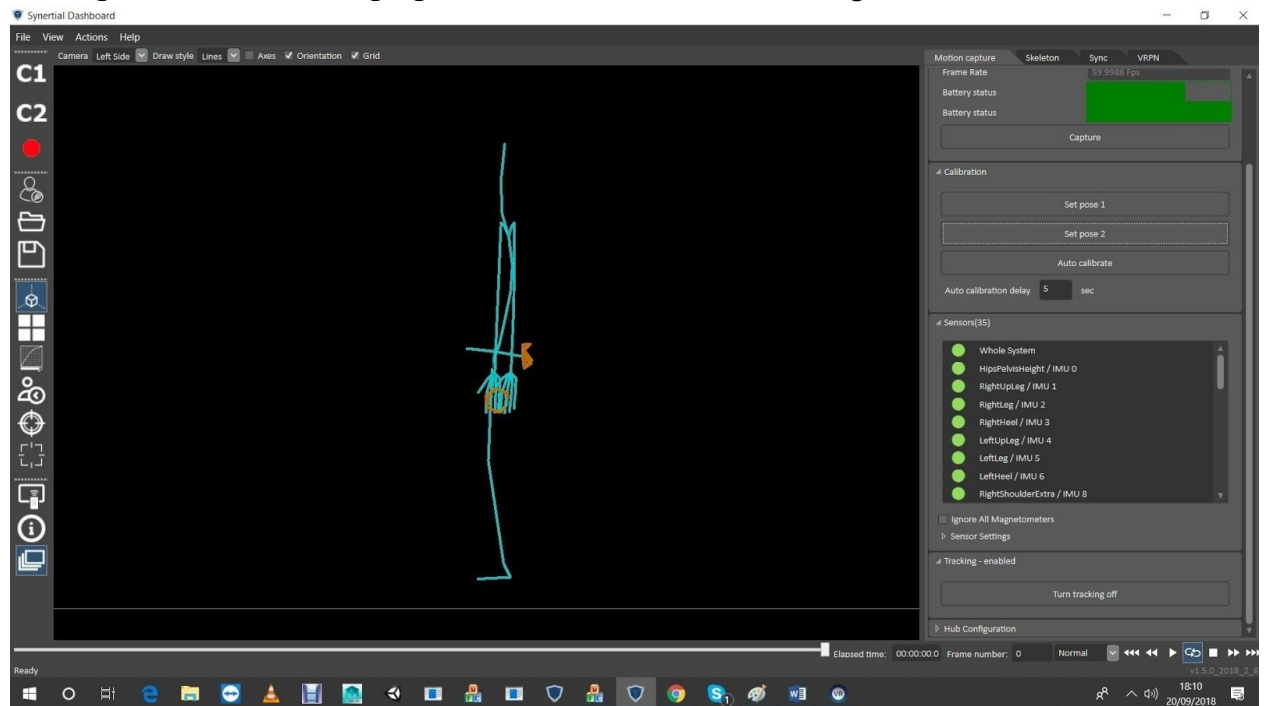
- Go to 'Bone Properties' and change the blue oval below (add to Z position) so the puck gets raised and pushes down the pelvis (since the Puck is an absolute position)
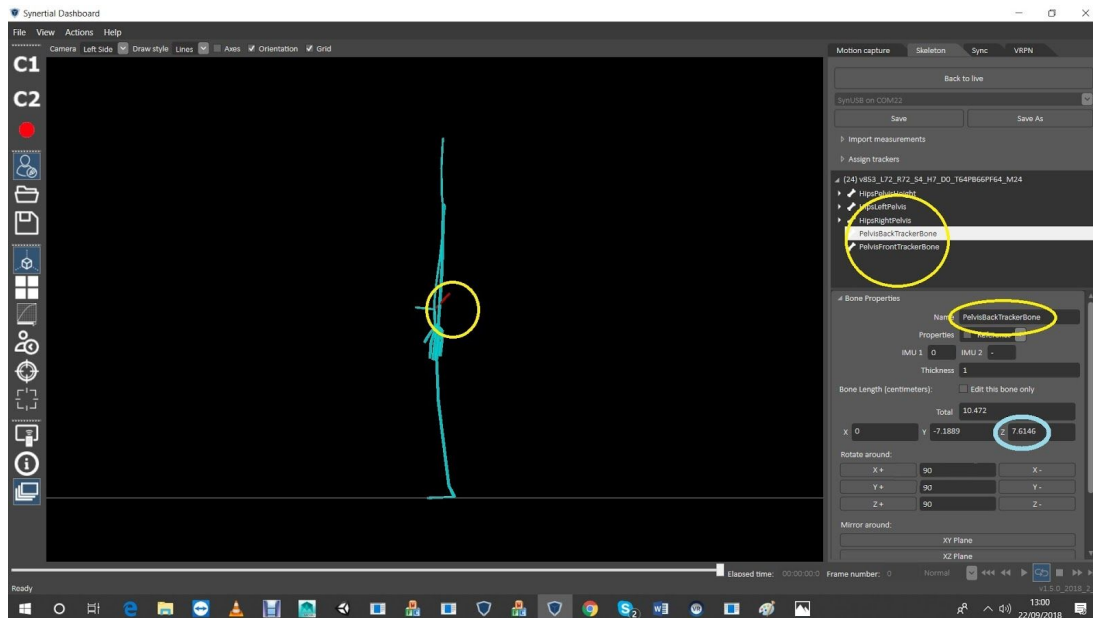
(*Fig-20*)

- Go to 'Live' mode and notice that the Puck's gone up, pushing the pelvis, knees and the feet down.
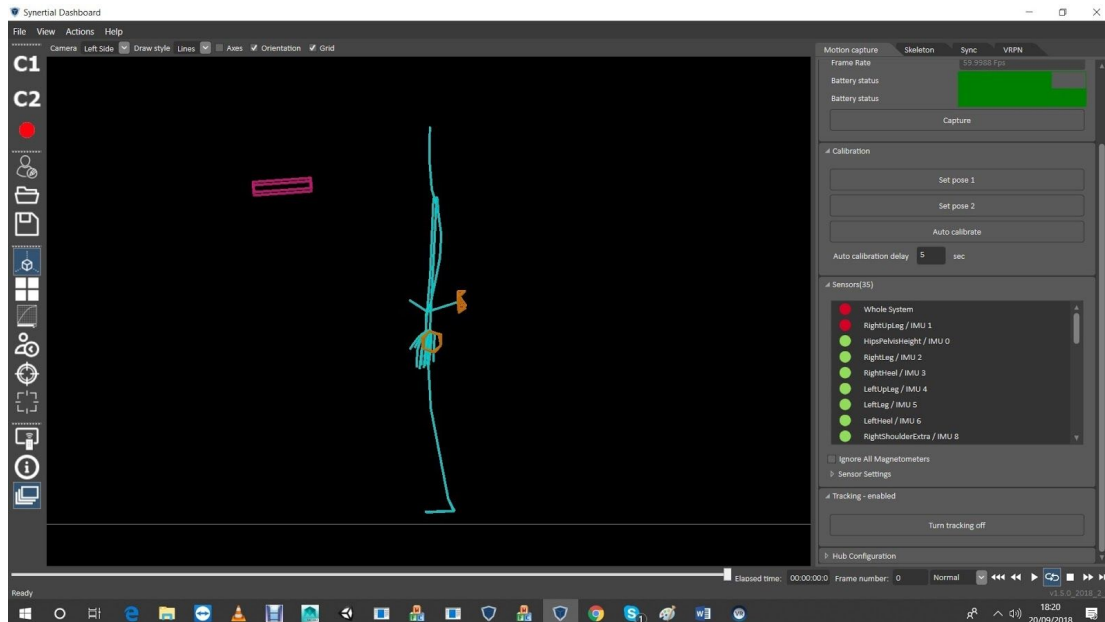
(*Fig-21*)
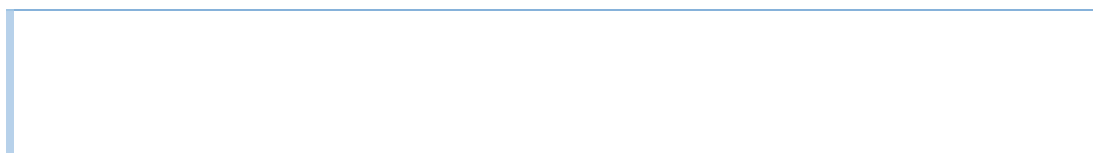
And running controller along thigh this time should look much better... **(Fig-22)**
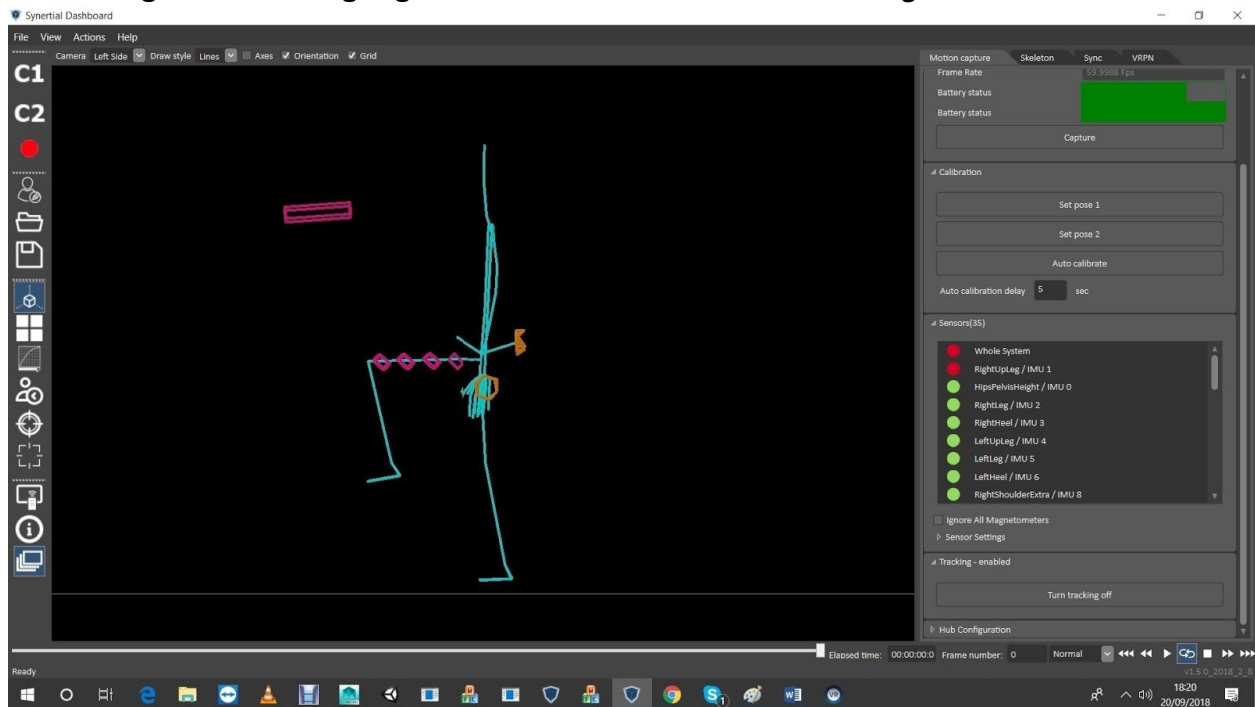
And inversely, if the pink controller boxes run too low when pictured along the levelled upper leg, looking like this instead. **(Fig-23)**
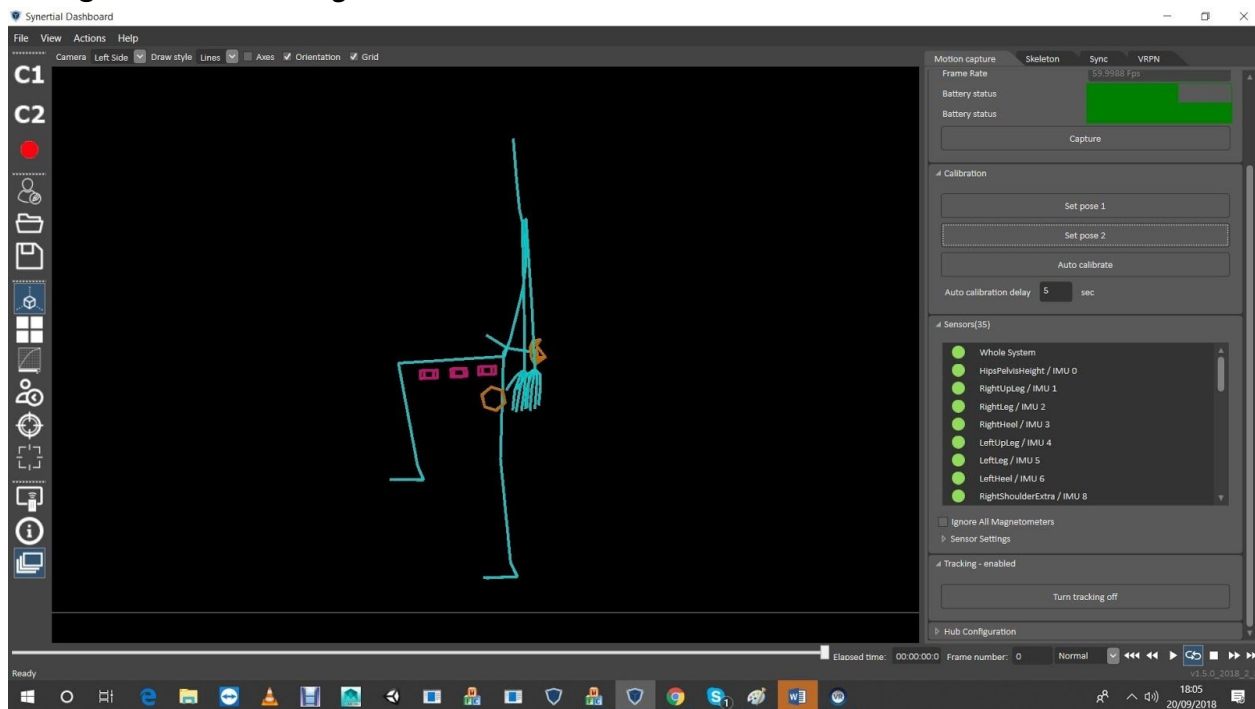
– Go to Editor, select 'PelvisBackTrackerBone' segment and 'reduce' the Z value.

