The MotionMonitor xGen Hardware Guide:
The MotionMonitor xGen Interface to OptiTrack – Motive Tracker and Motive Body

Overview

- **The MotionMonitor xGen** does not collect directly from OptiTrack cameras. Instead, the position and orientation data of markers are streamed when they are labelled and assigned to **Rigid Bodies** (**Assets**), **Skeletons, Active Sensors** or trained **Marker Sets**. There are two OptiTrack Motive 3.0 Software; 1) Motive Tracker which has limited functionality and only permits the creation and streaming of markers when they are assigned to **rigid bodies or** 2) **Motive Body** which supports all marker types.

- In either case the data are streamed via ethernet connection to the computer running the OptiTrack Motive 3.0 software.

- This guide has 8 sections:
  1. Camera Setup & Calibration in OptiTrack Motive 3.0
  2. Creating Rigid Body Clusters in Motive 3.0
  3. Streaming Settings for Motive 3.0
  4. Activation Settings in The MotionMonitor xGen for OptiTrack
  5. Defining Rigid Body Collections within The MotionMonitor xGen
  6. Setting up a Stylus
  7. Defining and Calibrating a Biomechanical Subject Model
  8. Saving Setup

This guide will focus on the creation of Rigid Bodies (Assets), please reach out to a Client Support Engineer if you need assistance with creating Skeletons or Marker Sets for your project**.**

Option 1. Rigid Body Cluster (Asset): A set of at least 3 markers (4 markers preferred) fixed rigidly to a plate in a unique non-symmetrical configuration. Each Cluster is predefined and attached to a body segment or object to be tracked.

Option 2. Marker Set: A group of markers that have been defined and trained to track together, this may include a combination of static and moving markers. Example opening a door, the frame would have stationary markers, and the door would have markers that move away from or toward the frame.

Option 3. Skeleton: A series of individual markers placed on the segment end points and segments of interest. OptiTrack Motive have a series of predefined options, some users may have the ability to customize those skeletons. If a skeleton template were to be used it would need to be applied and updated for each participant, so it tracks correctly.

Assumptions

User is using version Motive versions 3.1.3 Final or later. Please contact your Client Support Engineer for questions on support for specific versions of Motive software. Support@innsport.com or Support@TheMotionMonitor.com .

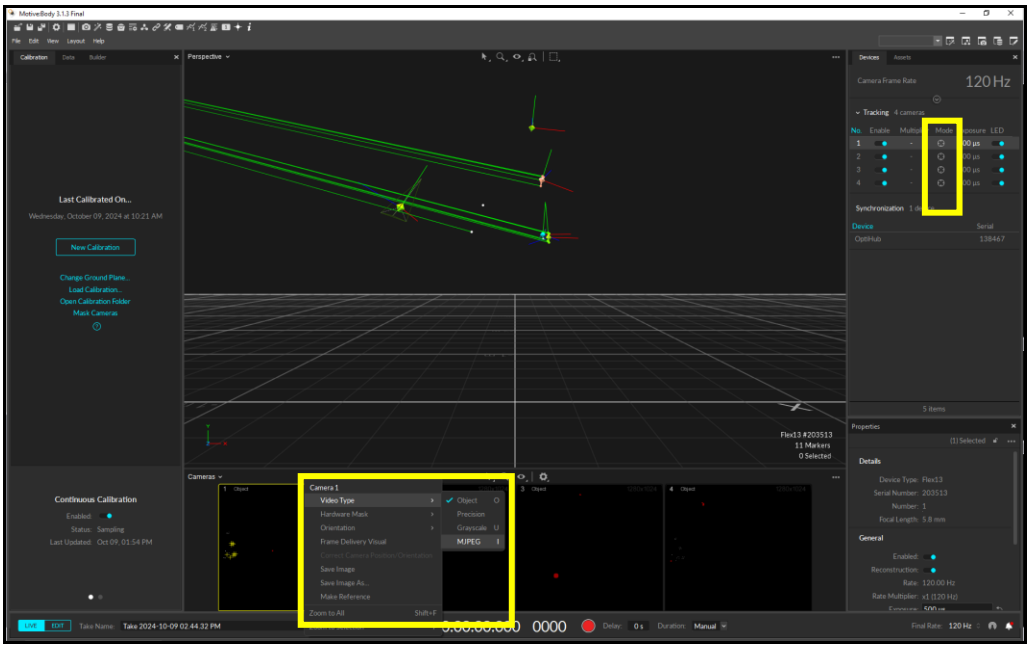
Section1: Camera Setup & Calibration in OptiTrack Motive 3.0

1. Launch OptiTrack Motive 3.0 application.

2. Open the **Camera Preview** window (camera icon), select each camera or all cameras by clicking on them in the camera window.

