# VICON \ N E X U S

## PART 2
## CUSTOM VSTs

### A TIP SHEET ON THE BASICS

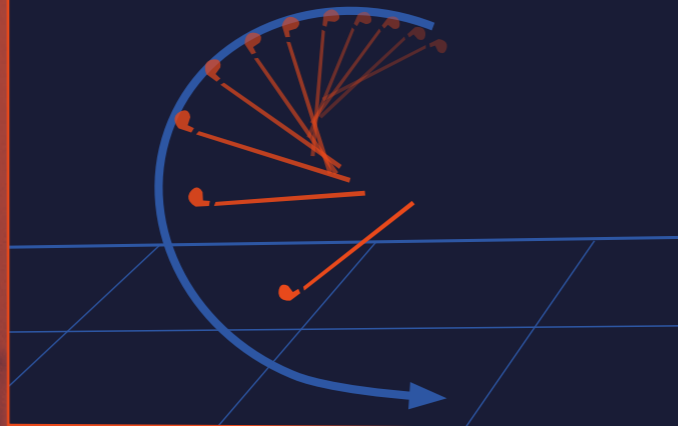# PART 2
# CUSTOM VSTs

## CONTENTS

# WHY DO I NEED A CUSTOM VST?

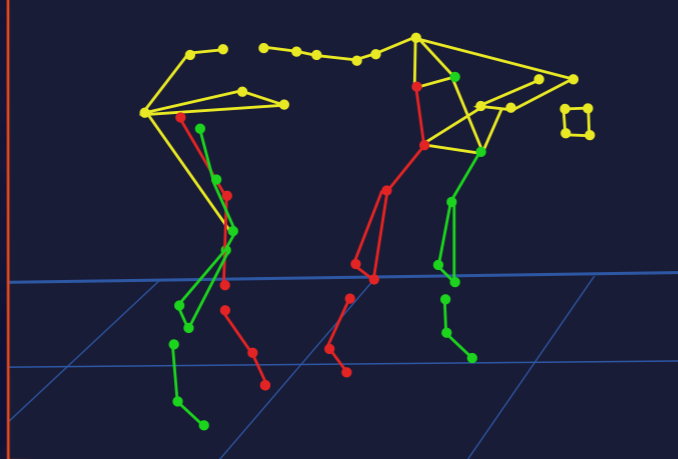If you would like to modify a native Nexus VST, or need a custom markerset, you can create a new VST template file.

## TO TRACK OBJECTS SUCH AS GOLF CLUBS
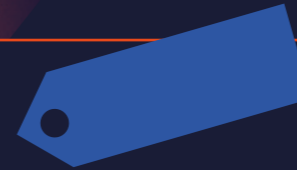
## FOR SPECIFIC STUDIES

## TO TRACK ANIMALS

# WHAT DO I NEED BEFORE STARTING?

## MARKER POSITIONS

Determine where markers will need to be located on the subject so that the future desired calculations can be performed correctly
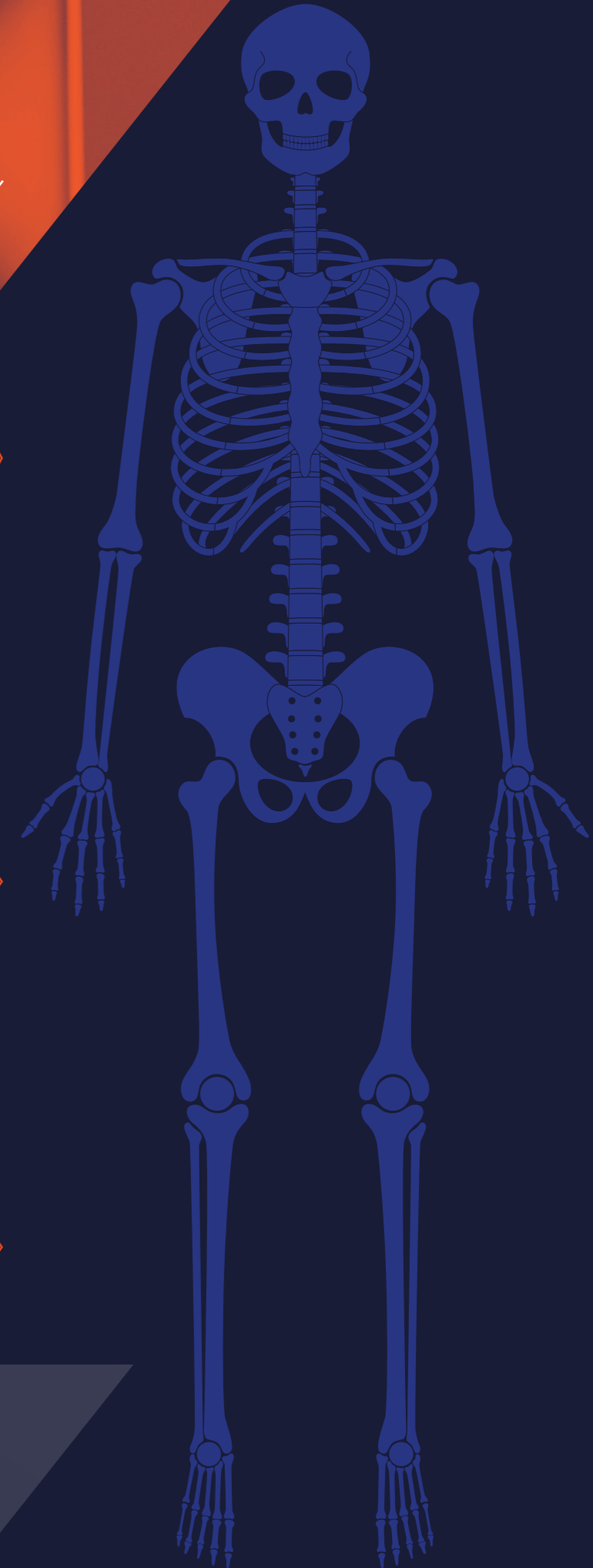
## LABELS

