# *The MotionMonitor xGen Hardware Guide:*
# *Tobii HMD Device Configuration*

This document reviews the procedures for configuring the Tobii Head Mounted Display in The MotionMonitor xGen software.

The Tobii HMD is built into the HTC Vive and communicates with the computer through the Vive's USB connection. The HTC Vive should be connected to the computer running Unity and SteamVR. All communication with the Tobii HMD, including the calibration procedure, are performed through SteamVR and Unity. Before using the Tobii HMD with SteamVR and Unity, it should be confirmed that the device is recognized through the Tobii Eye Tracker Manager software.

The SteamVR room setup application is used to configure the HTC Vive in your environment. A few considerations need to be made when performing this setup in order to properly align the VR environment with The MotionMonitor World Axes.
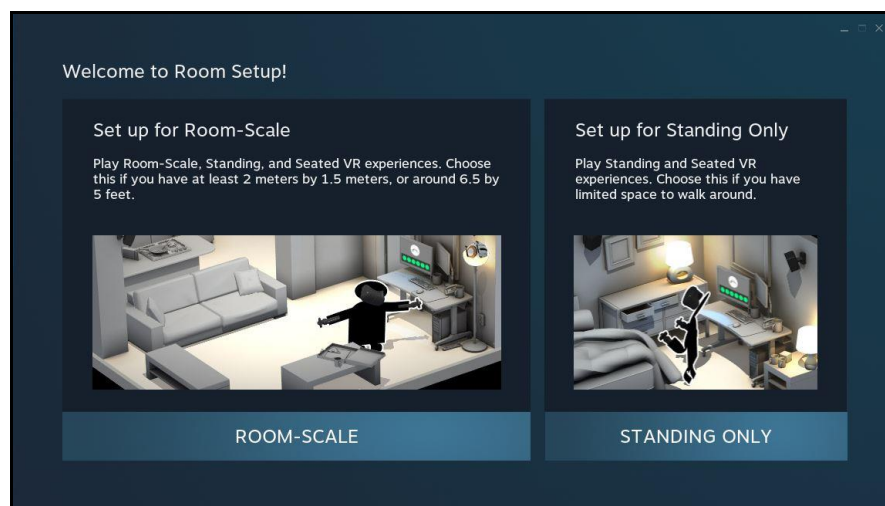
When Calibrating your Space, you want the HMD to be placed at or directly above the location that coincides with your World Axes origin in The MotionMonitor xGen. You also want to have the HMD facing the direction that coincides with the Negative-X direction in The MotionMonitor xGen. Finally, you will also want to define Positive-Z as the axis which points upward in The MotionMonitor xGen, but more on that later.
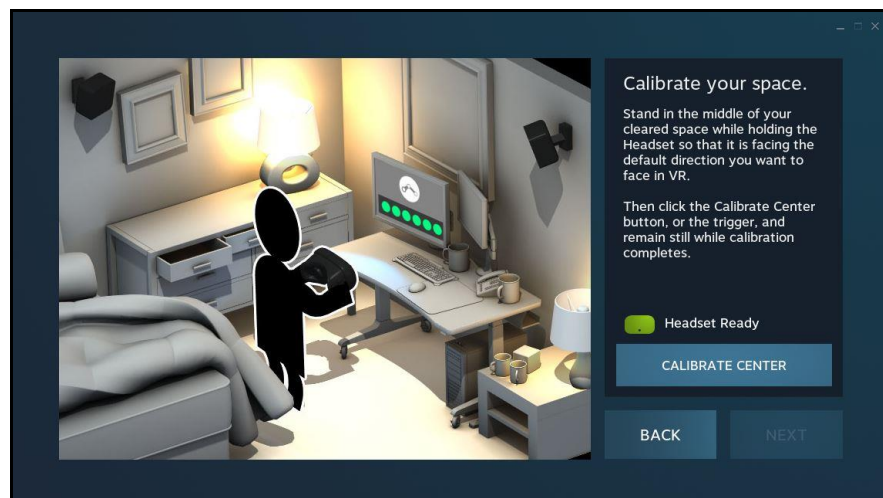
For locating the floor, if the HMD was placed at a location coinciding with the World Axes origin in The MotionMonitor xGen, enter 0. If the HMD was placed at a location above the World Axes origin in The MotionMonitor, enter that height here.
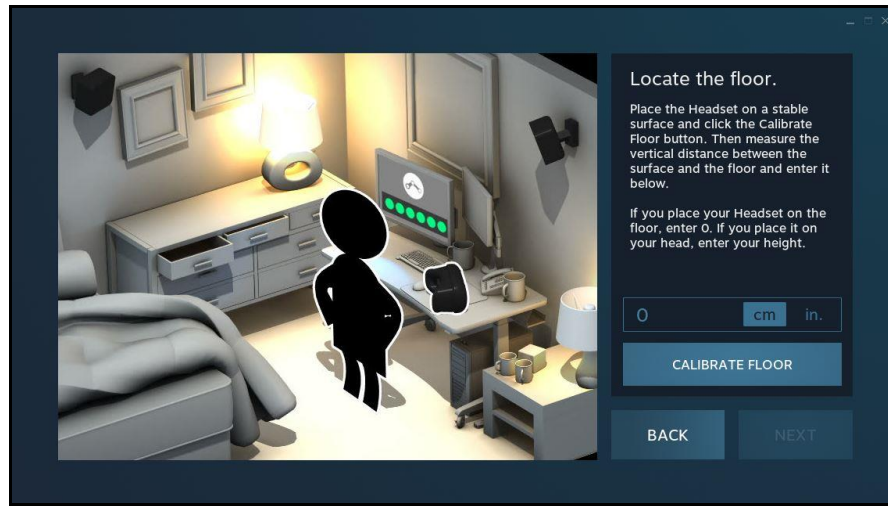