3. Either in the **Devices** tab, or by right clicking on a camera, switch the **Video Mode** to **MJPEG** for aiming/ focusing cameras and **Object Mode** for marker tracking and low CPU usage.

4. Place markers at the perimeter and in the center of the capture volume, and switch between the two camera modes to optimize camera settings.



5. **Adjust camera settings** in the Properties panel: .

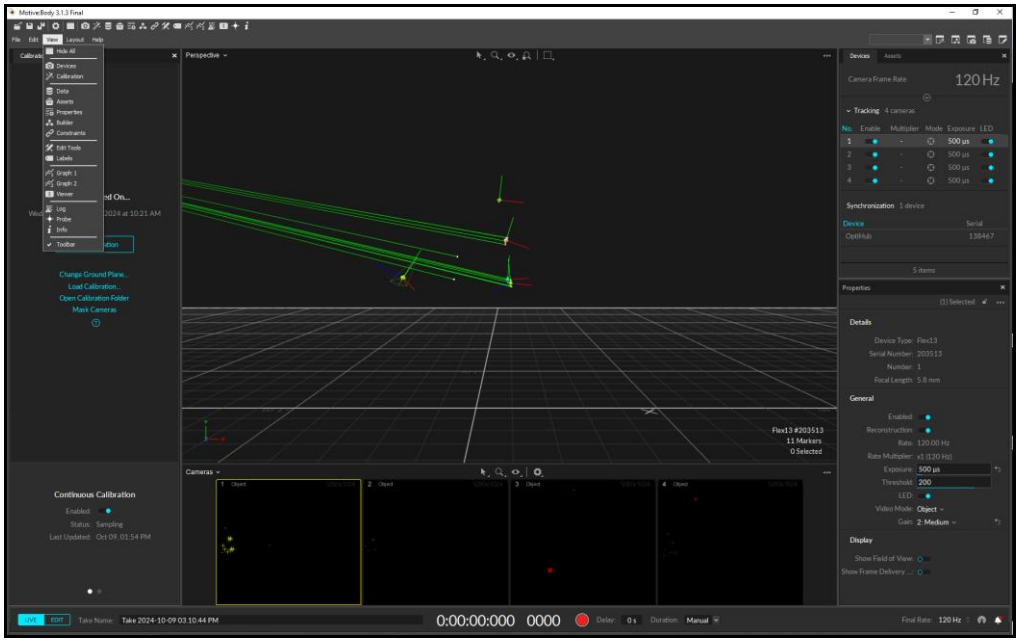
   - Set the **environmental lighting** and **camera capture rate** first, as these will affect the other settings.

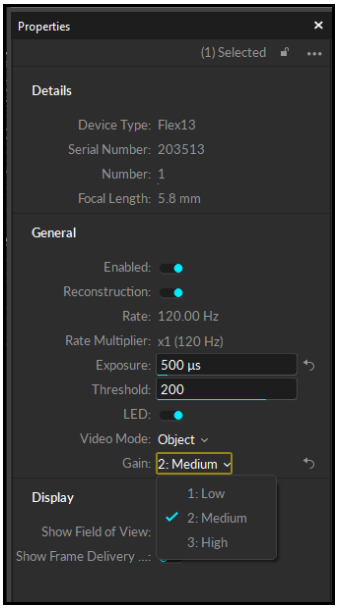
   - Adjust exposure, thresholds and intensities to reduce reflections.

- Set **gain** to low medium or high depending on camera distance.

    a. Some camera models may also have rings on the camera lens that can adjust the focus and f-number. (a special tool is required to adjust these)

    b. Some camera models may have Illumination Type. Strobe is the default, continuous may be needed when there is infra-red interference from other devices.