STEP 2 Find Floor: add or deduct from the 'UpperLegs' to level the toe-base to 2 cm off to the ground for bare feet (add more for shoes). (*Fig-24*)
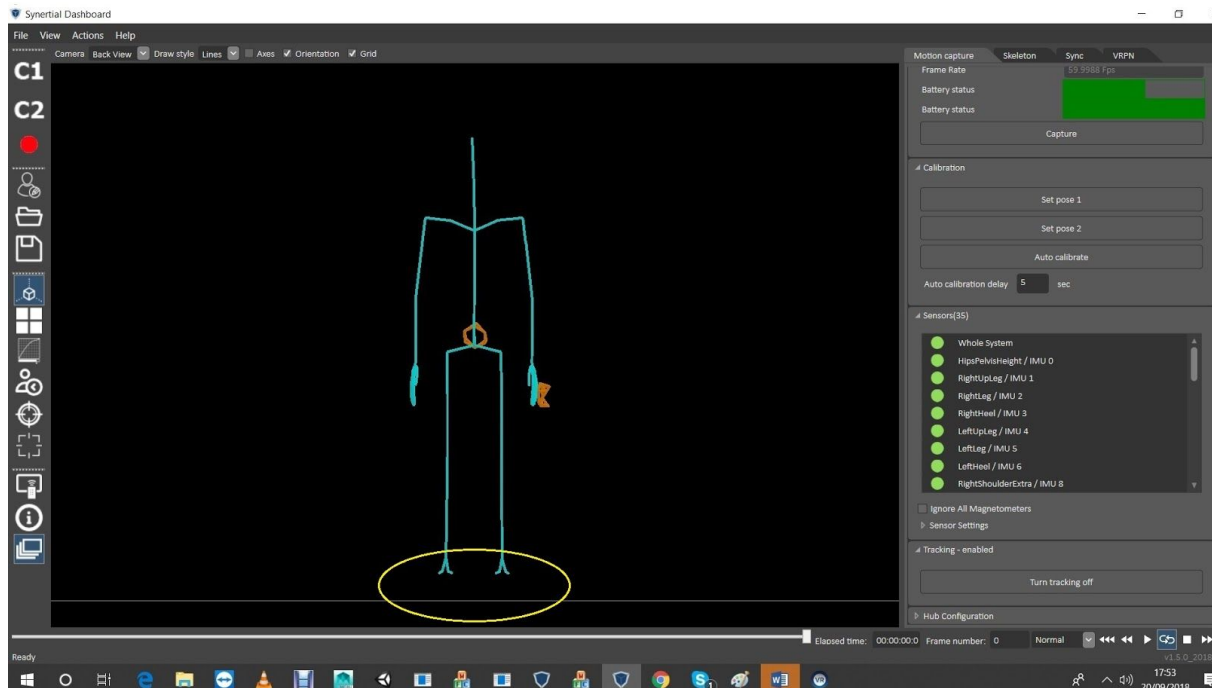
- Go to Editor, add or reduce from both upper leg 'Total' lengths: (*Fig-25*)
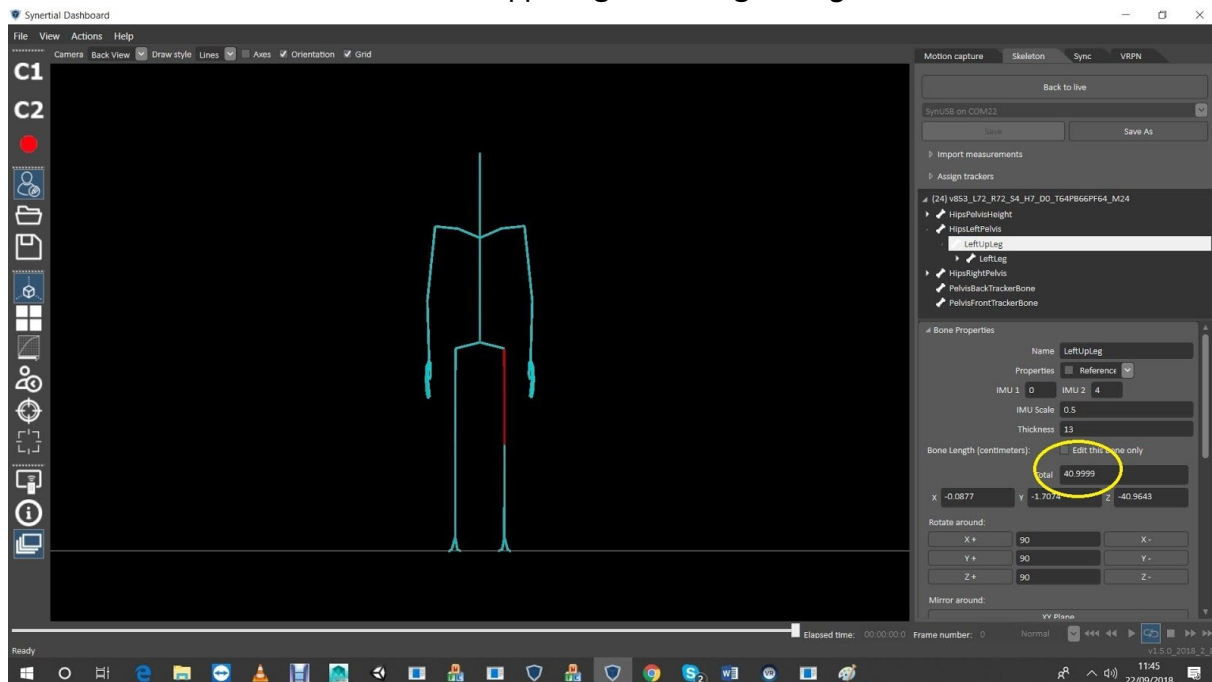
- And check results in 'Live' mode **(Fig-26):**
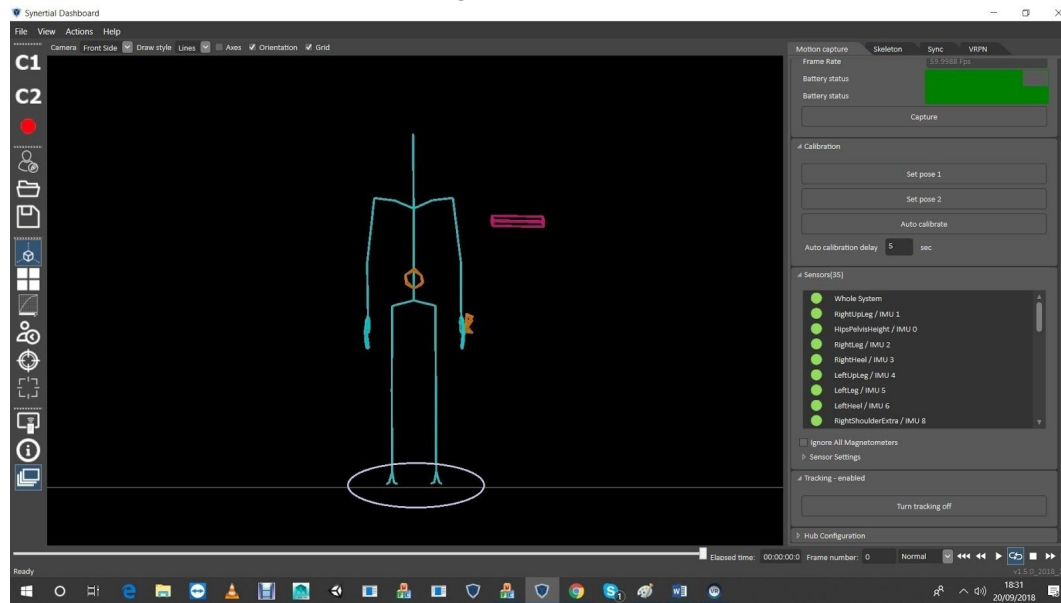
NOTE: if the floor line dissects feet then reduce Upper Leg Value 'Totals'

STEP 3 Check Knees: bend the Knees 10-20 degrees and place controller on
the side of one knee to find real Upper Leg lengths:

(Fig-27)