Please contact your Client Support Engineer for the Unity project and server files needed to connect Unity to The MotionMonitor. These scripts will allow for the communication between Unity and The MotionMonitor xGen, including Tobii HMD data and the control of the calibrating the Tobii HMD in Unity. Please note that the Unity project requires two cameras, a Main Camera and Camera Rig. The Main Camera is used for the Tobii HMD calibration. Otherwise, the Camera Rig is used for the perspective seen through the Vive HMD. Unity version 2018.3.14 is required and the IPD setup according to the HTC Vive guidelines should be performed.

The following steps will now walk through the configuration within The MotionMonitor xGen and its communication with the Unity server.

1. Launch The MotionMonitor xGen application and go to the Setup tab within the Components Window.

   As previously mentioned, the World Axes in The MotionMonitor xGen must have the Positive-Z axis defined as the axis which points upward. Also, whichever direction is specified as the Negative-X axis direction in The MotionMonitor xGen is the direction that the HMD should face during the room setup in Steam VR. The Axis which subject faces, which is the direction specified during the Subject Setup Neutral Stance calibration, can be specified as any axis. For additional information on configuring the World Axes, please refer to the tutorial video on setting up the world axes in The MotionMonitor xGen.
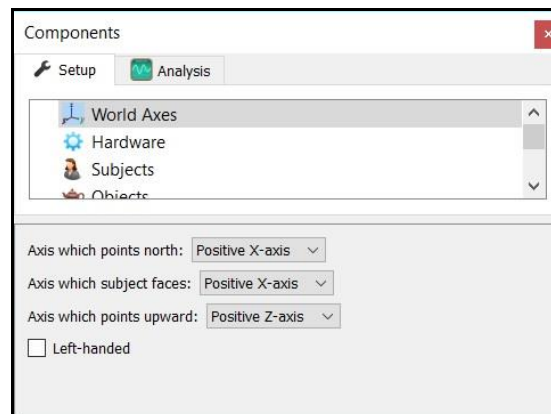
2. A stylus is required for performing the Tobii HMD alignment, among other things. If a stylus is not already defined in the current Workspace, go to the Hardware node in the Setup|Components window, add the Stylus device through the "Add" button at the bottom of the Components window or right-click on the Hardware node to add the device.
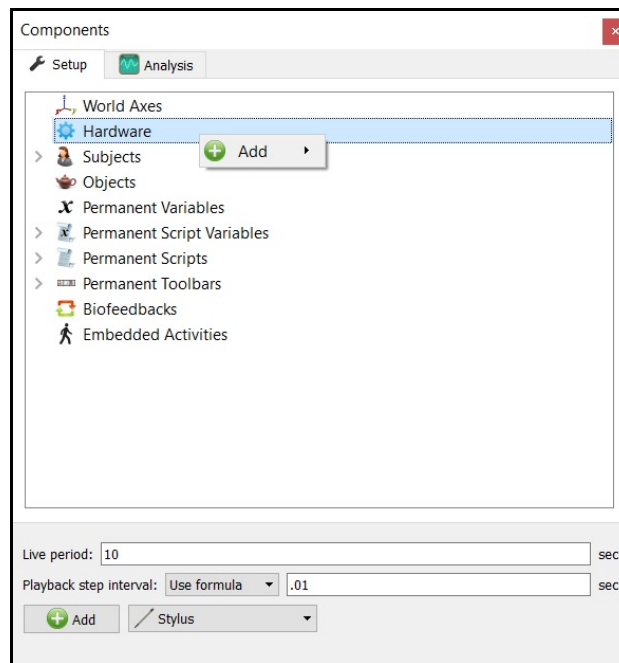