Assign a label to each marker

## STATIC TRIAL

Know which markers, if any, are only required for a static trial

# GETTING STARTED

## 1. CREATE YOUR TEMPLATE

- Use three markers per segment for best results

- Nexus can handle sharing markers between segments if necessary (e.g., fingers which share one marker between segments)

- If using clusters, try to use at least four markers

- Auto-labeling works when body is asymmetrical and the same marker positions/layouts are not used for clusters
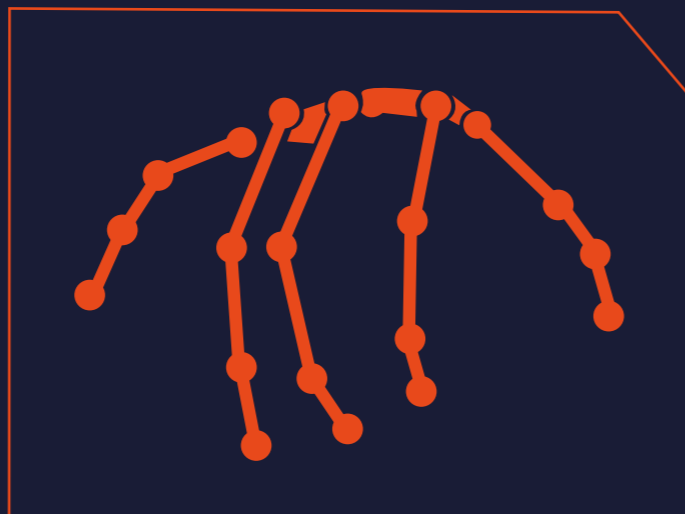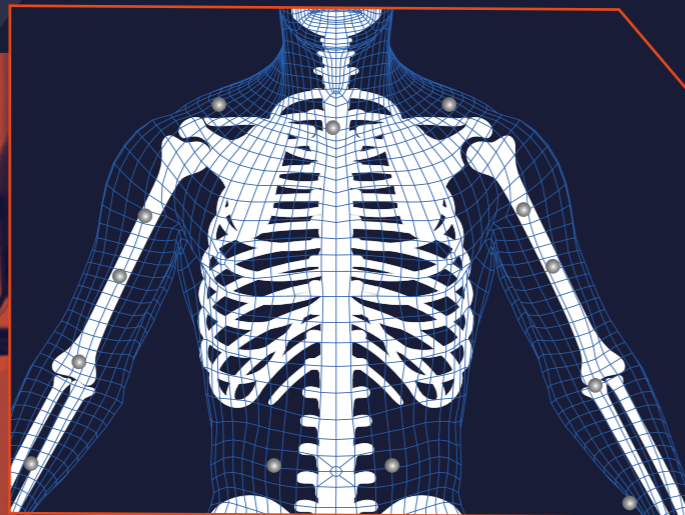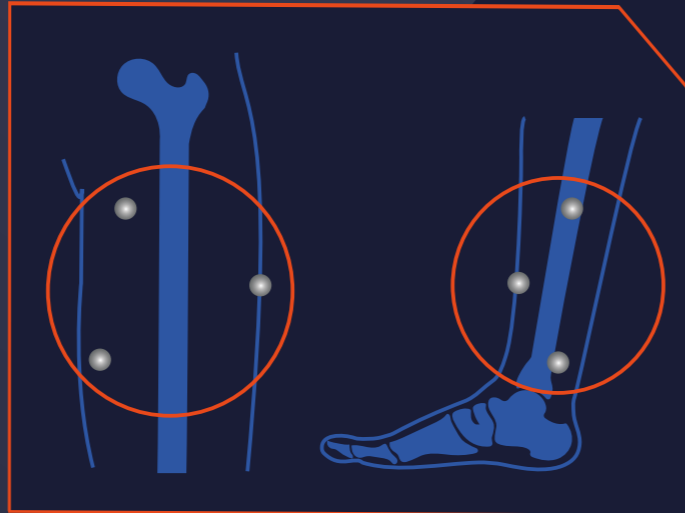
# 2. CAPTURE RAW UNLABELED MARKERS – STATIC TRIAL

One frame of the subject in A or T pose.
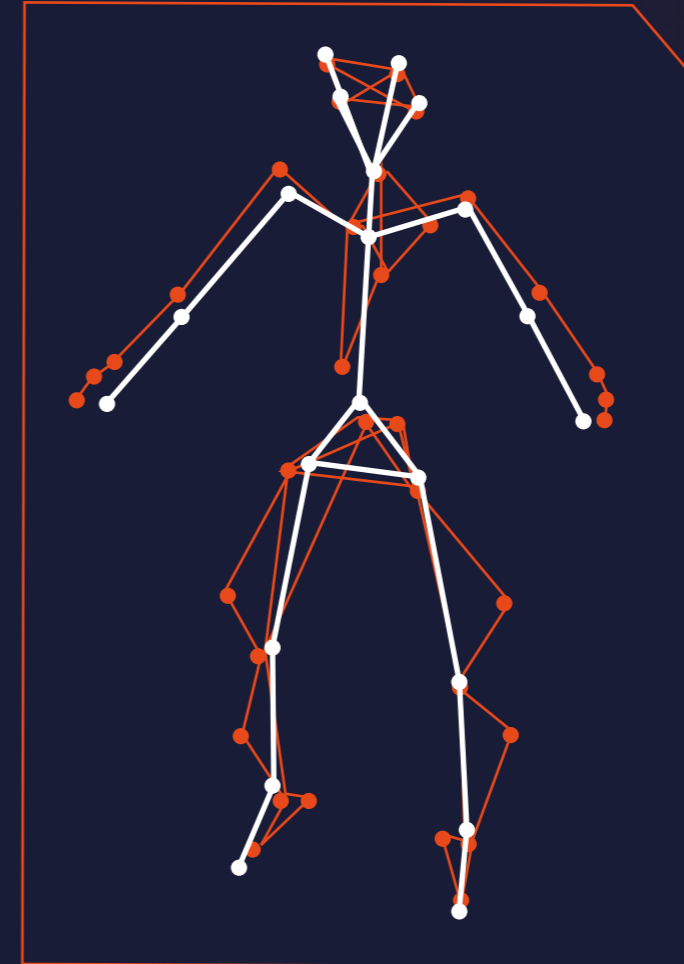
### A POSE

**PROs**
This is easy to hold, therefore a good option if the subject has physical limitations.

**CONs**
It is difficult to achieve a consistent leg and arm stance between subjects.

### CALIBRATING ANIMALS

We understand that capturing a static trial with an animal is not easy. Choose a single frame of a dynamic trial that the animal can replicate easily through its regular movement pattern.