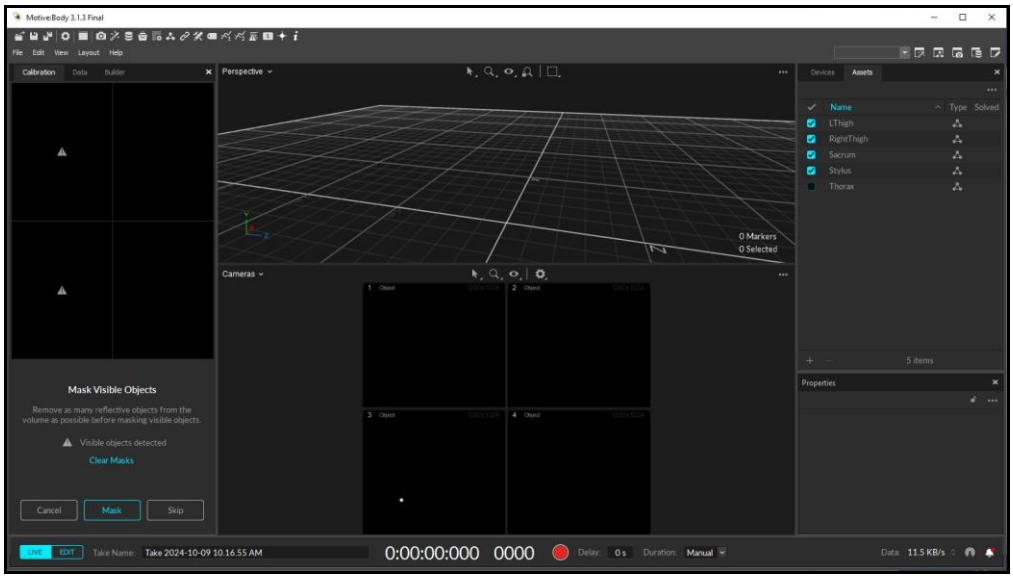


- **Warm-up:** turn cameras on and let them warm up for at least **30 minutes**.

- **Masking:** Camera optimization from the steps above should remove/ minimize the number of reflections.
    a. For those reflections that cannot be removed, use "**Mask**" In the calibration panel  (Magic wand icon), masked pixels will appear red in the camera view.

    b. Frequent calibration of cameras is recommended as any adjustments to camera settings or camera position may impact marker tracking quality. Motive 3 and above include visual notifications when cameras are out of alignment with the calibration.

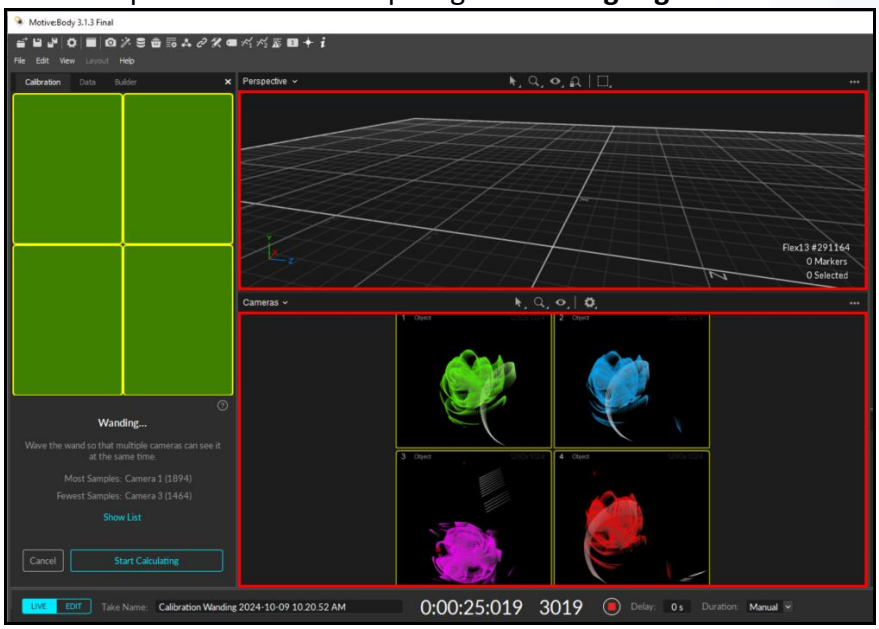
    c. **Clear Masks** will remove existing masks.



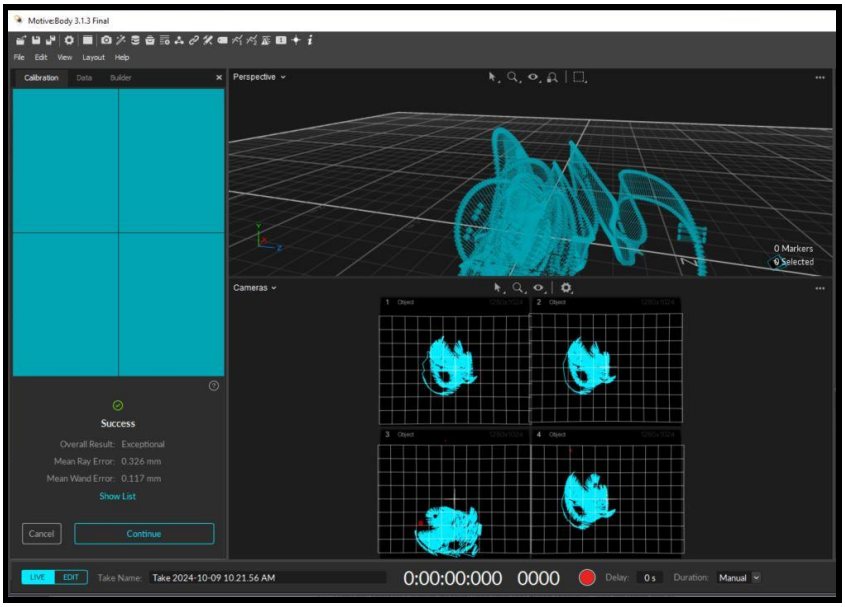
6. Once masked, click continue within the calibration pane. **Update** the wand dimensions to match the camera calibration wand to be used. Click **Start Wanding**.