3. Before calibration of the stylus can be performed, the rigid body affixed to the object being used as the stylus needs to be selected through the "Rigid body" drop-list menu. If a remote OK button is to be used during the digitizing process, that Boolean expression would need to be defined through the "Is-button-pressed expression" drop-list menu or formula field. If the origin for the rigid body is at the tip of the stylus, as can be the case for certain kinematic tracking systems, the "Rigid body is at stylus tip" check box should be enabled.
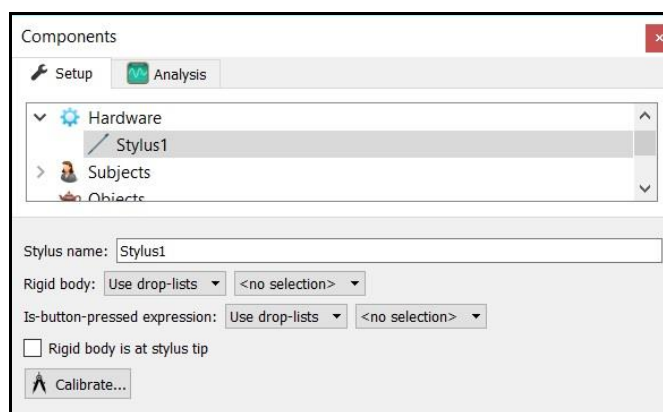
Once all parameter fields are completed, click the "Calibrate" button and follow the prompts to calibrate your stylus. A tutorial video for configuring the stylus can be found here.

4. If gaze data that's collocated with the biomechanical model is desired, a subject setup must be performed. If a Subject is not already defined in the current workspace, go to the Subject node under the Setup|Components window and click the "Add Subject" button at the bottom of the Components window or right-click on the Subjects node and select Add Subject. At minimum, the Subject's Head Segment and Joints must be defined.
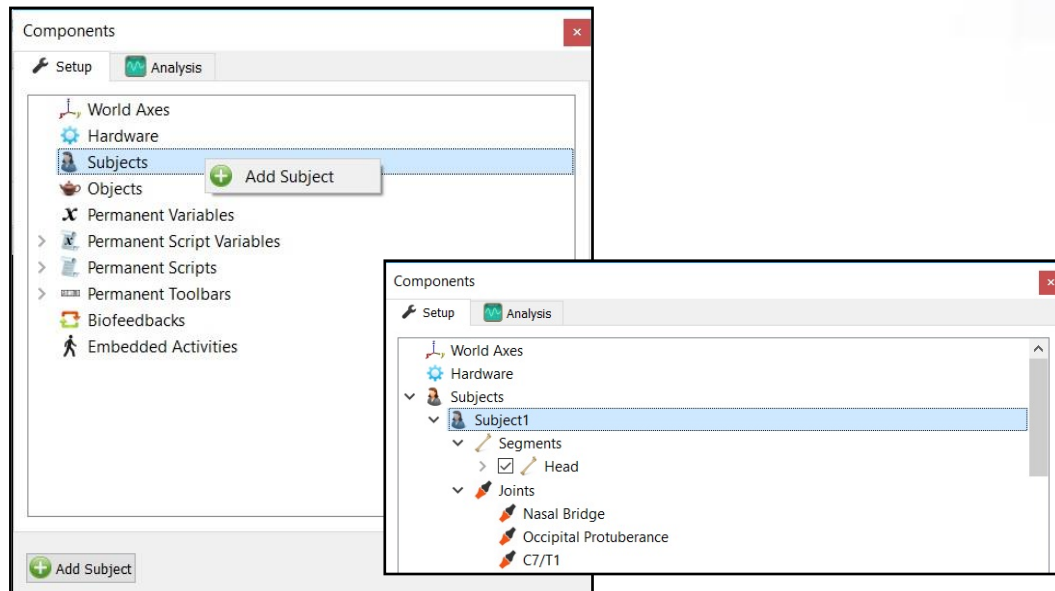

If the same rigid body assigned to the Subject's head is used to track the Tobii HMD, the calibration of the subject should not be performed until after the Tobii HMD device has been aligned (Step 8).