[WATCH VIDEO]
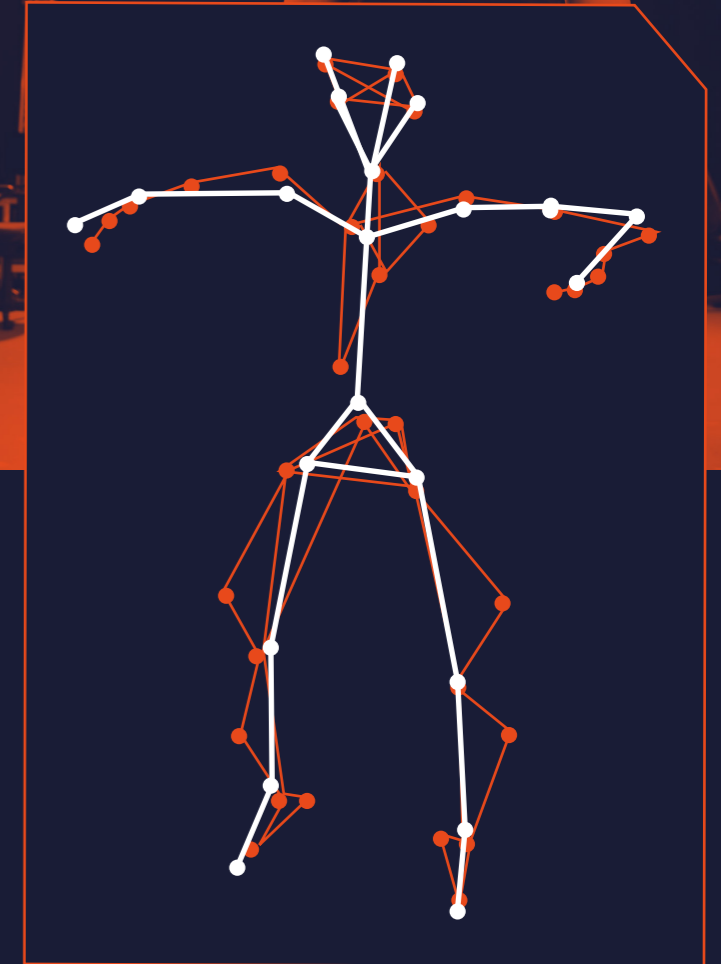
### T POSE

**PROs**
This option is easy to standardize as it is clear how to hold arms horizontally at shoulder height.

PiG uses this as its standardized pose.

**CONs**
This may be difficult to achieve if the subject has physical limitations.

# GETTING STARTED

## 3. CREATE SEGMENTS FROM MARKERS



Link the markers in their segments.