- Use the 'Edit this bone only' to set knees so the puck to floor relationship is not disturbed. **(*Fig-28*)**
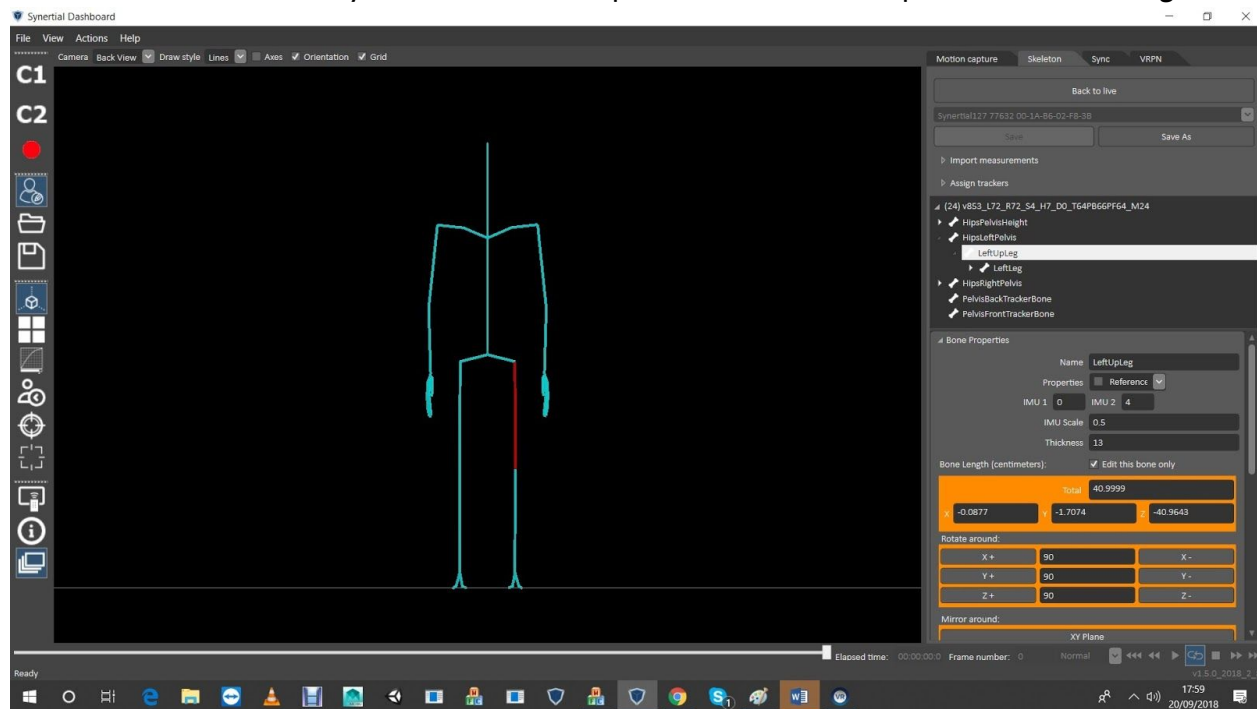
- Then if tracker indicated as shown, in Editor add to Upper Leg 'Total' x 2 **(*Fig-29*)**
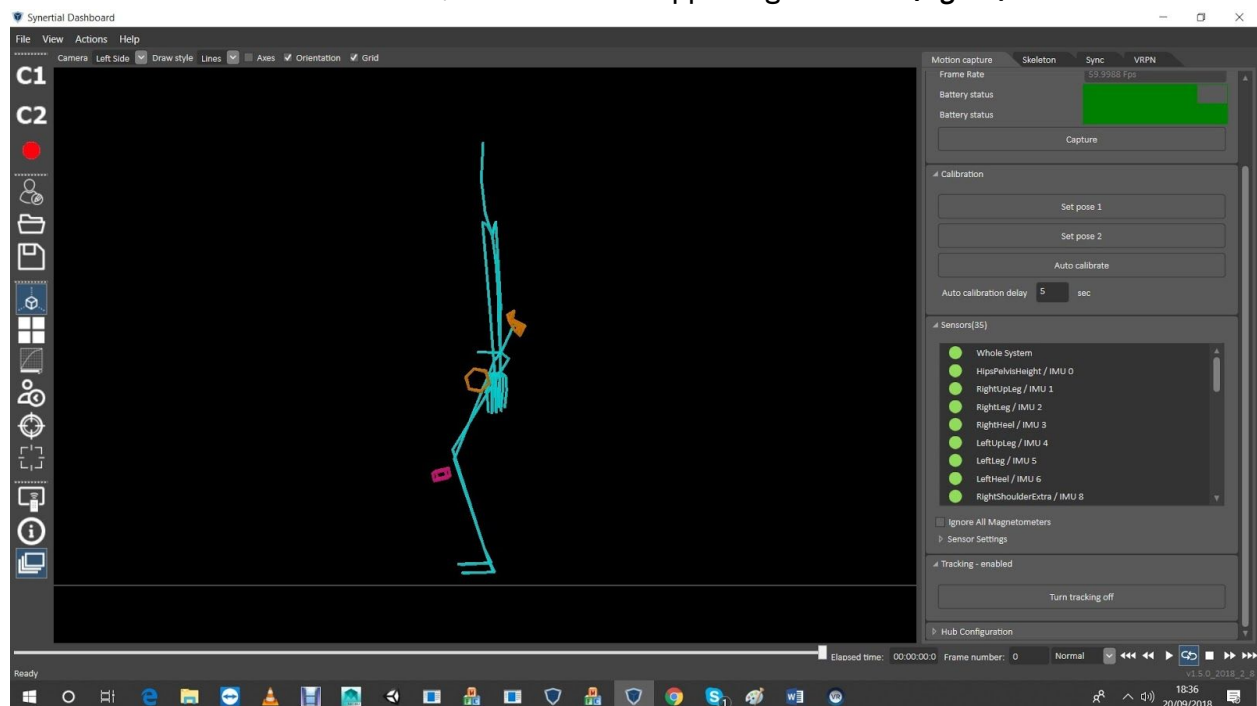
- Here rotate Upper Leg in 'X' (probably add a little 'Total' length as well). (*Fig-30*)
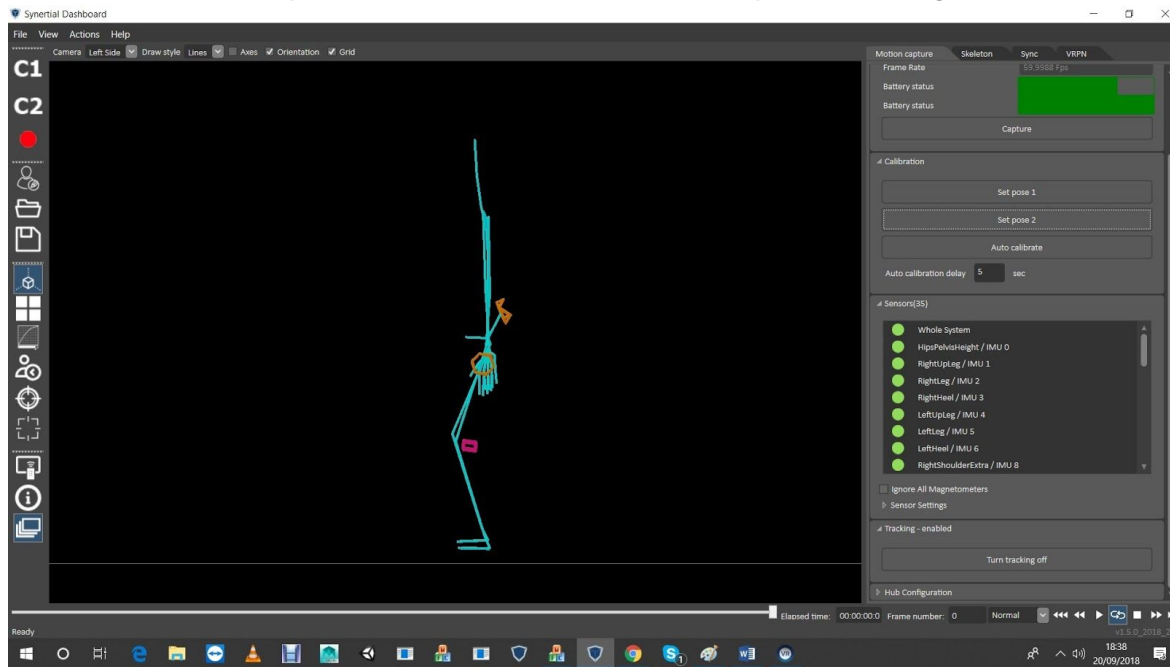
- Need to make the knee-check look like this (*Fig-31*):
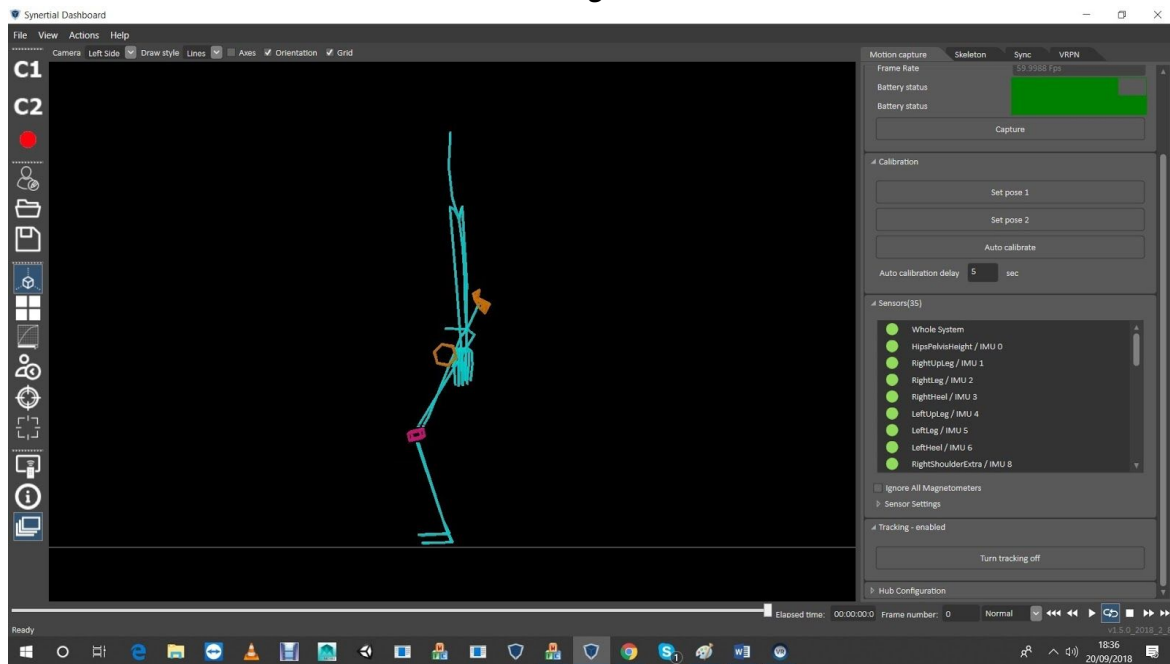
STEP 4 Find Ankles by putting controller on the side of the Ankle.

(Fig-32)

- In this case the Vive showed like so **(Fig-33)**:
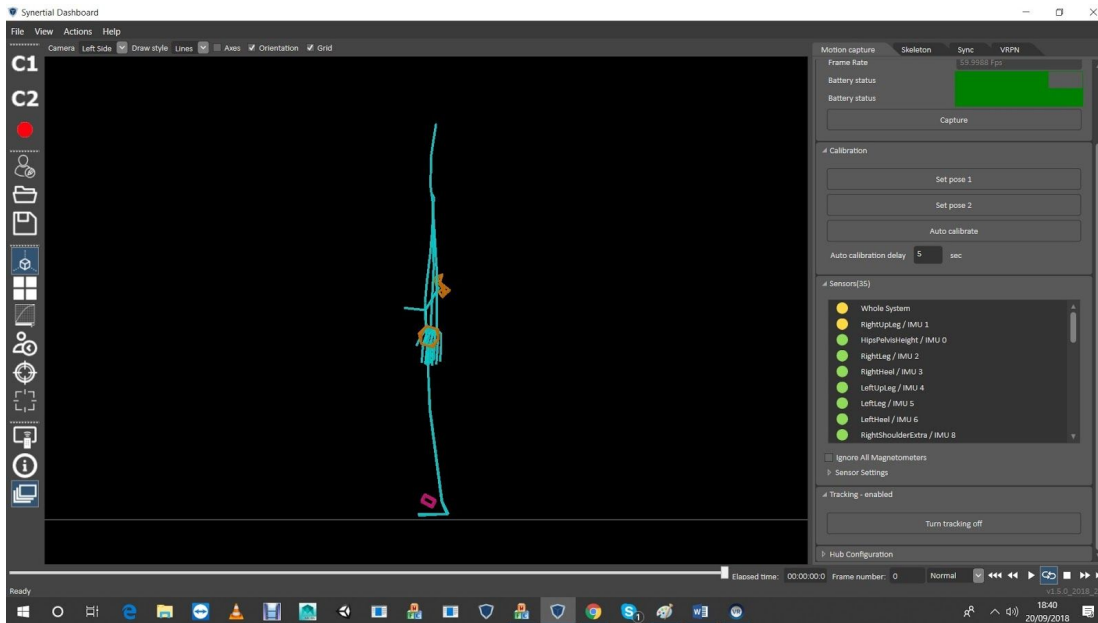
- In Editor, change the orientation of the Lower Legs in X. (*Fig-34*)
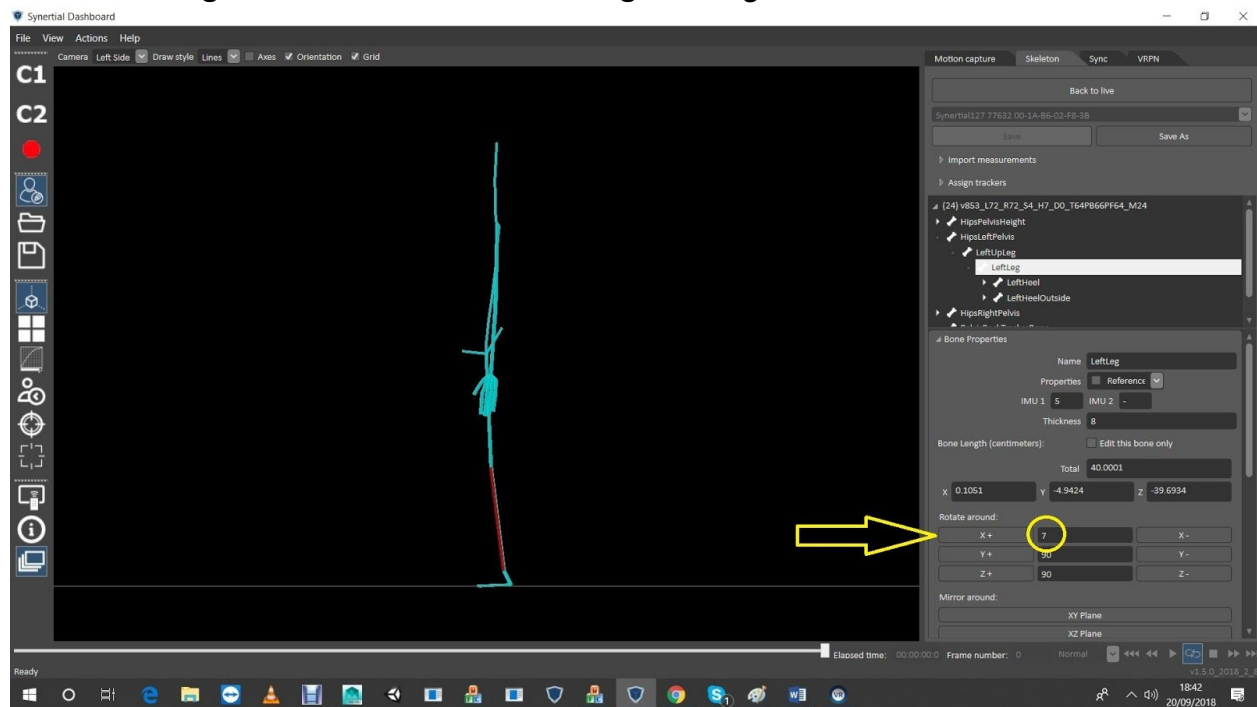
- Use the 'Edit this bone only' feature if you want to add or decrease Lower Leg lengths. (*Fig-35*)
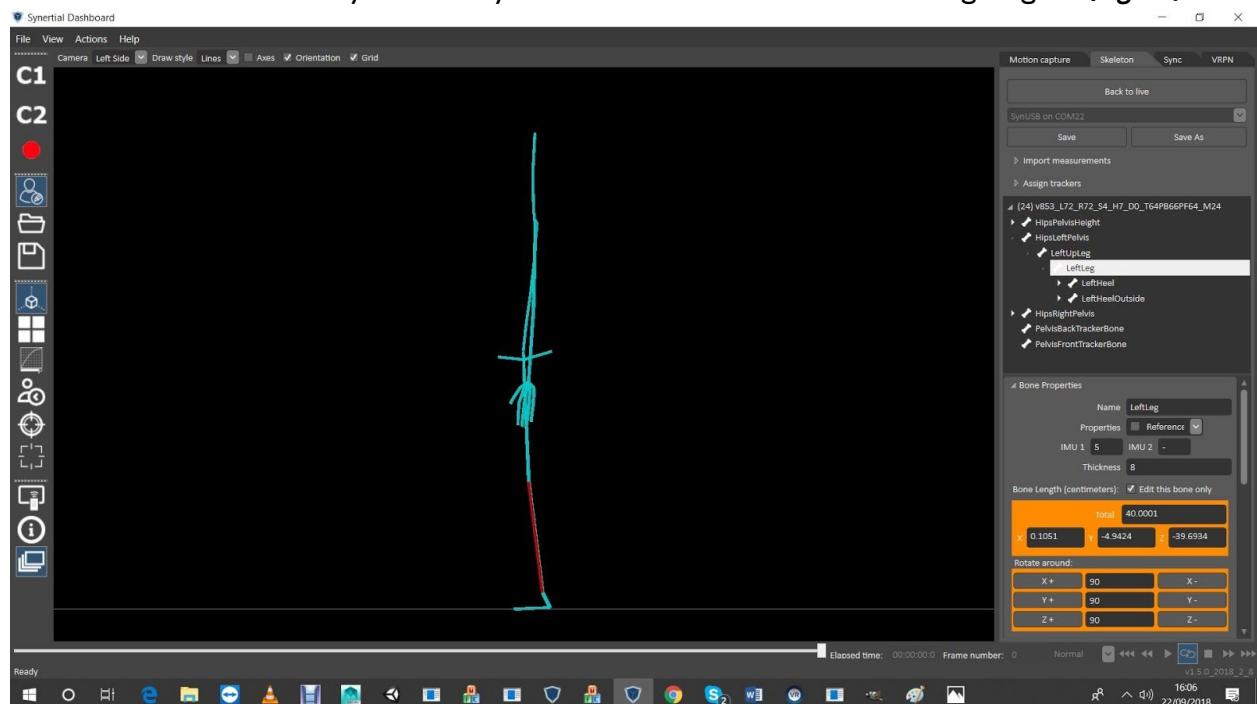
- until they match the Vive tracker indications. (*Fig-36*)
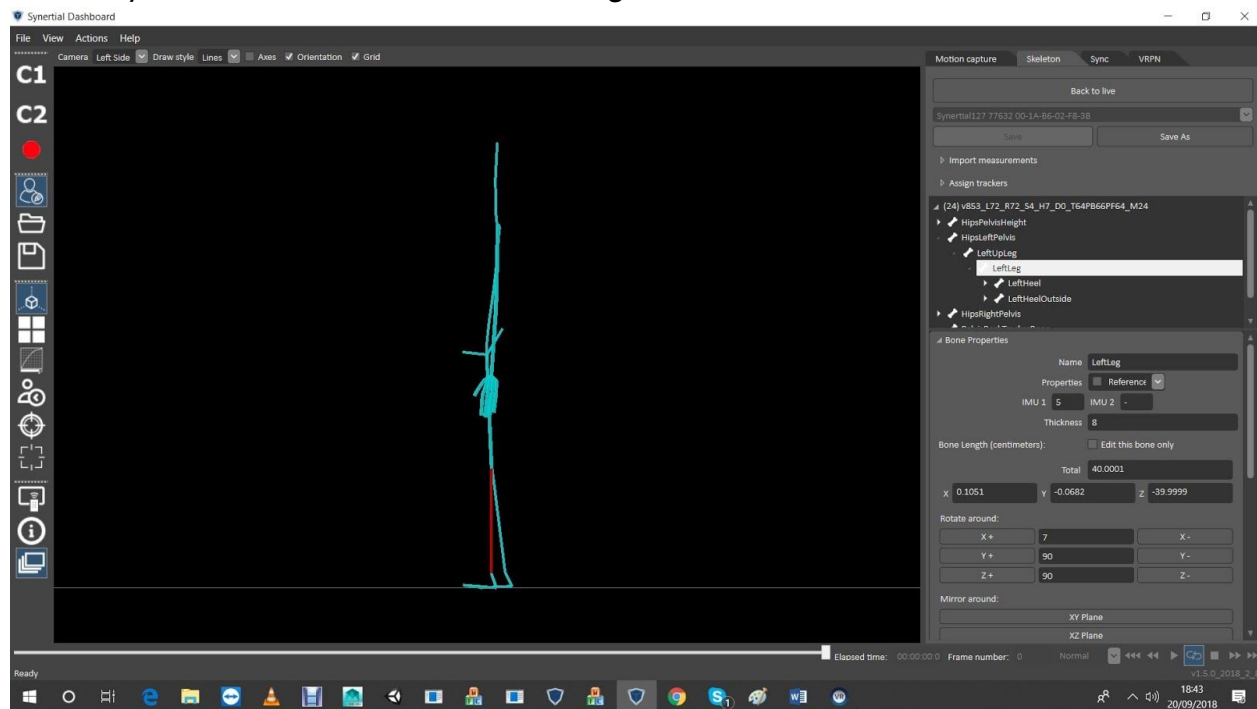
- Good! Move on... (*Fig-37*)
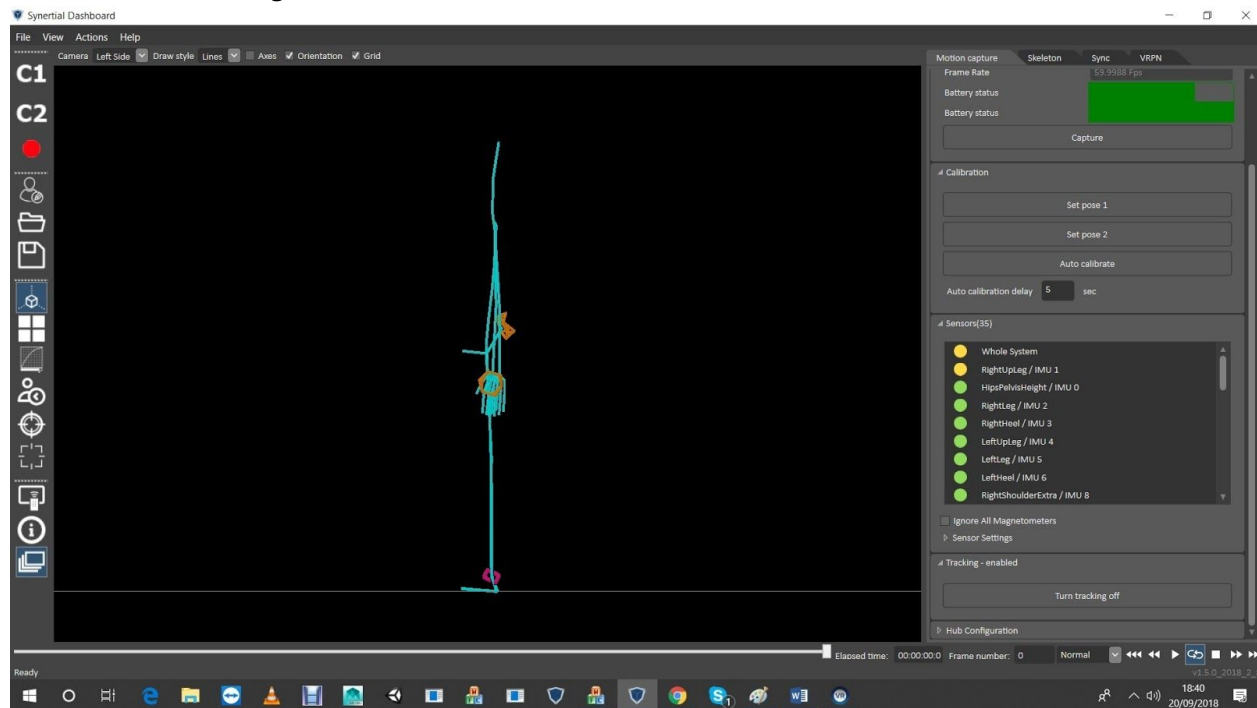
STEP 5 Find Upper Legs Width Run controller along the front of thighs