When ready, click the "Calibrate" button and follow the software prompts to calibrate your biomechanical model. Tutorial videos for configuring a subject can be found at https://themotionmonitor.com/support/.

Note: If a subject is not calibrated and Biomechanical data are not desired, the Tobii HMD data will report relative to the default HMD if an alignment has not been performed or to the motion capture world if an alignment has been performed.

5. Before configuring the Tobii HMD device a virtual reality component must also be added. As previously mentioned, this is due to the fact that the Tobii HMD calibration is actually performed through the Unity Server. If a Virtual Reality hardware component is not already defined in the current Workspace, go to the Hardware node in the Components window setup tab and add the Virtual Reality device through the "Add" button at the bottom of the Components window or right-click on the Hardware node to add the device.
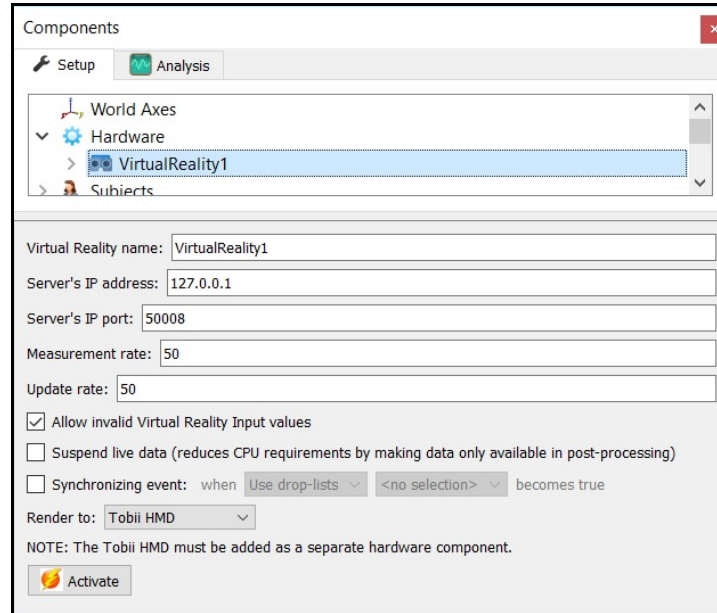

The Server's IP address is either that of the local computer or of the server computer running the Unity VR application. The IP port should not change. The Measurement rate is the rate at which the VR application sends data to The MotionMonitor xGen. The Update rate is the rate at which The MotionMonitor xGen outputs data to the VR application. The "Render To" field should be selected as *Tobii HMD.* At this point you should confirm that the Unity Server is running the project files provided by your Client Support Engineer. After activating the Virtual Reality component in The MotionMonitor xGen the calibration can be performed from the Tobii HMD Parameters panel.

For more information of the virtual reality interface and rendering objects to virtual worlds please contact your Client Support Engineer.