Optional: once done, change colors and marker diameters to aide identification.
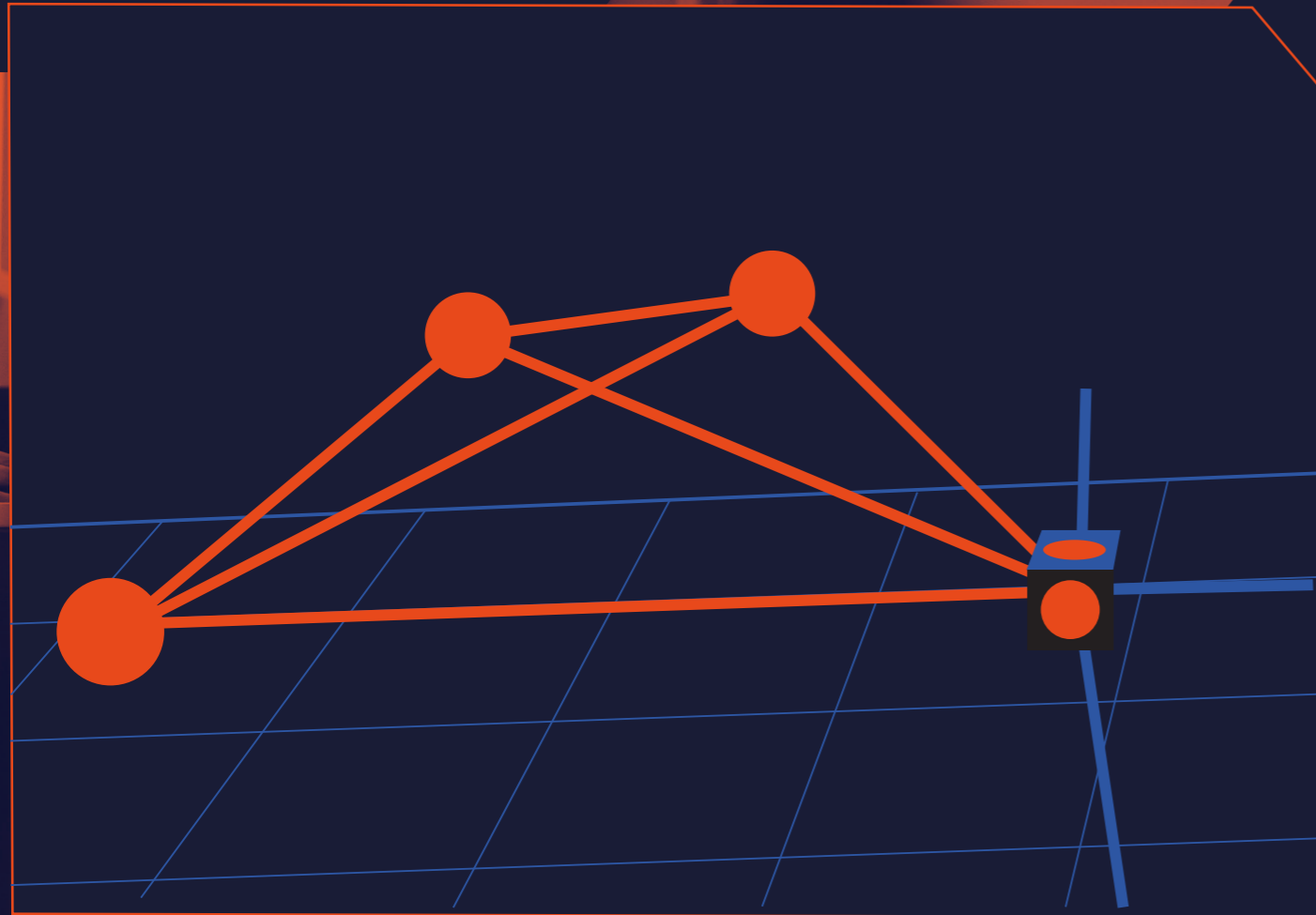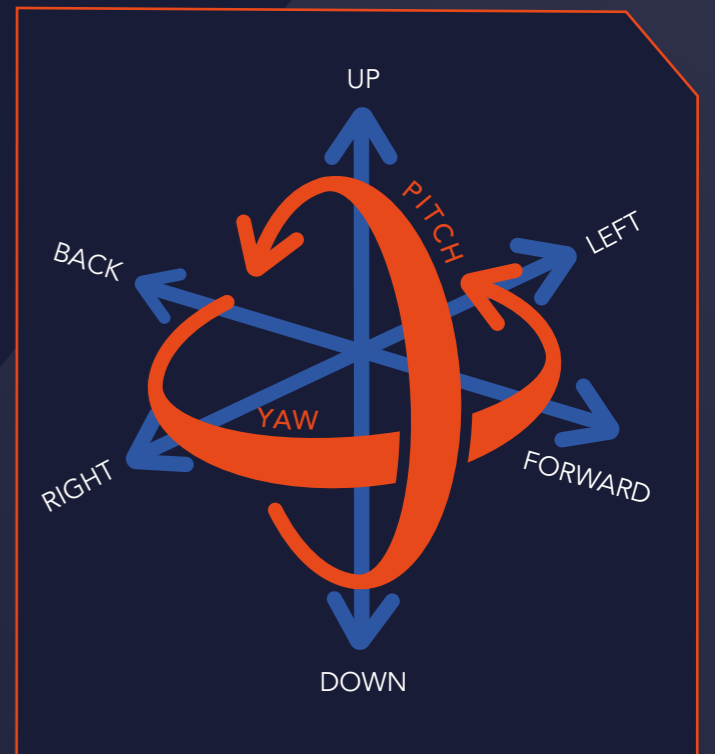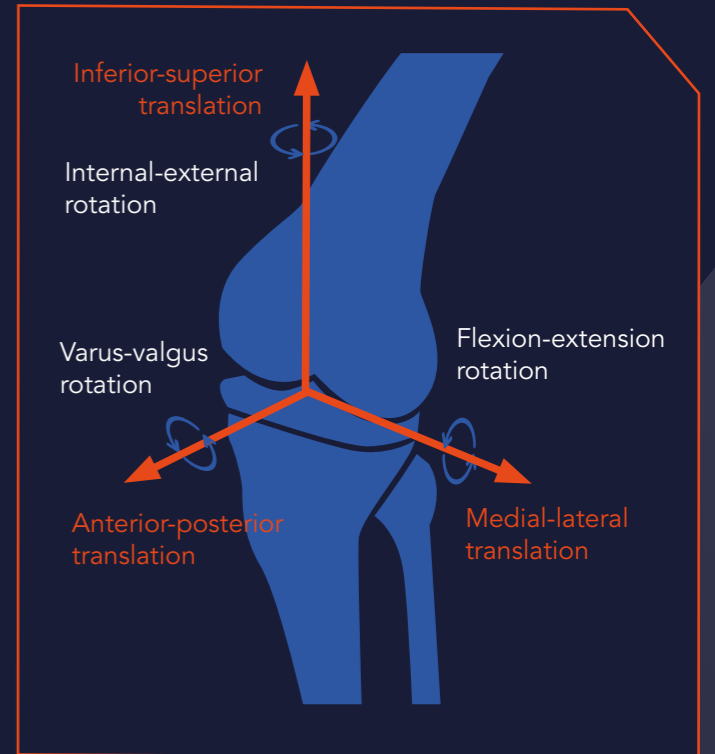
## 4. LINK SEGMENTS (JOINT TYPES)

When choosing a joint type it is best to choose one which represents a simplified version of the anatomical joint(s). The intention is to provide the labeler with the most realistic relationship between segments.

**Free Joint** - links two segments that are not adjacent to each other (6DOF) e.g., tracking only head and pelvis. Often used where movement of parent segment does not affect movement of child segment.

**Ball Joint** - links two segments that are typically adjacent to each other (3DOF) e.g., foot and shank. Often used where movement of parent segment affects the child segment.

**Hardy Spicer Joint** - links two segments that are always adjacent to each other but has a reduced degree of freedom compared to the ball joint. Two rotational degrees around two axis, with two perpendicular vectors defining the directions of the axes around which the joint can rotate (2DOF) e.g., wrist joint between hand and forearm.