to see:

(*Fig-38*)

- Want it looking like this, so...
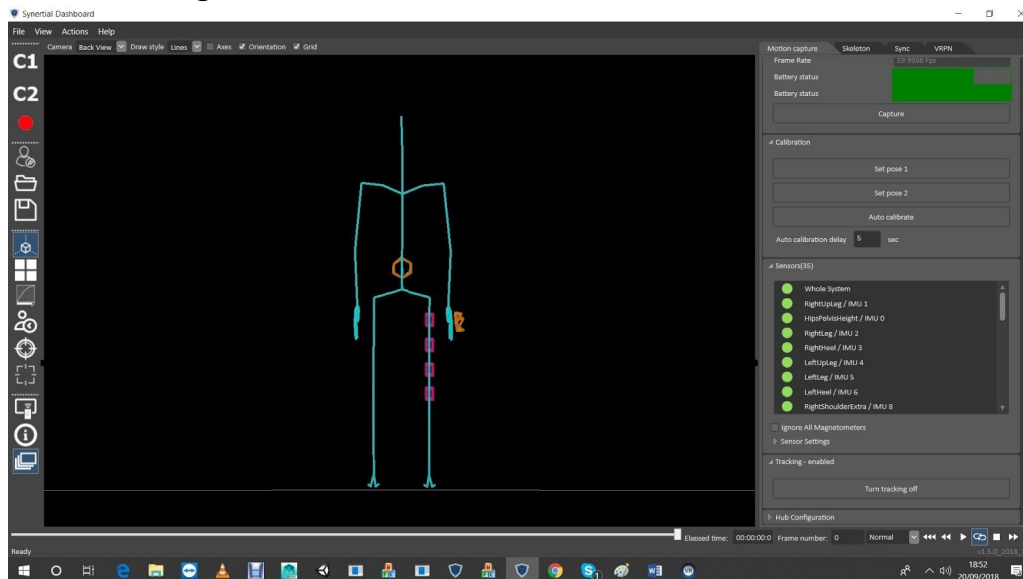
(*Fig-39*)

- By regulating the 'Right' and 'Left' pelvis in the Editor **(*Fig-40):*
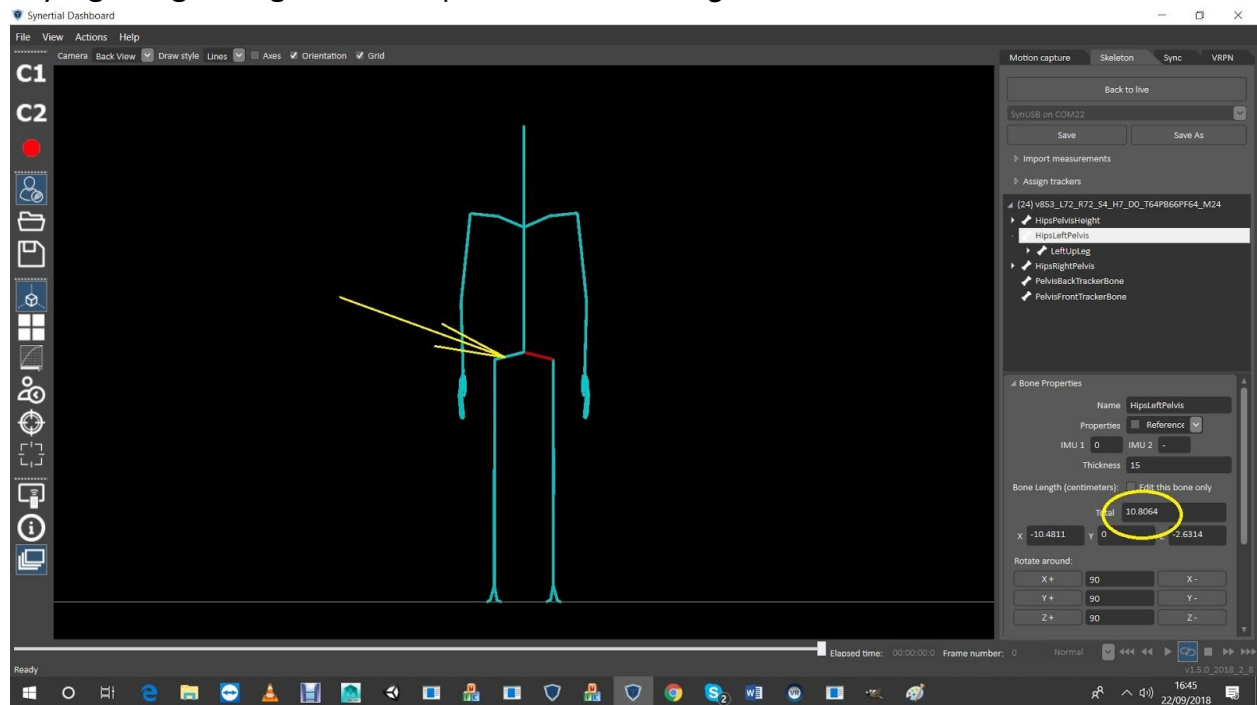
- Here reducing the 'Total' **(*Fig-41)*:
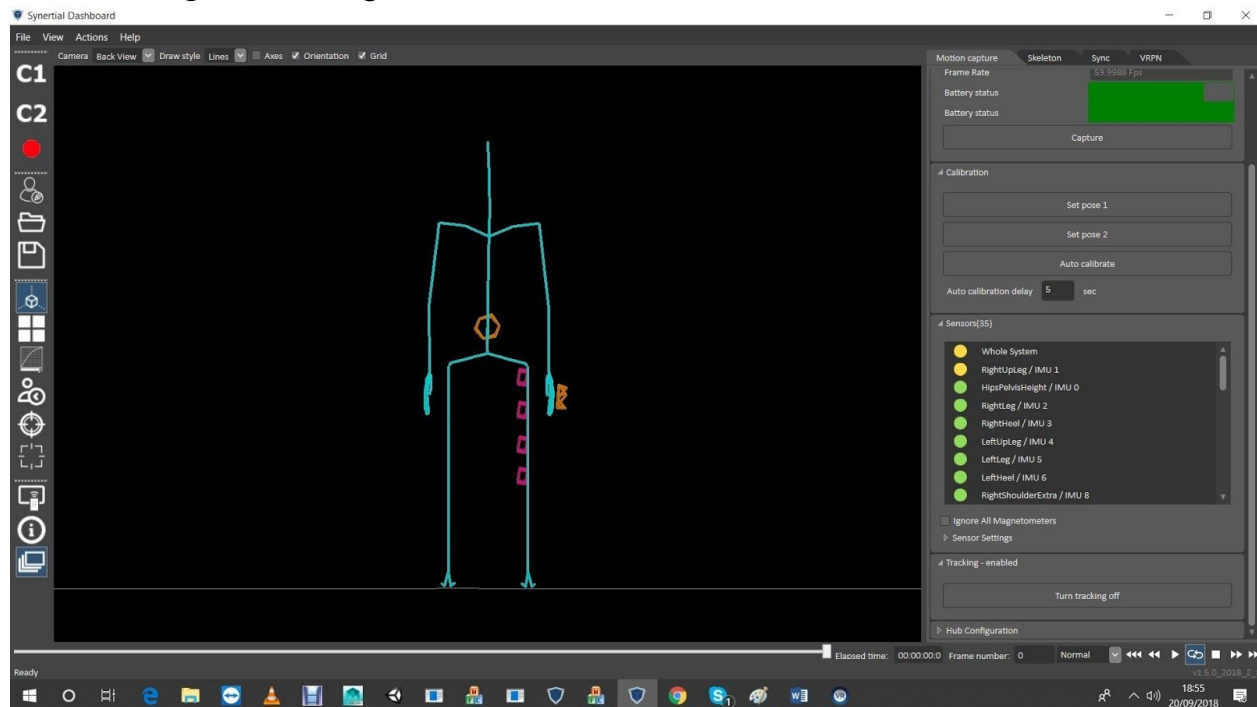
- Increasing: in this example **(*Fig-42)*:**
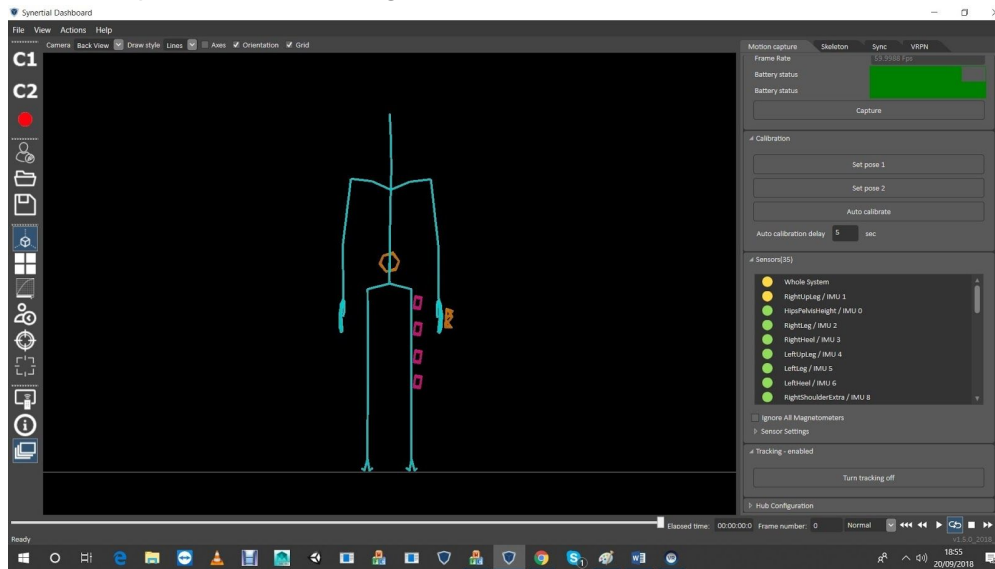
STEP 6 Find Bows in Lower Leg Controller from front, along the shins