- Move smoothly through the capture volume sweeping left to right, and up and down, turning frequently, so as not to block one specific camera for too long. Avoid striking the wand against objects.

- When an acceptable amount of data is ready for calculation, the boxes in the calibration pane will turn from pale green to **bright green**.



7. Click **Start Calculating**, the system will refine the calibration and the boxes will turn blue.



8. Click **Continue** to set the Ground Plane and determine the global coordinate system (place in the same place each time).

9. Select the L-frame or set to Auto to be auto detected, Click **Set Ground Plane** and **save the calibration files** to the calibration folder.

Section 2: Creating Rigid Body Clusters in Motive 3.0

1. Create Rigid bodies with at least 3 non-linear markers. Click on the **Builder** Icon () in the toolbar or from the view menu.

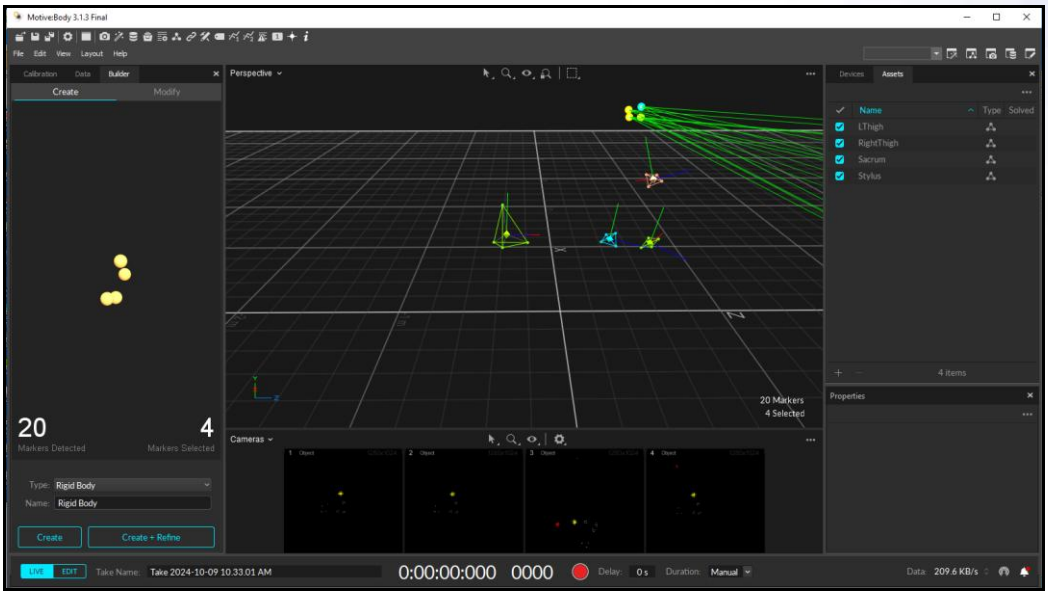
2. Click on the markers or left mouse click and drag to select a range of markers.

    - Click the **Create** from the builder pane.

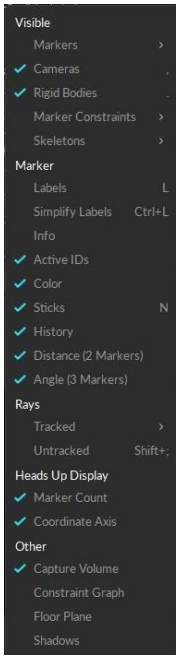
    - Rigid bodies can be **refined** by moving the cluster through the space to improve its tracking.

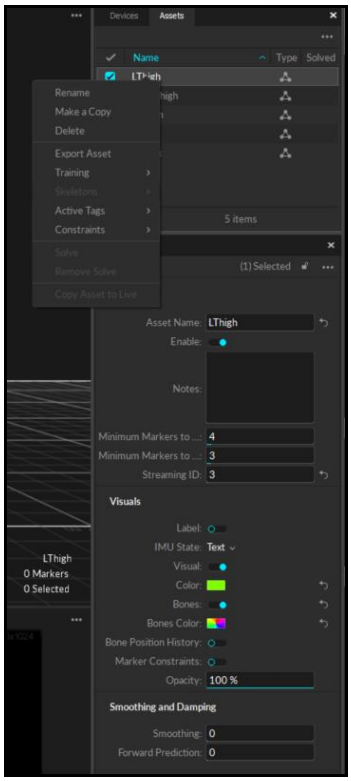
3. From the Rigid Body Settings in the **Assets Pane** () give the Rigid Body an appropriate name for the segment or object it will be tracking, i.e. **LThigh**.