**Hinge Joint** - links two segments that share two markers for rotation around a single axis (1DOF) e.g., femur and tibia.
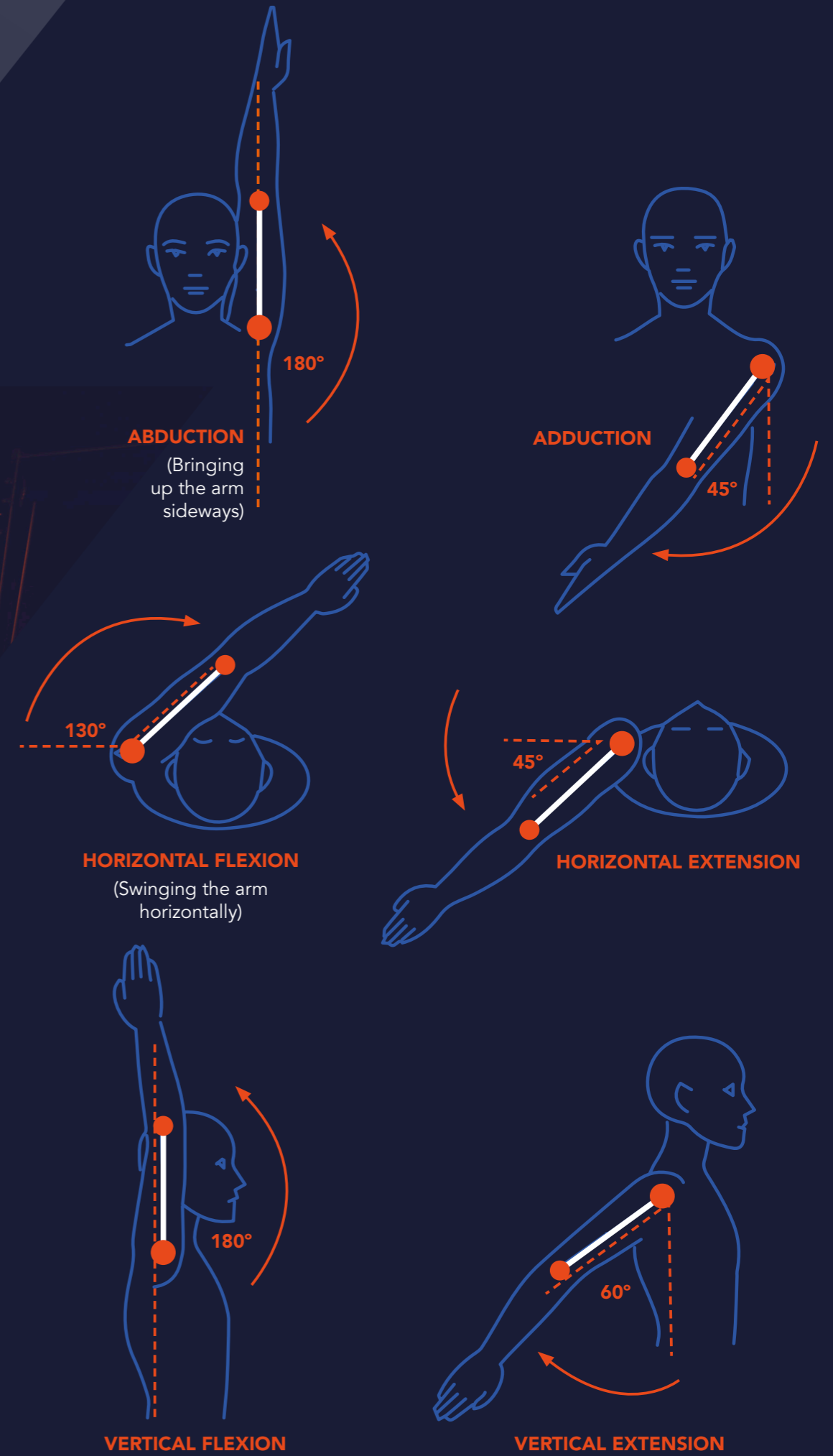


Inferior-superior translation

Internal-external rotation

Varus-valgus rotation

Flexion-extension rotation

Anterior-posterior translation

Medial-lateral translation



UP

PITCH

BACK

LEFT

YAW

RIGHT

FORWARD

DOWN

# GETTING STARTED

## 5. FUNCTIONAL CALIBRATION

A Range of Motion (ROM) trial is used to improve the VST by scaling the subject to optimize the joint positions. After the functional calibration, the VST knows how the different segments of the skeleton move relative to one another, and how the markers move relative to the skeleton. This information is extremely helpful for the auto-labeller and helps account for soft tissue artifact.