like you just completed on the thighs:

**(*Fig-43)*

- Looking to alter values of the Lower Legs orientations in (Y), add if it looks like figure-44 and reduce if the check looks like figure-45
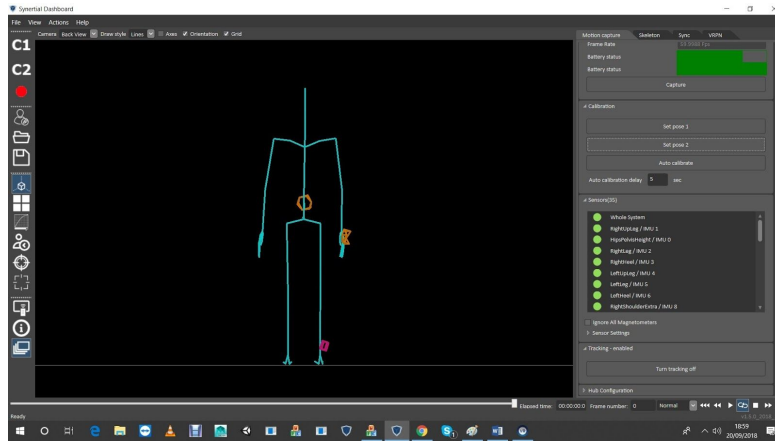
(*Fig-44*)
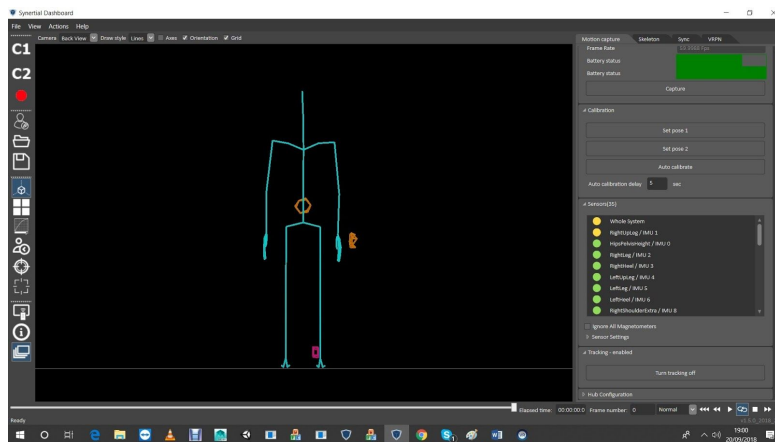
(*Fig-45*)

- But we got this so we Move on!
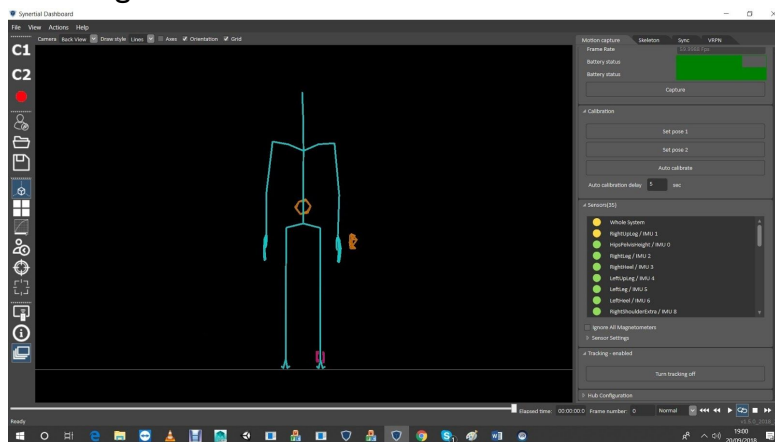
(*Fig-46*)

STEP 7 Find Torso Lean Stick controller on the side of the neck to find the line
between the top of the Upper Legs and the base of neck.

(*Fig-47*)

(*Fig-48*)

- Here after Pose-1/Pose-2, I would ask Rosie to lift her left lower arm so it wouldn't get in the way of the controller, and she rotated the lower arm only, trying to freeze all other bones.

- We got this so we need to go to Editor and rotate in (X) the Torso, but which part?
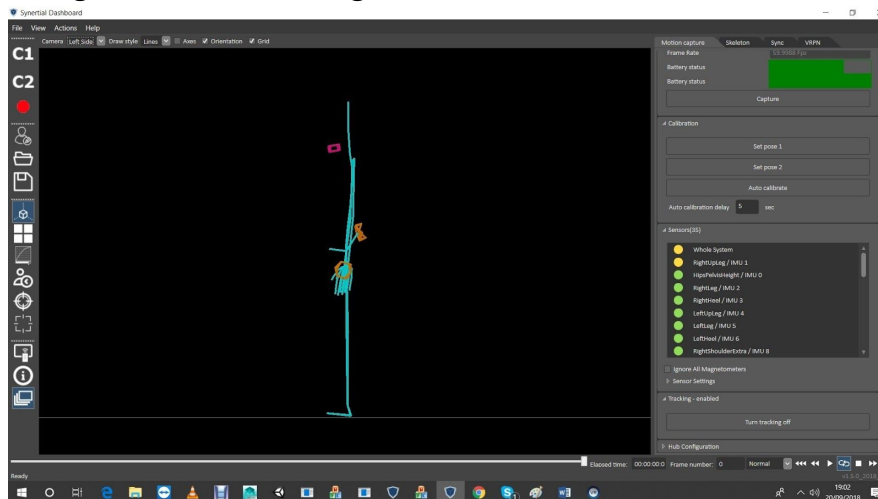
(*Fig-49*)

- Asked Rosie to rotate her arm to double check we are right on the femur before checking the side of the neck again:
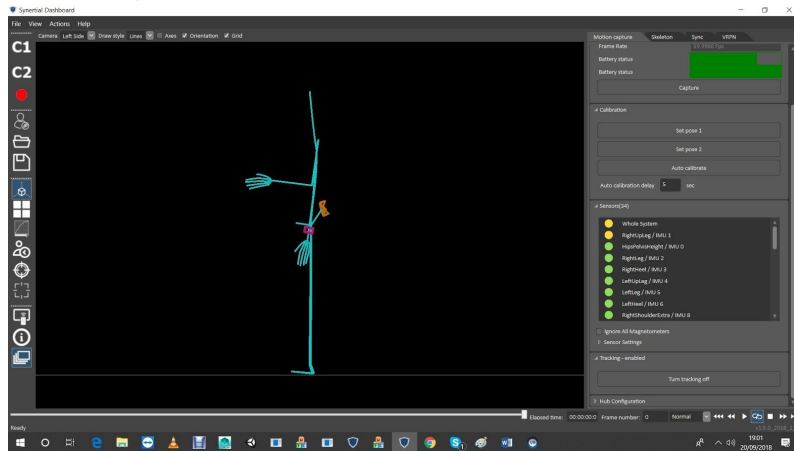
(*Fig-50*)

- After rechecking, decided to move the Torso a few degrees in X, forward. Highlighted 'Spine' segment (representing the lumbar section of the spine), changed its increment to (1) degree and going for (X-)
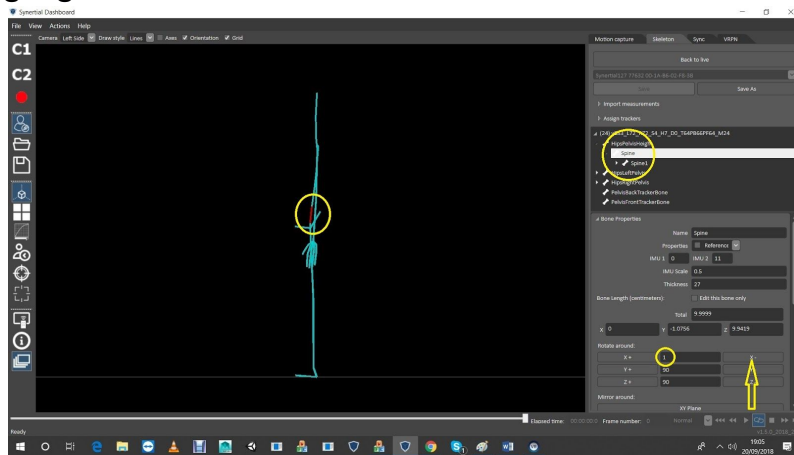
(*Fig-51*)

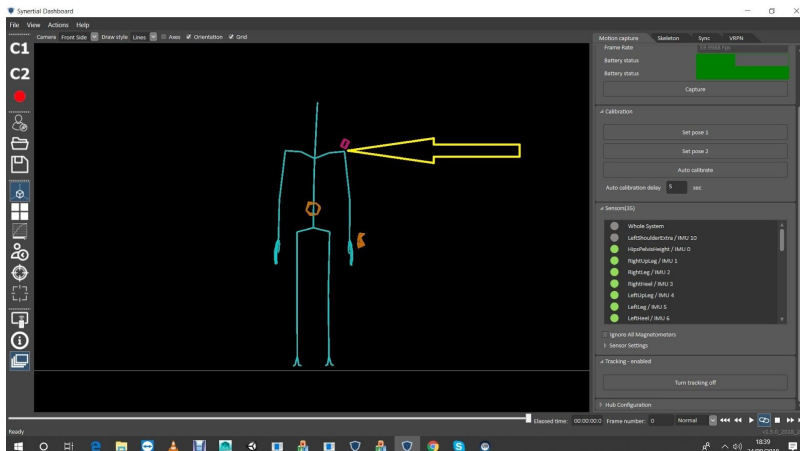- After a few clicks on (X-), we like the new posture:
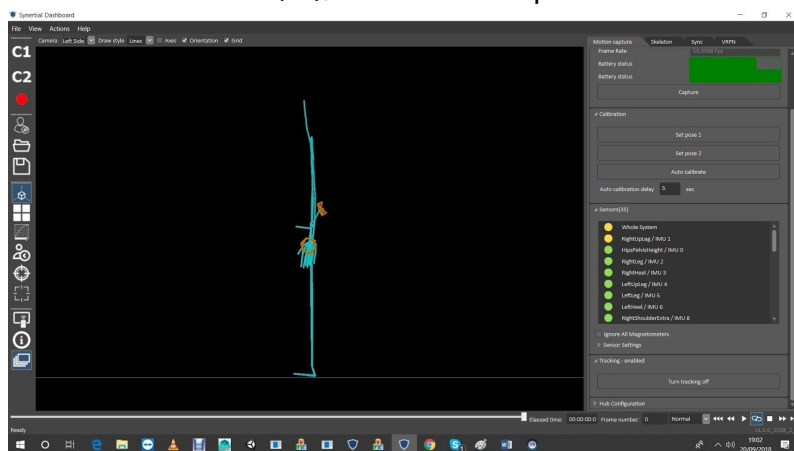
(*Fig-52)*

STEP 8 Fit Shoulders

A: (Back View) Find Shoulder Height & Width Controller on the center of the ball-socket joint

(*Fig-53*)

Need to raise the shoulder line about 4

(*Fig-54*)