    - Be Consistent with naming/ capitalization for all the rigid bodies.



4. Adjust marker/rigid body properties in the properties panel.
   - Visualizations such as labelling can be toggled on in the perspective view by clicking the Visual Option Icon ( ).
   - Once setup, minimize the additonal visualizations to reduce CPU usage for optimal streaming.





5. **Repeat** these steps 1-4 for each body segment or object Rigid Body.

6. Create a **Rigid Body Asset** for the **Stylus**, this will be used in The MotionMonitor to digitize landmarks, define joint centers and to co-locate force plates

7. Delete or **Toggle off** any Rigid Body Assets that are **not** in use, prior to activating in The MotionMonitor xGen. Active Assets that are not in use may cause unnecessary marker swapping.

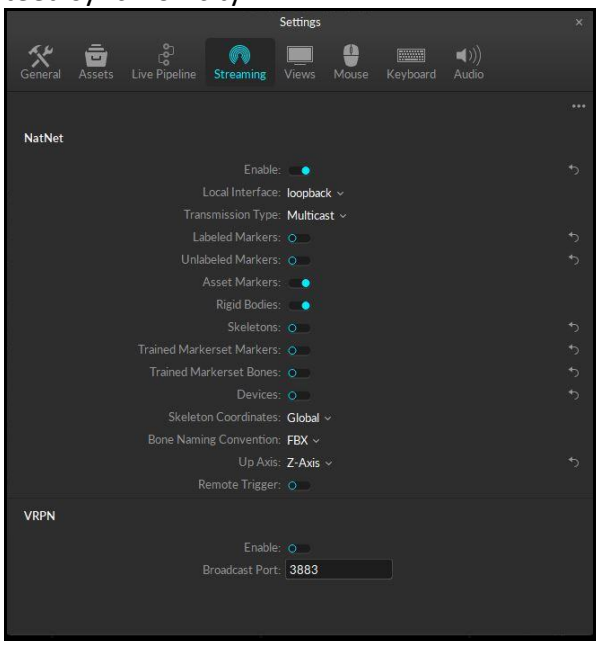
Section 3: Streaming Settings for Motive 3.0

1. Update the Motive Streaming Settings by clicking on the **Settings** Icon ( ) and selecting the **Streaming** tab.

    - When Motive is on the same computer as The MotionMonitor xGen:
        a. The NatNet should be enabled.
        b. Local interface should be set to **loopback**.
        c. Transmission type should be **multicast**.
        d. **Toggle on** the appropriate items for the models that were defined.
            i.e., Asset Markers, Rigid Bodies, Skeletons and Trained Marker Set Markers.

        e. Define an appropriate **up axis** (make a note this will impact The MotionMonitor xGen Settings).

- **Devices should be disabled**. Force plates, EMG and other peripheral hardware will be connected directly into TheMotionMonitor xGen, necessary for guaranteed synchronicity.



2. Leave Motive **running in the background**, the window may be minimized.

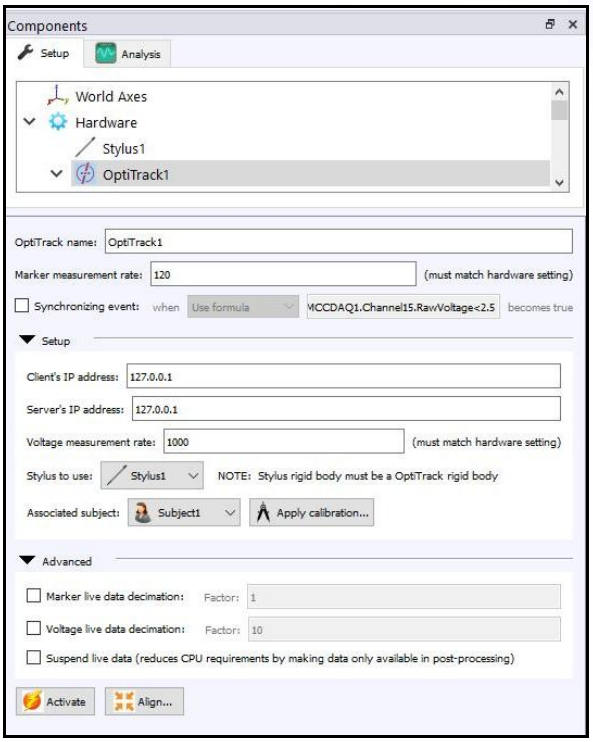
Section 4: Activation Settings in The MotionMonitor for OptiTrack

1. Open **The MotionMonitor xGen**.

2. Go To Components Window> Setup Tab> OptiTrack1, if OptiTrack1 is not Visable Right Click on Hardware, Click Add and select OptiTrack.