## 6. SAVE AS THE VST FOR FUTURE SUBJECT TRIALS



**ABDUCTION**
(Bringing up the arm sideways)
180°

**ADDUCTION**
45°

**HORIZONTAL FLEXION**
(Swinging the arm horizontally)
130°

**HORIZONTAL EXTENSION**
45°

**VERTICAL FLEXION**
180°

**VERTICAL EXTENSION**
60°

# CREATING AN UPPER BODY VST

**Now it's time to put theory into practice. Bring VSTs to life and focus on research, with highly customizable yet simple processing pipelines, clinically validated model outputs and powerful analysis and modelling of data.**
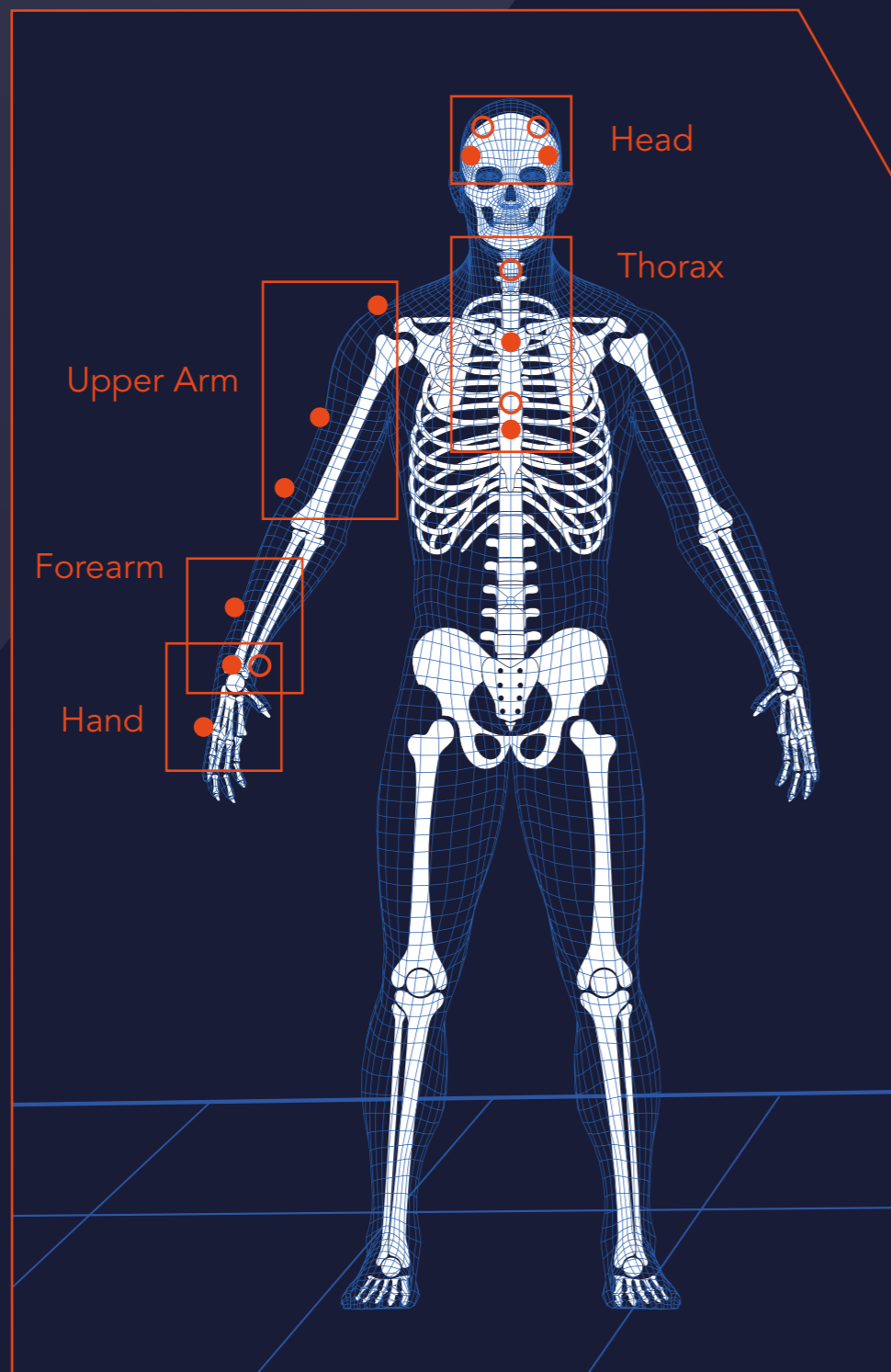
For this demonstration we track a subject's right arm performing a 'reaching' task. The full step by step instructions are available to watch here:

[VIDEO 1]

[VIDEO 2]

## TO BEGIN

- Collect a Range of Motion (ROM) trial with the subject starting in a static pose
- Open ROM trial
- Reconstruct raw markers
- Check all markers are present in 3D perspective



## STEP 1: CREATING SEGMENTS

This labeling template has five segments, all on the right side. In the Labelling Template Builder, enter the name of the root segment ('Thorax' in this case), and then select the markers that belong to the segment. Repeat the procedure for all child segments.
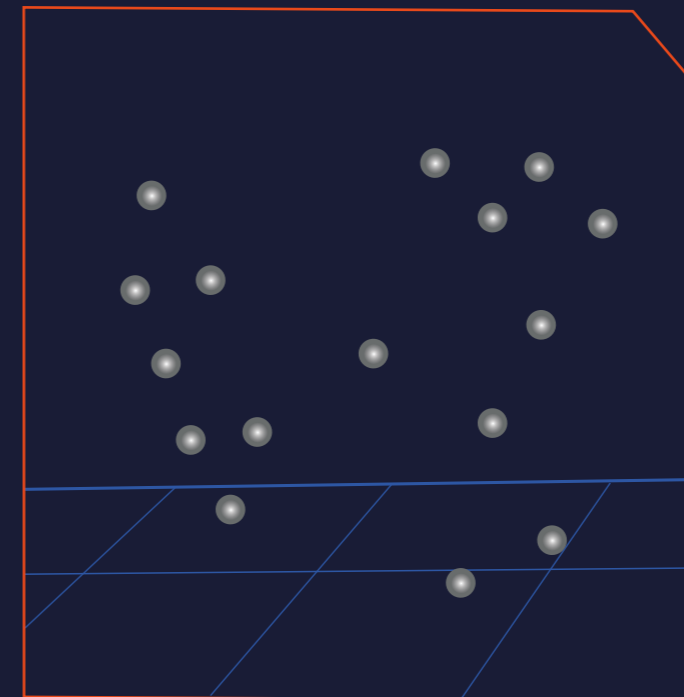


## STEP 2: LINKING SEGMENTS

Link segments hierarchically beginning at the root, using the appropriate joint. Repeat until complete.

Each segment must be linked to another segment.
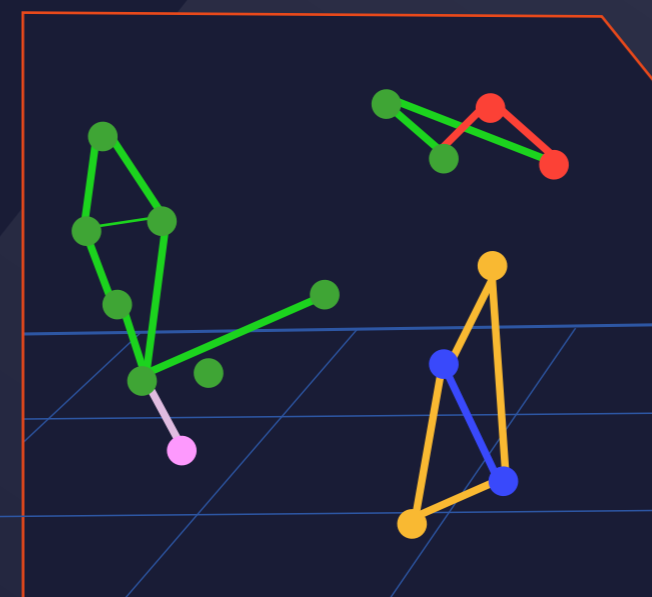


## STEP 3: MANAGE MARKER AND TEMPLATE PROPERTIES

Customize marker list to edit marker names, color and status.