To raise the shooulder to the pink box, add length to one or more of the following spine bones.
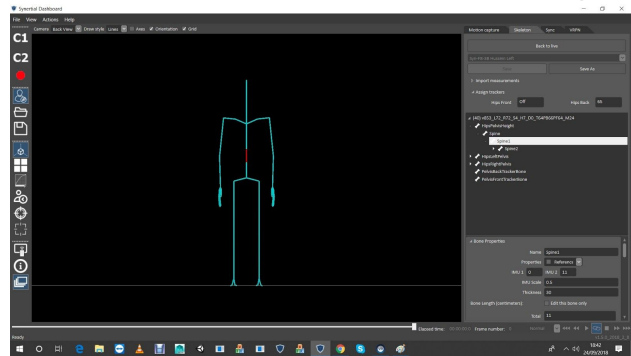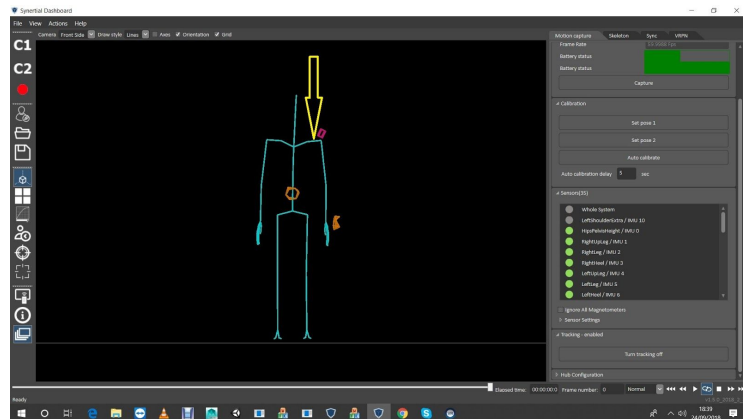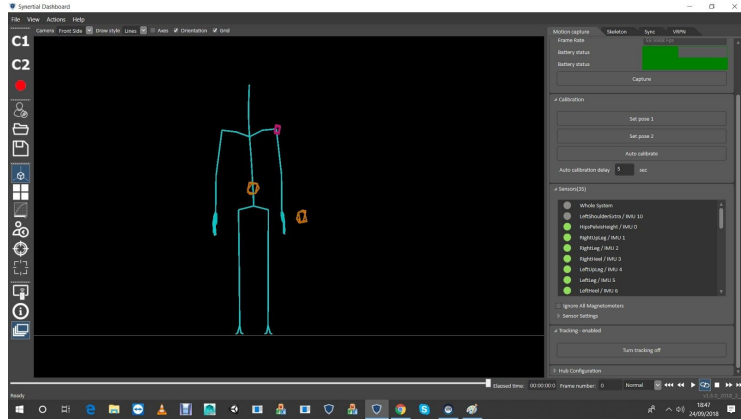

(*Fig-55*)
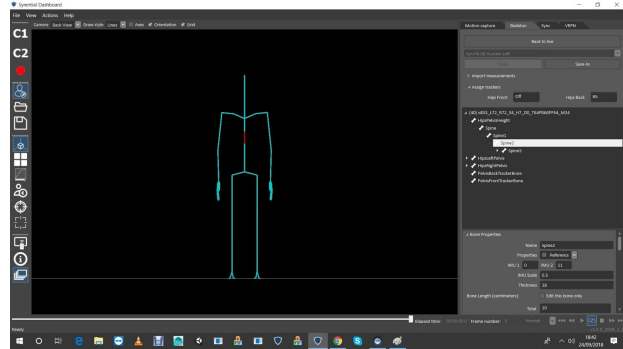
(*Fig-56*)
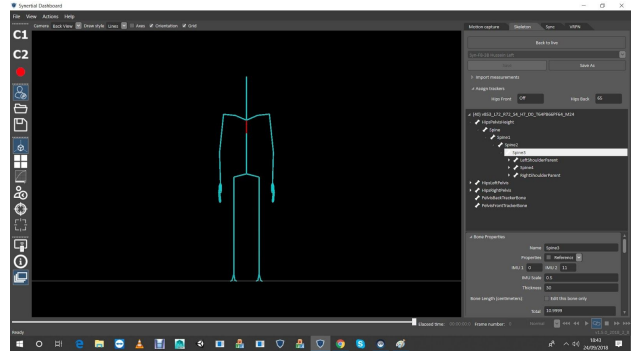
(*Fig-57*)

And to move the joint toward the pink horizontally, add or reduce to 'Total' Lengths of either shoulder or Shoulder Extra on both sides

(*Fig-58*)

Should look something like this:

(Fig-59)

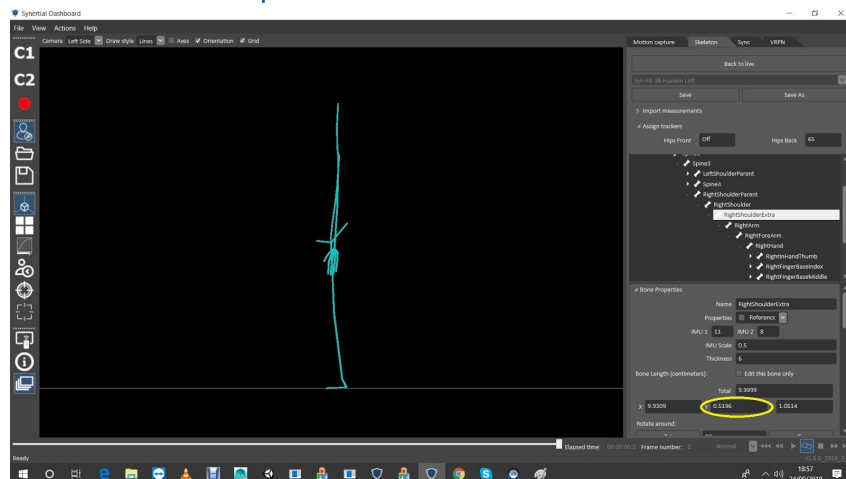## B: (Left Side) Find Shoulder Depth Aim at the center of the ball-socket joint

(Fig-60)

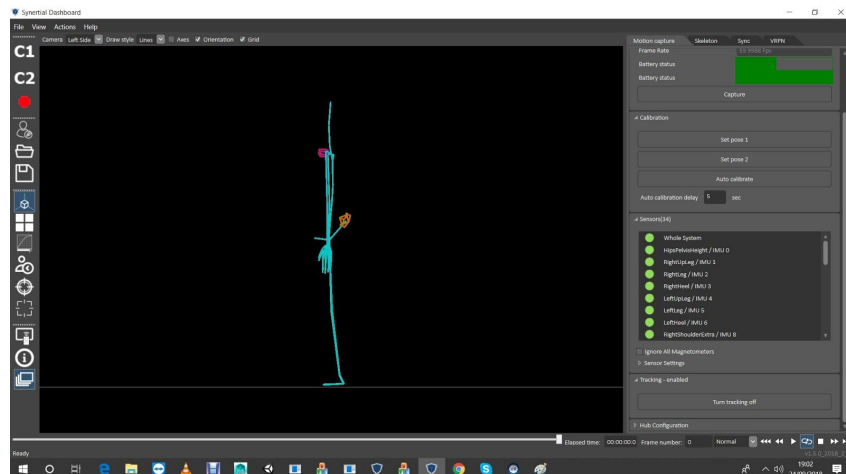Need to bring the shoulder tip to the center of the pink box
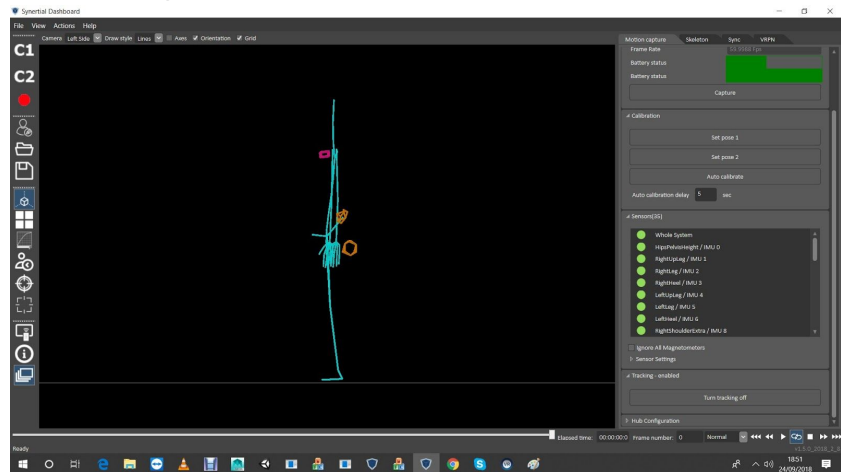
(*Fig-61*)

Add/reduce the translation in (Y) of the 'ShoulderExtra' node to move the shoulder joint to the front (or back) toward the pick box.

(*Fig-62*)

We want it to look like this:

(*Fig-63*)

STEP 9 Fit Elbows

A: (Left Side) Find Elbow Side Controller on the side of the elbow

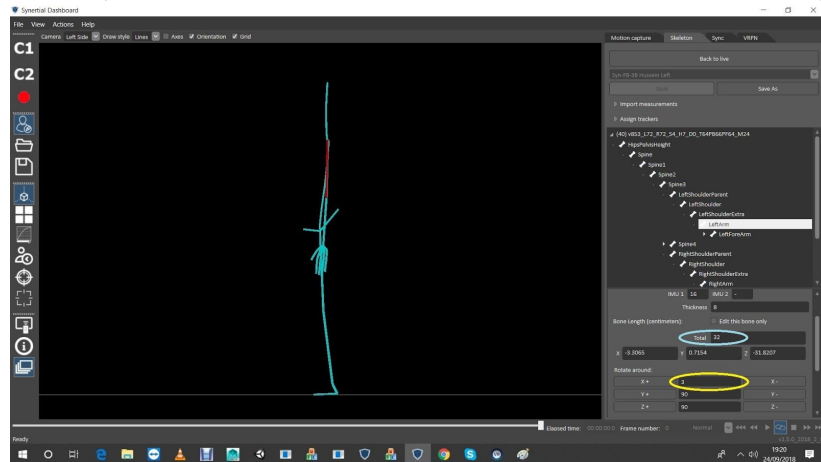And modify Upper Arms Totals and rotation in X to place the elbow joint in the pick box

(*Fig-64*)

(*Fig-65*)