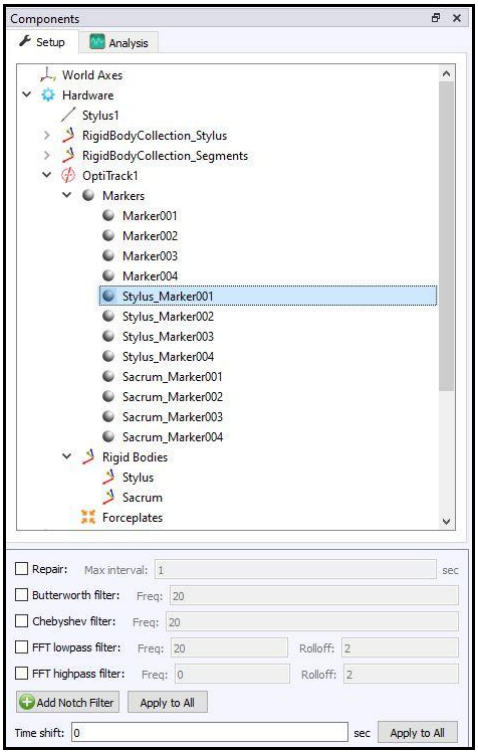
3. In the parameters panel Check the **IP address**, and **camera measurement rate** match the settings in Motive.

   - Data decimations may be applied to reduce CPU load in a live mode. If used, the full measurement rate will be collected and viewable in an activity.



4. Click Activate

5. Markers and Rigid Bodies will populate under the OptiTrack1 node. Data repair and smoothing settings can be enabled or disabled at the marker level or rigid body level, pre or post data collection.



- It is best practice to use marker data to generate RigidBodyCollections within The MotionMonitor. This facilitates more functionalities to correct marker exchanges and filter/ remove subsections of bad marker tracking data when needed.

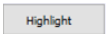
Section 5: Defining Rigid Body Collections within The MotionMonitor xGen

1. In the Components Tab> Setup> Right Click on Hardware and Click **Add**, Click **Rigid Body Collection**. One rigid body collection would be used for the stylus and another for the subject segments, please name appropriately.

2. Irrespective of whether rigid bodies or skeletons are used to stream marker data. Groups of **>3 markers** will need to be assigned to Rigid Body Collections.

   - In the Animation pane left click and hold shift key to draw a box around the markers, right click on the yellow box click Create Rigid Body, Add to either the RigidBodyCollection_Stylus or RigidBodyCollection_Segments.
   - Give an appropriate name to each rigid body grouping i.e., “Stylus” “LThigh”.

3. Check each rigid body in the RigidBodyCollections have the appropriately labelled markers.
   - remove any markers that are named generically such as “Marker1” or “Marker001” without the name of the rigid body as suffix will not track consistently and needs to be removed.

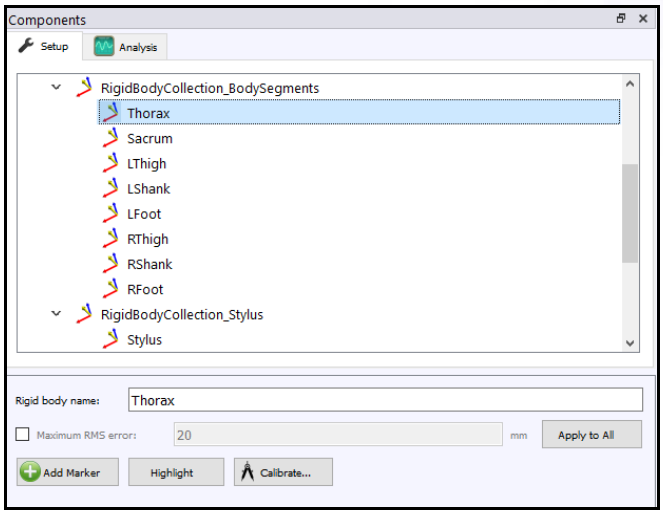
4. Use the **Highlight** Button 

so identified markers flash.
   - If markers are missing, add markers manually by right clicking on the RigidBody Name and clicking add marker, use the drop-down list to map to OptiTrack1>Markers> and select the missing marker/s.