6. From the Hardware node in the Setup Components window add the Tobii HMD device through the "Add" button at the bottom of the Components window or right-click on the Hardware node to add the device.
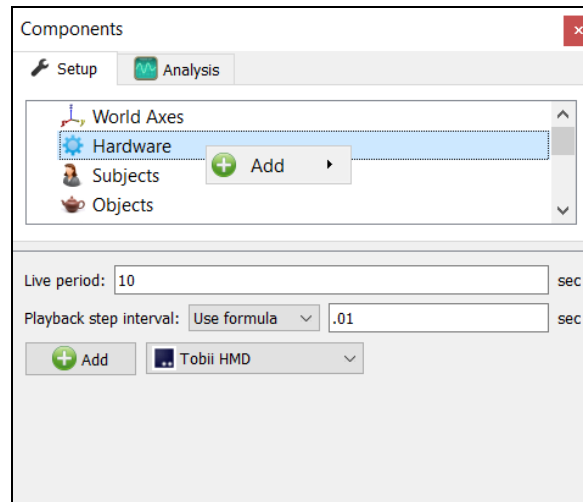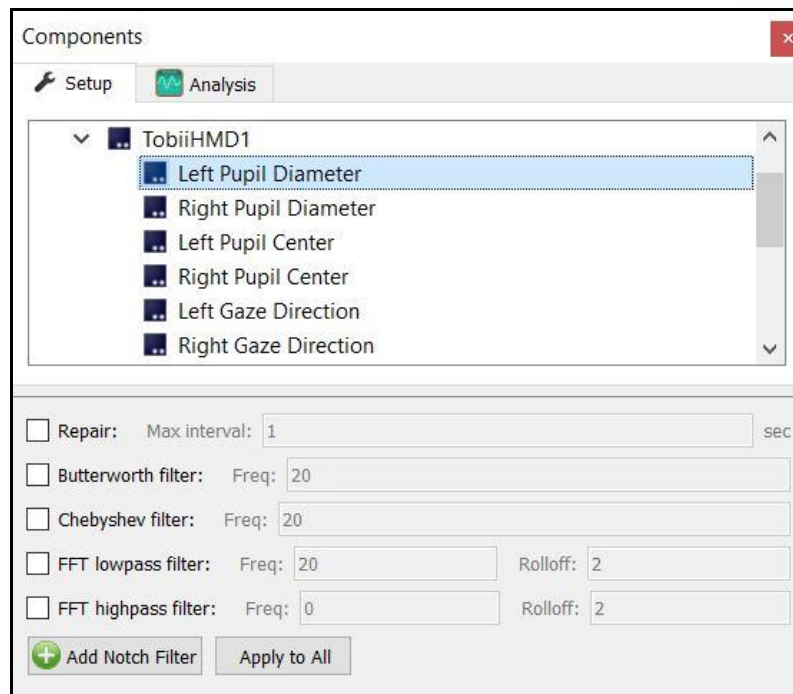

7. In the Tobii HMD parameters panel specify the measurement rate as 120Hz. To simplify the experimental and hardware setup, the same rigid body that was assigned to the Head segment of your Subject can also be used in the "Track with rigid body" field. Also select your stylus from the "Stylus to use" drop-list. The Suspend Live data checkbox will disable live streaming of data from the Tobii HMD to reduce computer processing demands and is generally not enabled. The Synchronizing event field allows for an event captured in the Tobii HMD data to be used as an active synchronization with the same event also captured in other data streams. When not enabled, default synchronization is applied for the alignment with other hardware data streams.
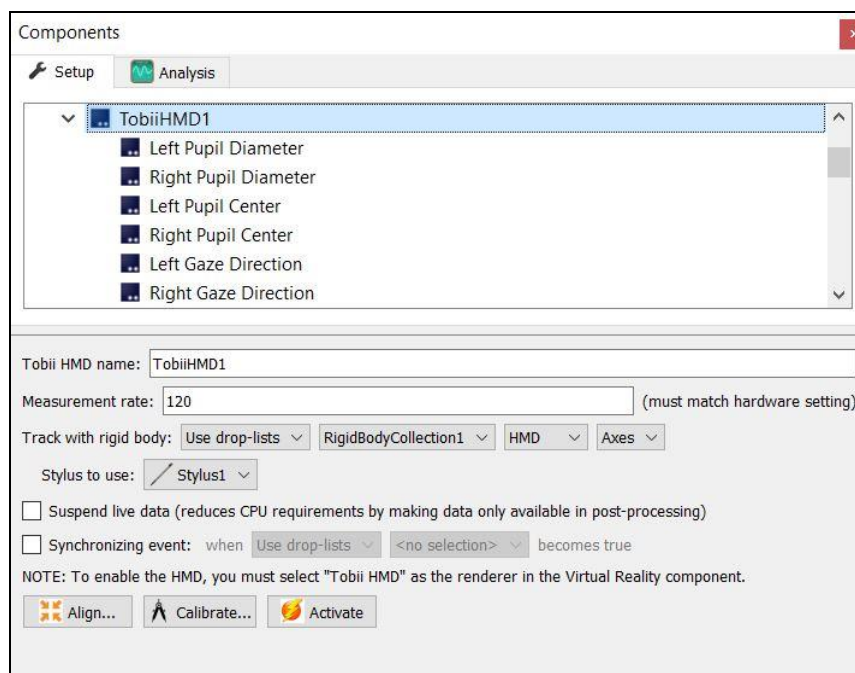

Note that the Calibration and Activation steps cannot be successful performed if the Suspend live data option is enabled.