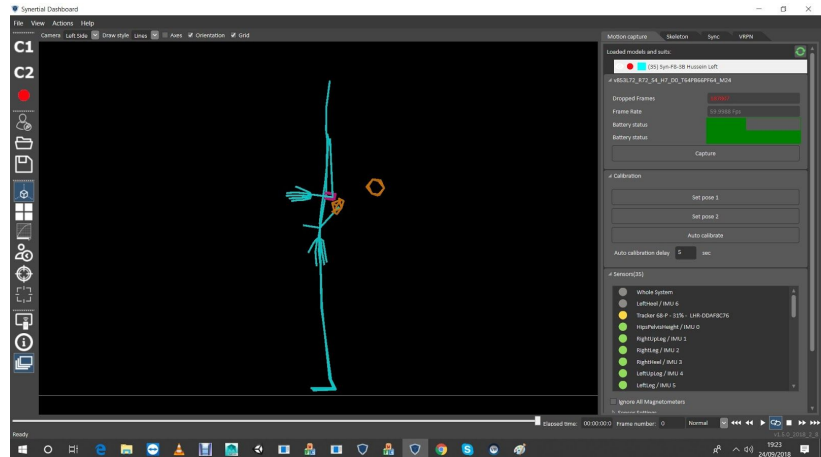Need to bring the elbow joint back about 3cm. (*Fig-66*)
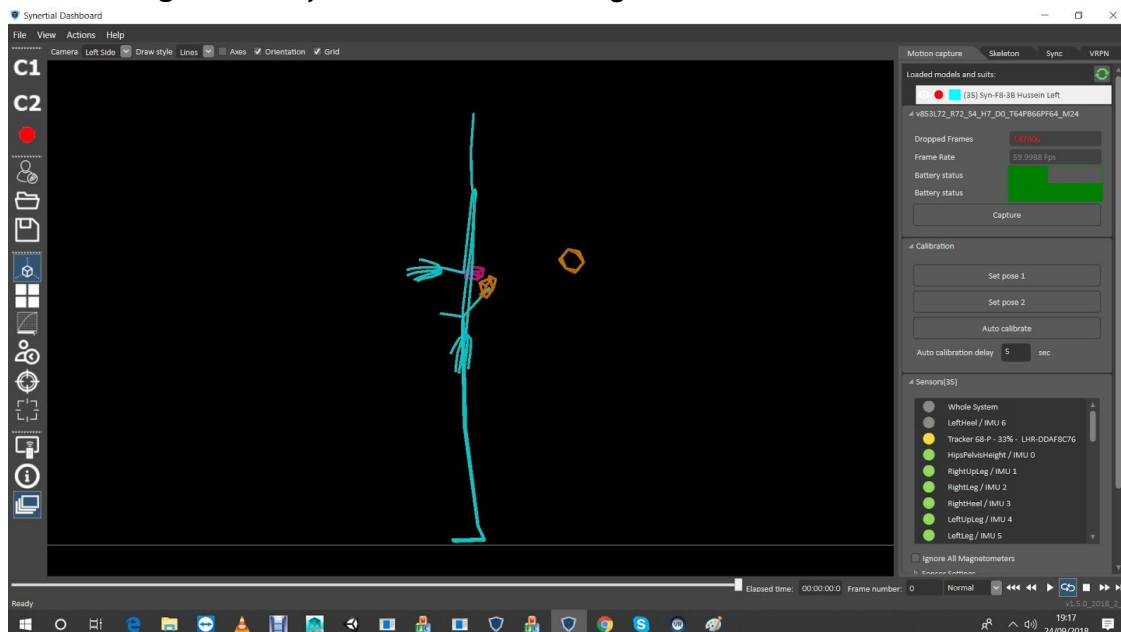
This will be done by rotating the 'UpperArm' in (X). Notice that the height of the elbow joint did not need adjustment here. If it was needed, the 'UpperArm' 'Total' length (blue oval) should get adjusted.
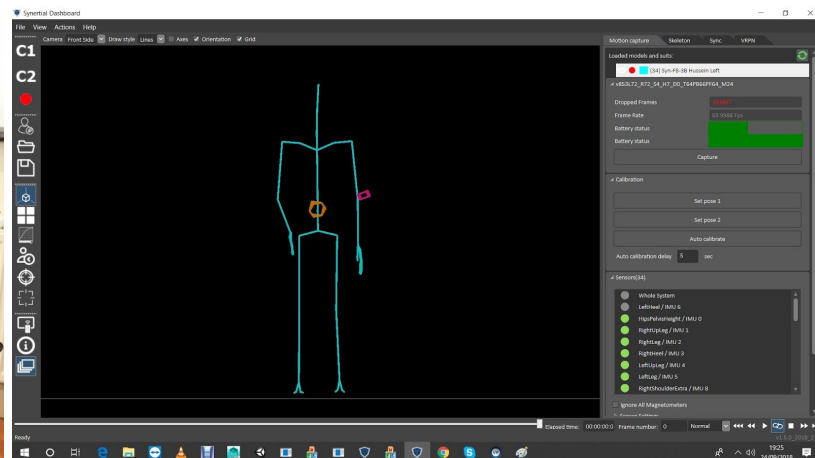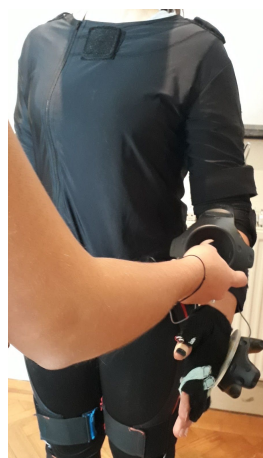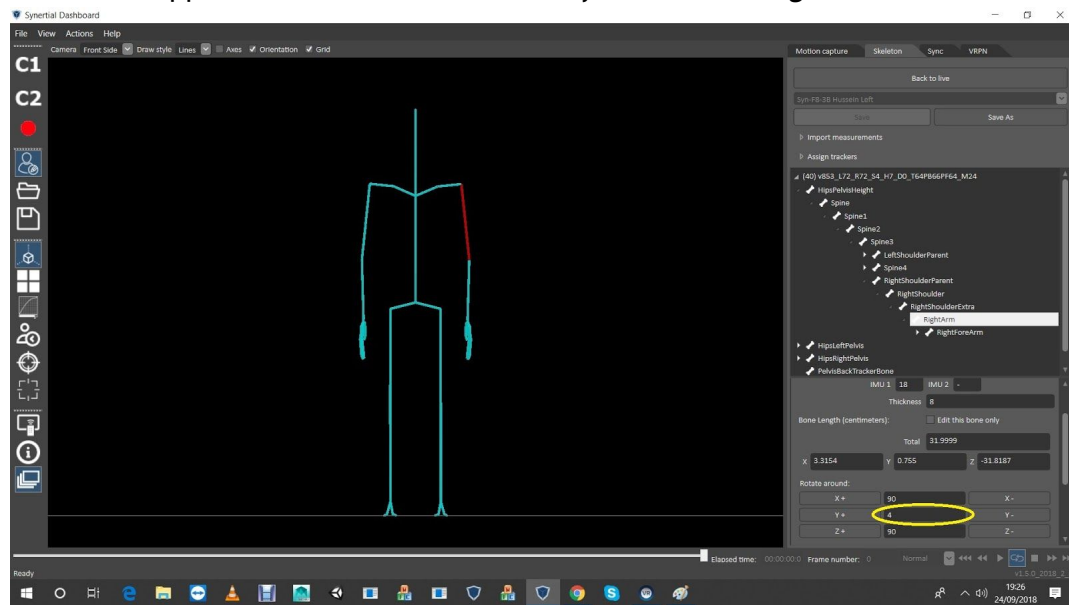

(Fig-67)

Adjusted toreach the pink box.

(Fig-68)

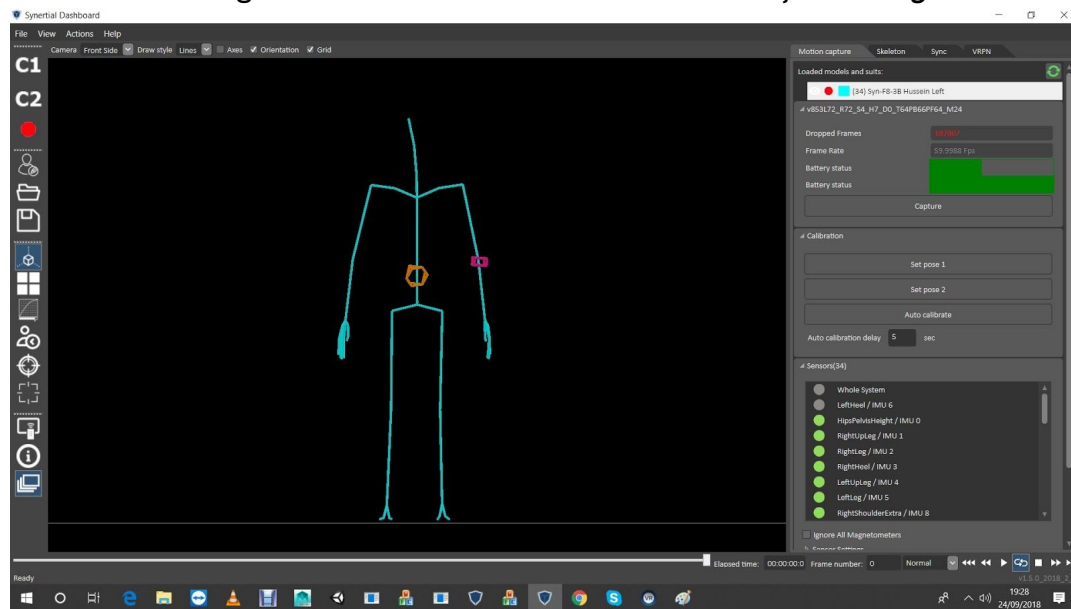# B: (Back View) Find Elbow Width   Controller on the bottom/front of upper arm

(Fig-69)

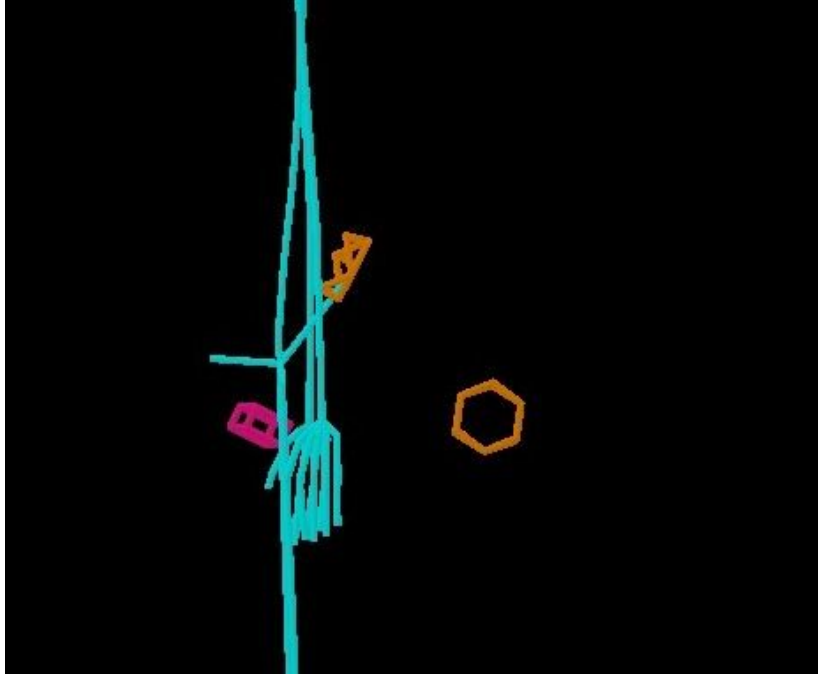Rotate the 'UpperArm' in (Y) to take the elbow joint out a bit. (*Fig-70*)

Will look something like this (while the lower arms are still unadjusted). (*Fig-71*)
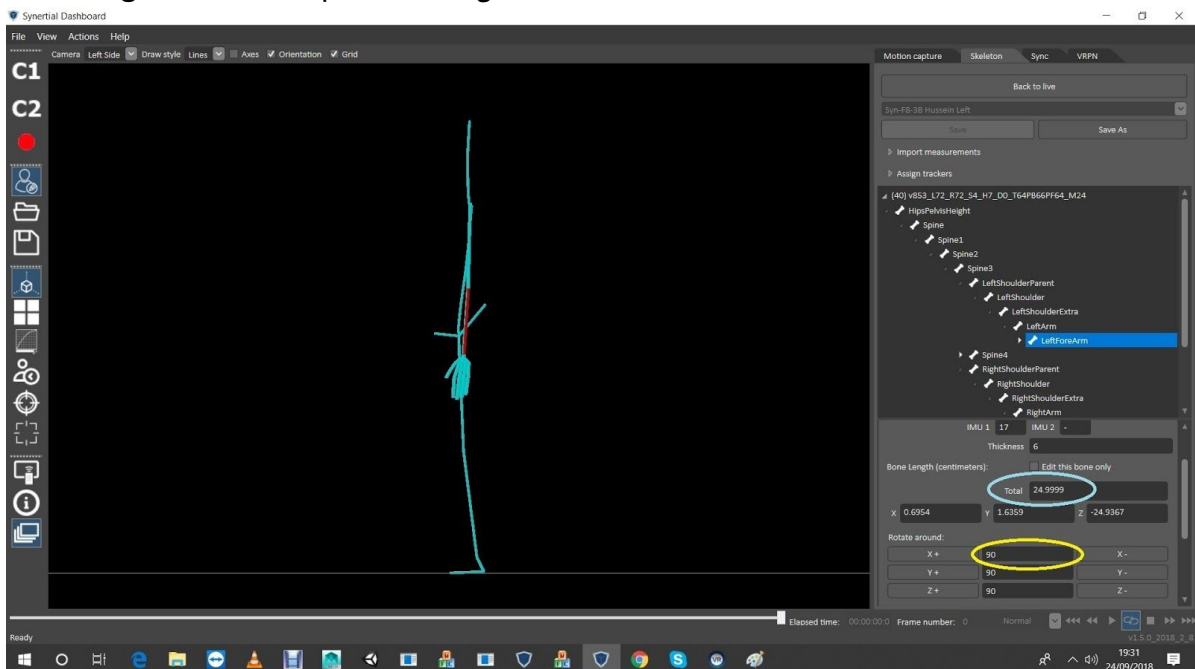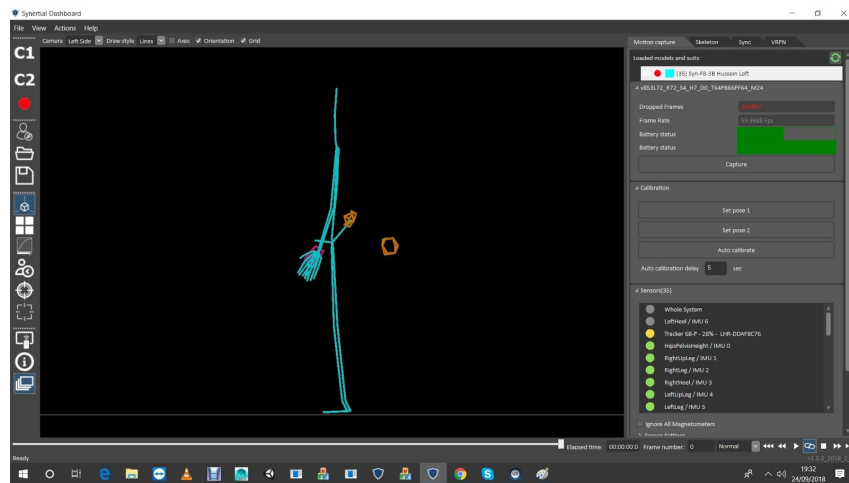
STEP 10 Fit Wrists

A: (Left Side) Find Wrist Side Controller on the side of the wrist
And modify Lower Arms Totals and rotation in X (*Fig-72*)