5. Do not include markers that are to be removed for dynamic trials.
   - Once all markers have been added to the RigidBodyCollections, from the top level of the RigidBody Collection, with all the markers in view of the camera click **Calibrate All**, keep the markers still during this time.

   - Repeat for the Stylus or any other rigid body grouping.

   - This process can be seen in our Creating Rigid Bodies Video Tutorial available on our support page https://themotionmonitor.com/support/ click watch tutorials.



6. If Skeletons were used to stream marker data Step 5 will need repeating for the RigidBodyCollection for segments for each participant.

7. The RMS threshold may be toggled on and value updated. If the RMS exceeds the value Rigid Body derived data will become invalid. These can be used in a live mode or in collected activity.

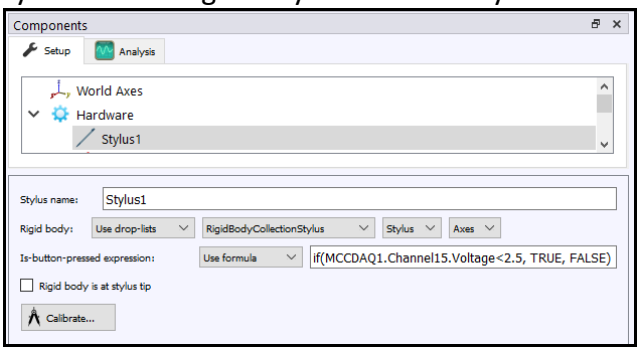
8. If changes are to be made to the rigid body and marker list in OptiTrack Motive, **always deactivate in The MotionMonitor xGen first.**

    - Once the changes have been made and The MotinMonitor is reactivated, recheck all the RigidBodyCollection marker definitions are correct.

Section 6: Setting up a Stylus

1. In Components Window> Setup Tab Right click on Hardware to add a Stylus.

2. For the Rigid body define the RigidBodyCollection > Stylus >Axes



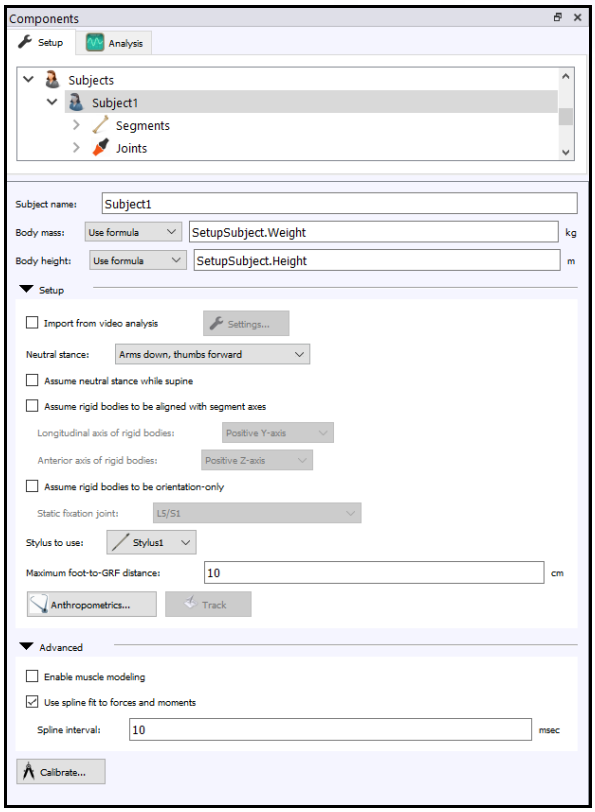
3. Provide an Is-button pressed expression. This could be a hand-held event marker if available. This expression, when TRUE allows you to use the button press as an OK button during subject setup.

4. Calibrate the stylus, follow the process shown in the tutorial video for Setting up a Stylus available on our support page https://themotionmonitor.com/support/ click watch tutorials.

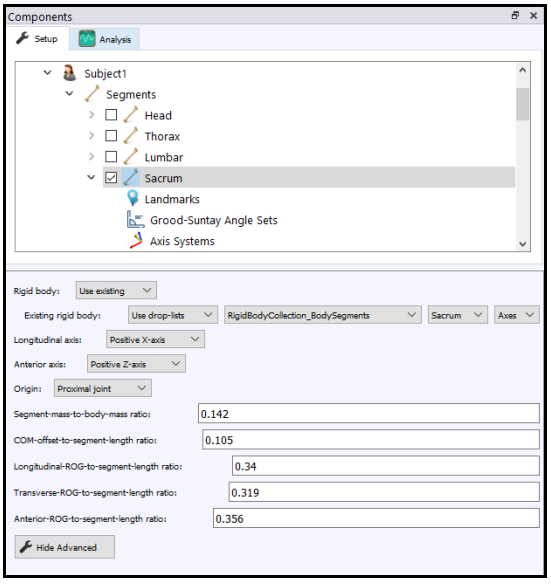
5. Use the calibrated stylus to define a World Axes and Co-Locate Force Plates, these tutorial videos are available on our Support page https://themotionmonitor.com/support/ click watch tutorials.