Change marker colors for easy identification and reorganise the sticks connecting markers to visualize. Finally, reordering the marker list helps manual labeling.

## STEP 4: OPTIMIZE YOUR LABELING SKELETON

Functionally calibrate the subject and update its parameters.

## STEP 5: SAVE THE TEMPLATE

Save the Labeling Skeleton as a template so that it can be used to automatically label future subjects wearing the same markerset. The VST is now ready.

## STEP 6: USE THE CALIBRATED VSK FILE TO LABEL DYNAMIC TRIALS

For use with future subjects to capture and calibrate a static trial. Collect dynamic trials and process using Reconstruct and Label. On the pipeline tab calibrate the labeling template. Run to calibrate, save, and process dynamic trials. Use the pipeline shortcut to reconstruct and label data. And now the reaching task is automatically labeled using the VST.

# ADAPTING A CUSTOM VST (INC. FINGERS)

This guide shows how a custom VST can be applied to another subject and adapted to include finger markers for more finger dexterity analysis.

## TO BEGIN

- Collect a Range of Motion (ROM) trial with the subject starting in a static pose
- Open ROM trial
- Reconstruct raw markers
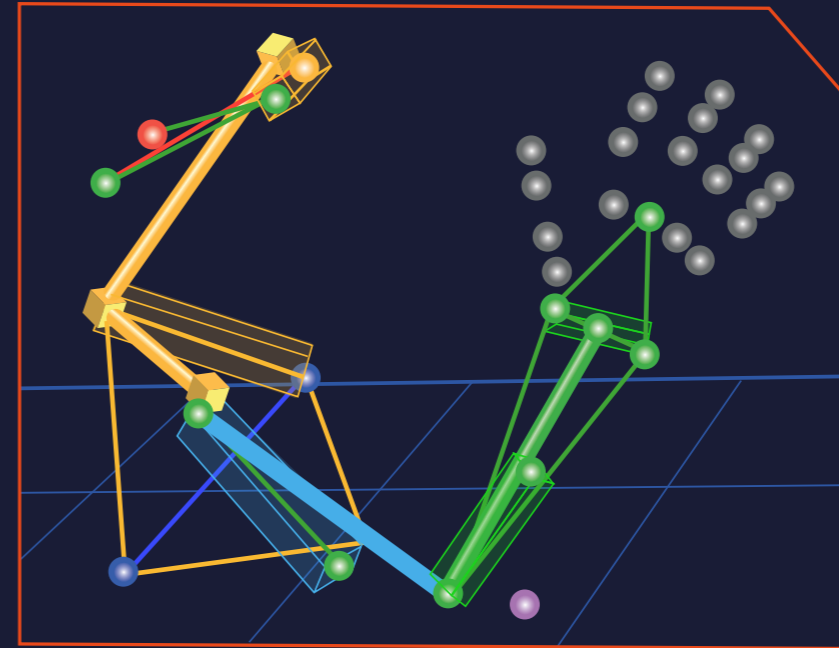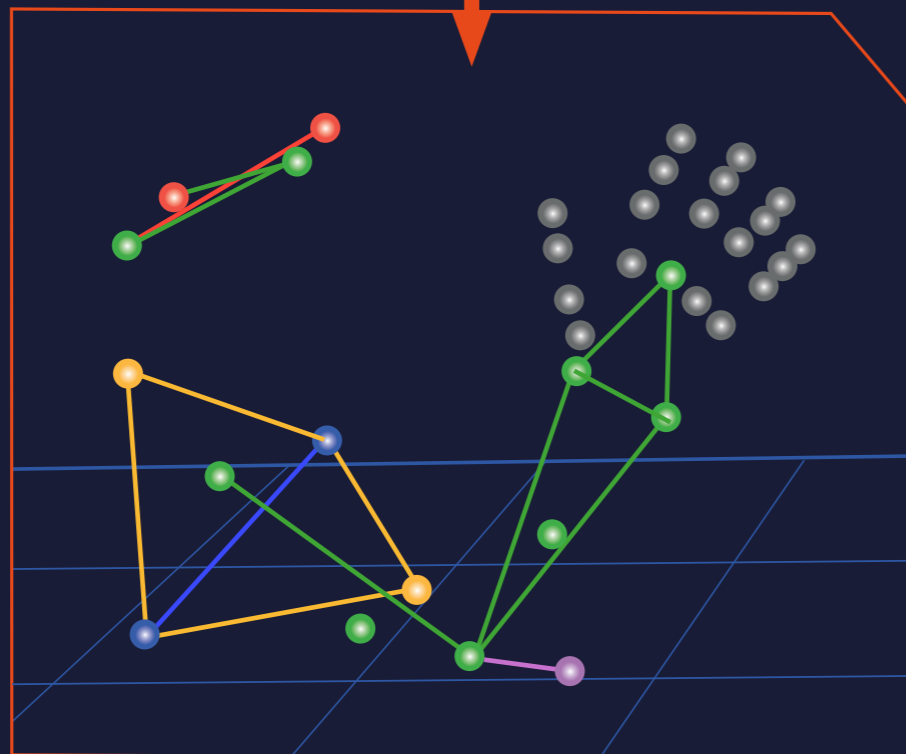- Check all markers are present in 3D perspective
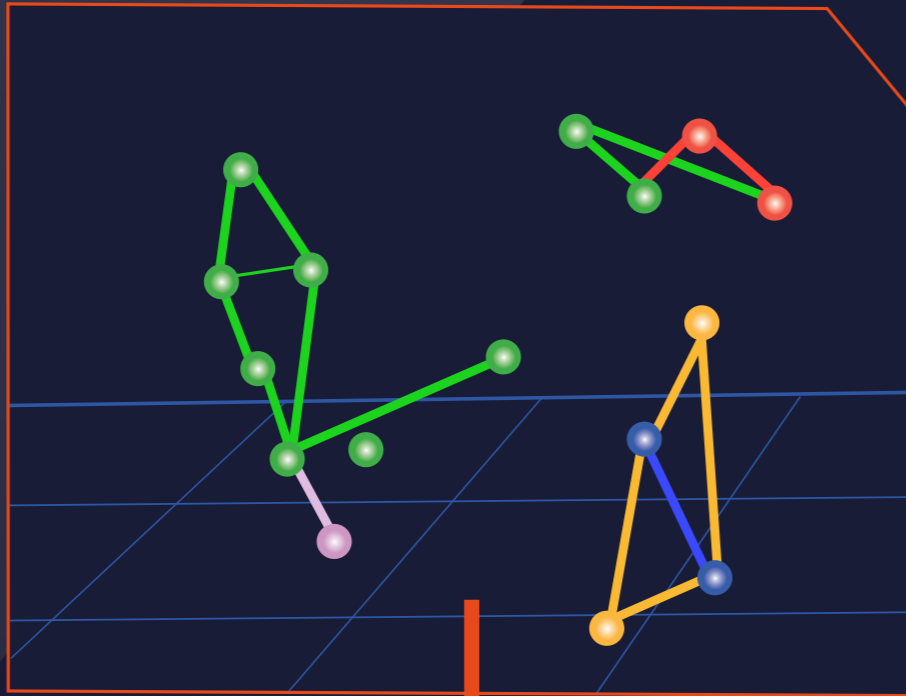
## STEP 1: APPLYING YOUR CUSTOM TEMPLATE