Add/reduce degrees to (X) of the 'LowerArm' rotation, and for height adjustment, add/reduce to the 'Total' length to reach the pink box. (*Fig-73*)
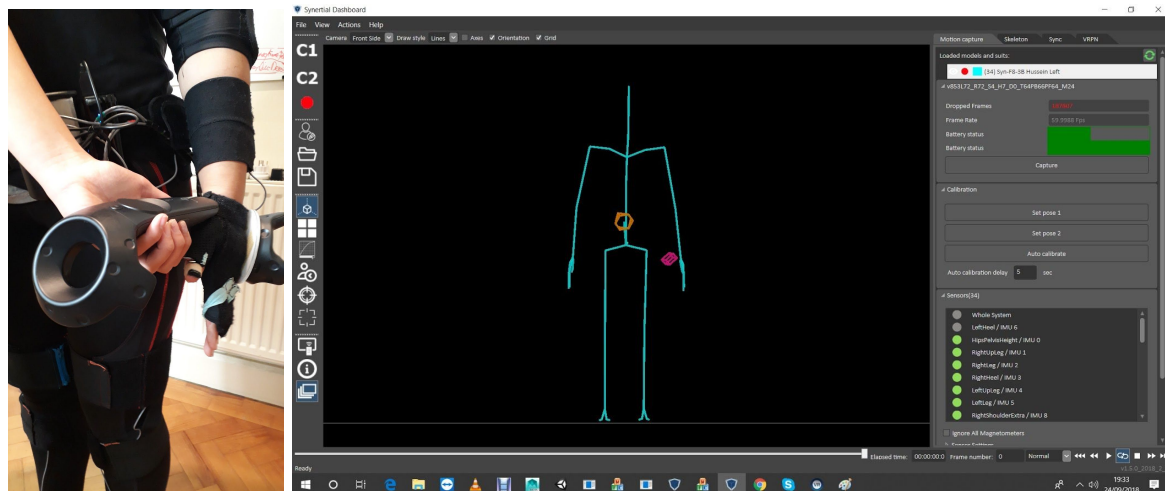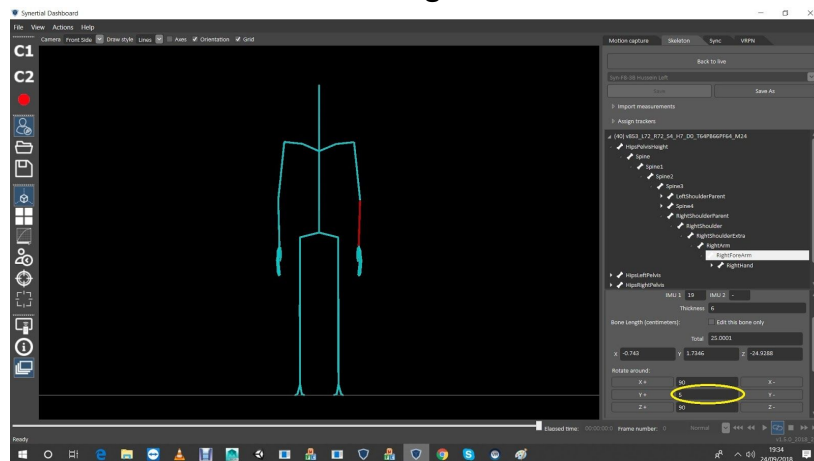
Done!

(Fig-74)

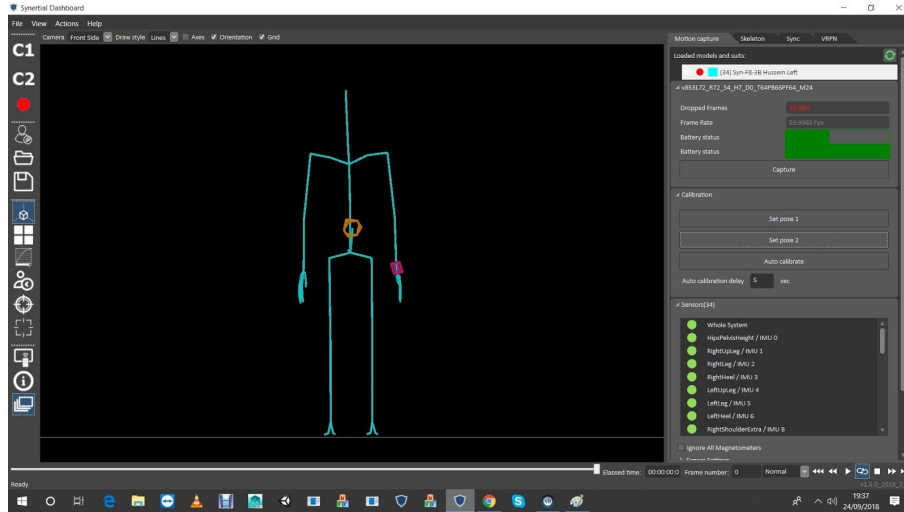# B: (Back View) Find Wrist Width Controller on front of the wrist **(Fig-75)**

Rotate the lower arm in (Y) to bring the wrist in a bit
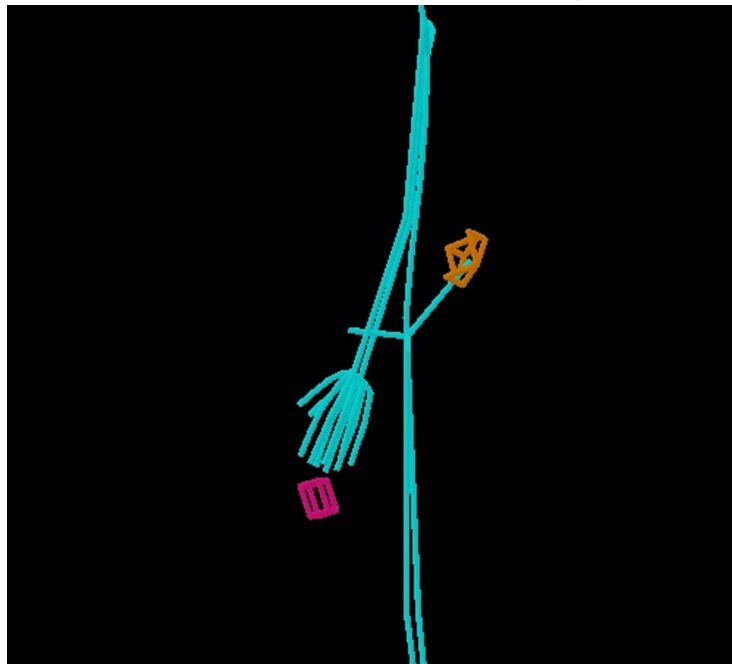

**(Fig-76)**

Done with the wrist! **(*Fig-77*)**

STEP 11 Fingertips Place controller near the middle fingertips to determine if any adjustments are needed

A: (Left Side) Find the Fingertips Controller to the fingertips
And modify 'Hands' rotation in X to aim at the pink box. In this example no adjustment is needed

(*Fig-78*)

B: (Back View) Find the Fingertips Controller to the fingertips
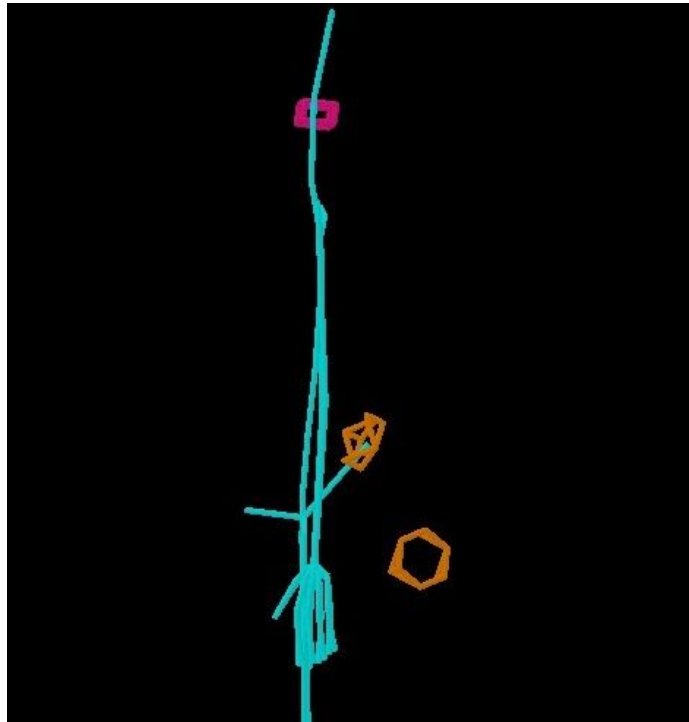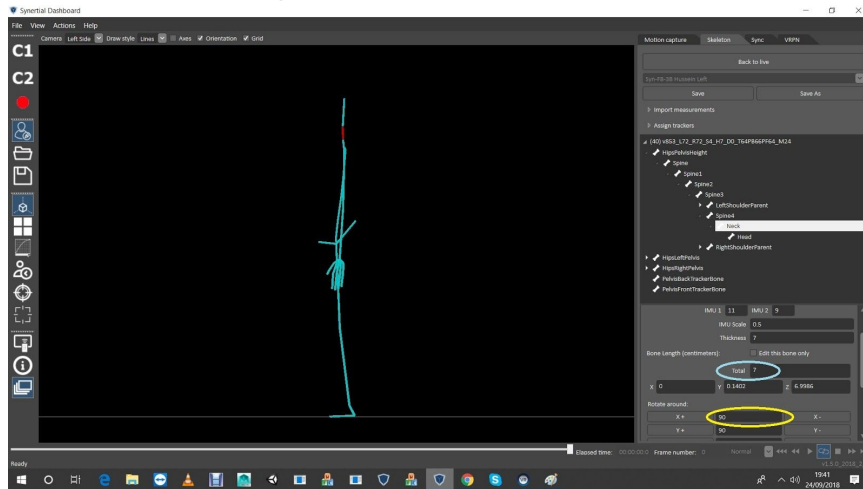And modify 'Hands' rotation in (Y) to aim at the pink box. In this example no adjustment is needed
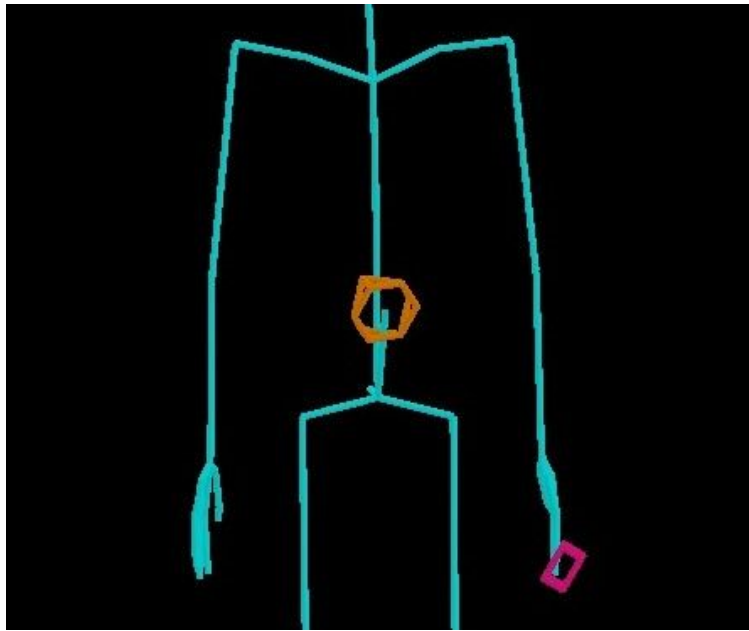
(*Fig-79*)

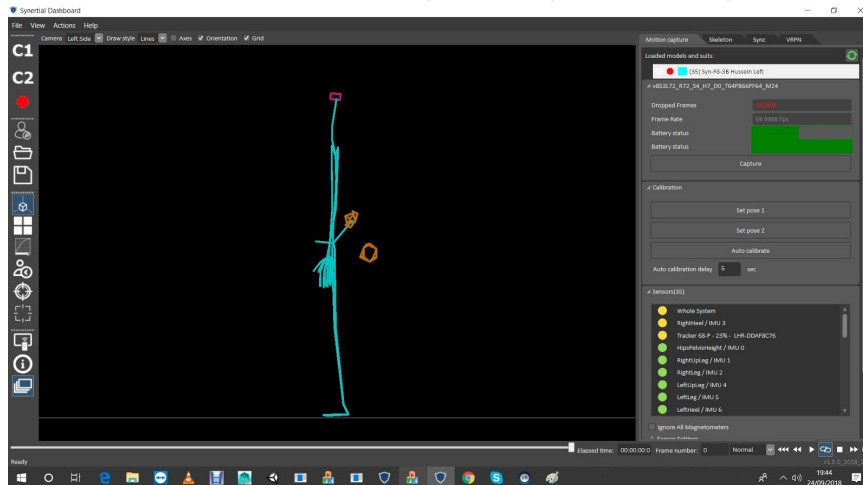# STEP 12 Head base and top Controller on atlas (under ear)

(*Fig-80*)

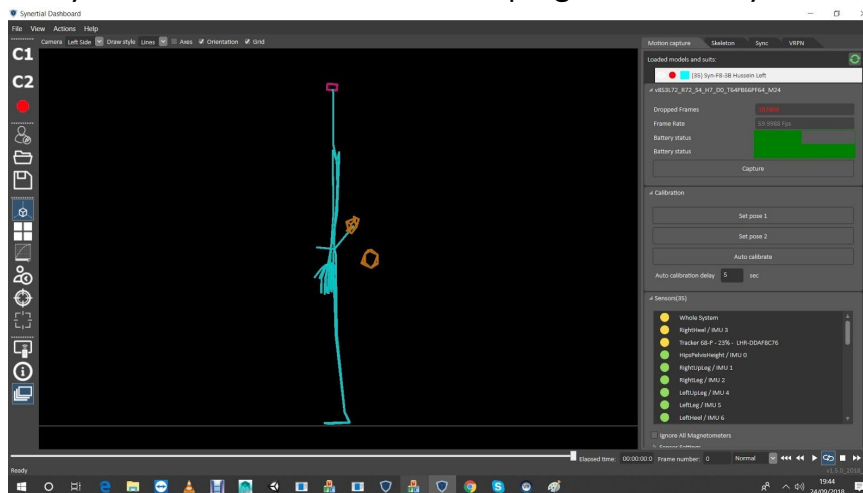- Edit Neck 'Total' Length and rotation in X to correct

(*Fig-81*)

Now check the top of head for height and adjust 'Total' length of the Head to match.

(*Fig-82*)

Finally rotate the Head in (X) to make it upraight if not already.

(*Fig-83*)   **The End**