Section 7: Defining and Calibrating a Biomechanical Subject Model

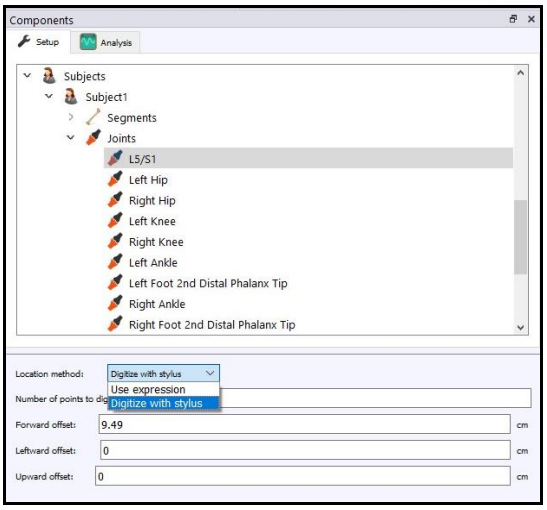
1. Add a subject if there is not already one in the workspace.
   - In the components Window>Setup Tab Right clicking on Hardware click Add Subject.
   - Select the Stylus to use.
   - Define neutral stance, the default is hands down thumbs forward.
   - Maximum foot-to-GRF distance can be changed if appropriate (how far the foot may be from the center of pressure), this may be adjusted in a live mode or updated in a recorded activity.
   - Anthropometric Data (used for joint force and moment calculations), this may be adjusted in a live mode or updated in a recorded activity.



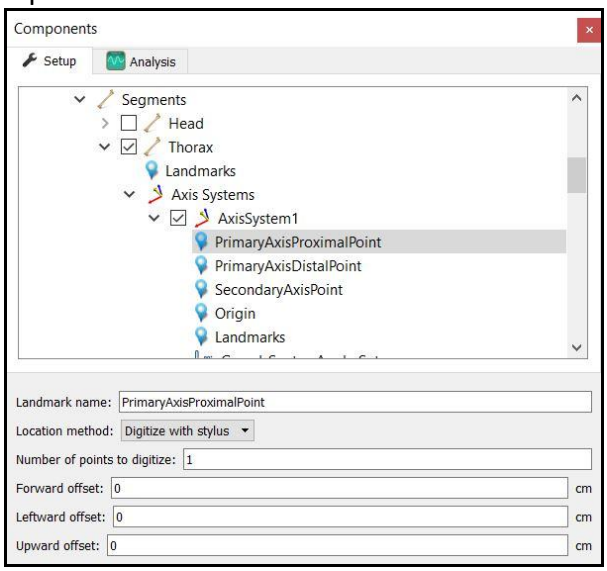
2. Select each segment you want to track, assign a RigidBodyCollection rigid body to each segment.



3. Depending on the segments enabled in step 2, the number of required joint centers/ segment end points will automatically populate.
   - Provide definitions, select between: 1. Digitizing with stylus and identifying the number of points, 2. Regression methods or 3. Functional rotations.



4. Optional - define any custom axes and required landmarks.
   - remove any axes or landmarks that have been added by mistake and do not include a complete definition.



5. The subject height and weight can be entered manually or as seen in the image for step 1 can be tied to a script.

6. Click Calibrate Subject

   - follow the prompts to digitize and take a neutral stance.

   - Tutorial videos for Subject Setup Part 1 and advance subject setup Part 2 are available on our support page https://themotionmonitor.com/support/, click watch tutorials.

- A warning message will be displayed for any definitions that have not been appropriately defined.
- The Calibrate Subject Icon  from the tool bar can also be selected this will include dialogs for script defined height and weight metrics.

7. Check the segments within the animation are appropriately sized and use the back button to re-digitize points.

8. Once the subject calibration is completed, if a segment is incorrect, or if a rigid body moves relative the other rigid bodies, then the **Revise Calibration** button 

can be used to re-digitize a single segment.

Section 8: Saving Setup

1. **Deactivate** hardware and save the setup by Clicking File> Save Workspace As or using the Icon, provide an appropriate name.

2. **Open** and **load** the named workspace, by going to File> Open Workspace prior to each data collection.

3. There is an icon for Save Workspace this will save over a workspace named: “Current.iws” this also saves automatically when the software closes or after a subject calibration.

   - Best practice is to also have a named workspace, as changes could be made to the current workspace, which could subsequently cause issues to activation or subject calibration.