Selecting any of the Tobii HMD data types will bring up the properties panel which includes their filtering parameters. Each data type can be filtered independently, and filters can be applied either before data collection or in post processing. An example for the Left Pupil Diameter is displayed below.
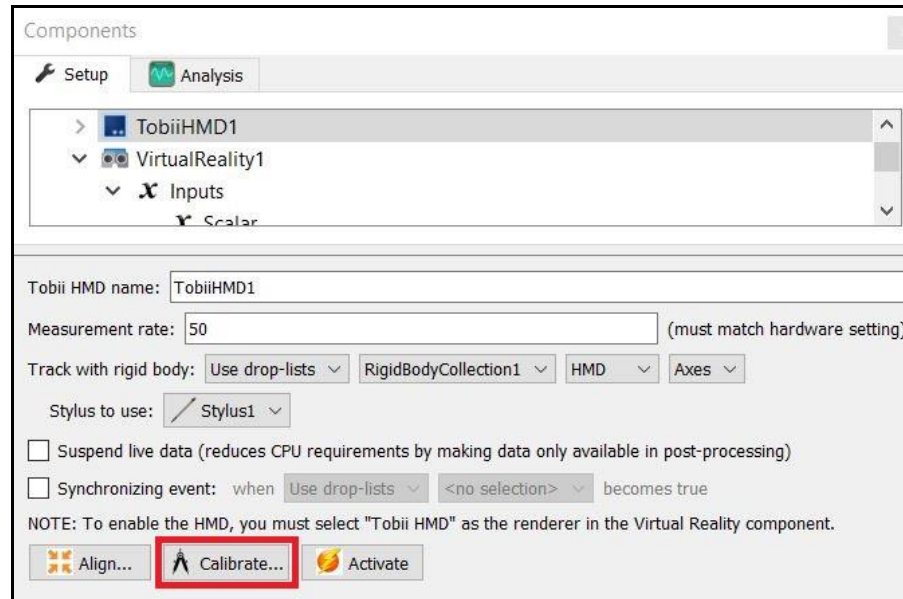

8. From the Tobii HMD parameters panel, click on the "Align" button and follow the prompts to collocate your Tobii HMD device with the subject and kinematic tracking system. The alignment process consists of digitizing the top and bottom edge of each lens.
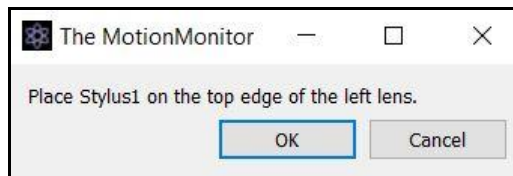
After each reading a dialog displaying the RMS value will appear. The reported RMS error is that of the stylus tip position and Tobii HMD rigid body, over the two-second period where the readings were captured. Things that would contribute to this error include: a poor stylus calibration, loose attachment of either the stylus or HMD rigid bodies, inaccuracy in the rigid body hardware readings, and actual movement of the stylus tip relative to the HMD. The target RMS should be sub-millimeter, but recognize that it is dependent on your hardware's resolution. If this is level RMS is not attained, troubleshooting the aforementioned factors should be performed. Once the Alignment procedure has been completed, the headset can be put on the subject and the Subject calibration can be performed at any subsequent point.

9. Clicking on the "Calibrate" button under the Tobii HMD device will run the eye tracker calibration procedure in the head mounted display. A series of 5 points will be displayed in the field of view of the Tobii HMD. The subject should be instructed to focus on each dot until they disappear.

Once calibrated, the Tobii HMD device can be activated using the Activate button from the Tobii HMD parameters panel and is ready to use for data collection. Although the Align, Calibrate and Activate buttons can technically be performed in any order, it is recommended to move left to right, as described in this document to ensure the most accurate setup possible.

10. Tobii data can be displayed in the Animation window, defined as Analysis Variables and plotted in Graphs, as seen in the images below. Tutorial videos for adding variables and graphs can be found at https://themotionmonitor.com/support/.