Here the marker set from the previous example is used with additional finger markers. Start by using this with that custom VST.
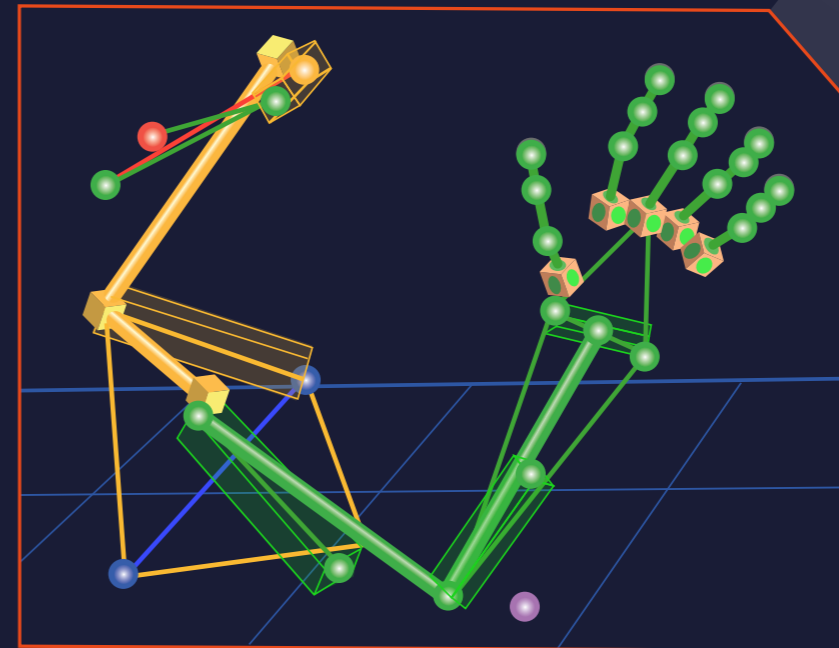
Open the static trial and reconstruct, ensuring that all markers are present.
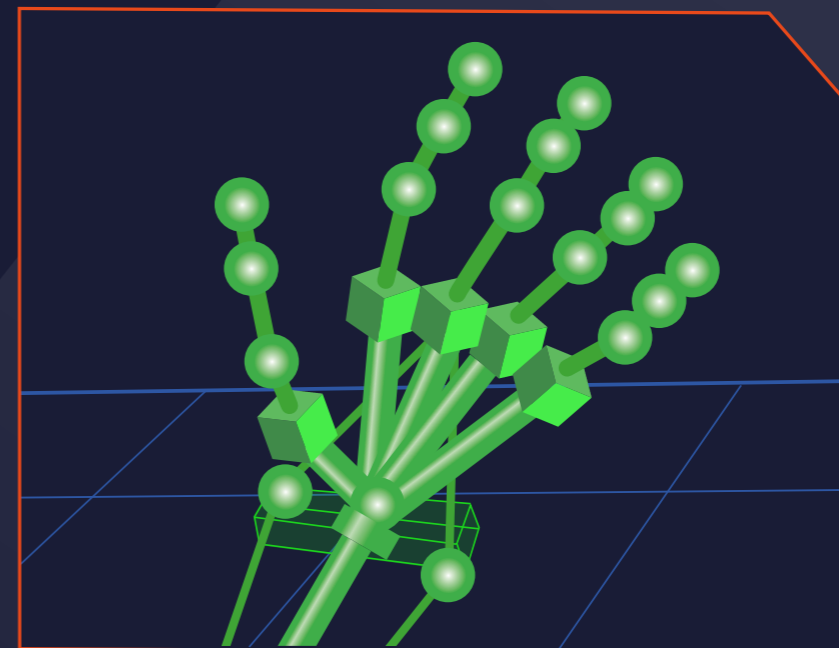
Manually label markers according to previous template.

## STEP 2: SCALE AND CALIBRATE THE SUBJECT

This allows you to add segments to the existing skeleton.

## STEP 3: CREATE FINGER SEGMENTS

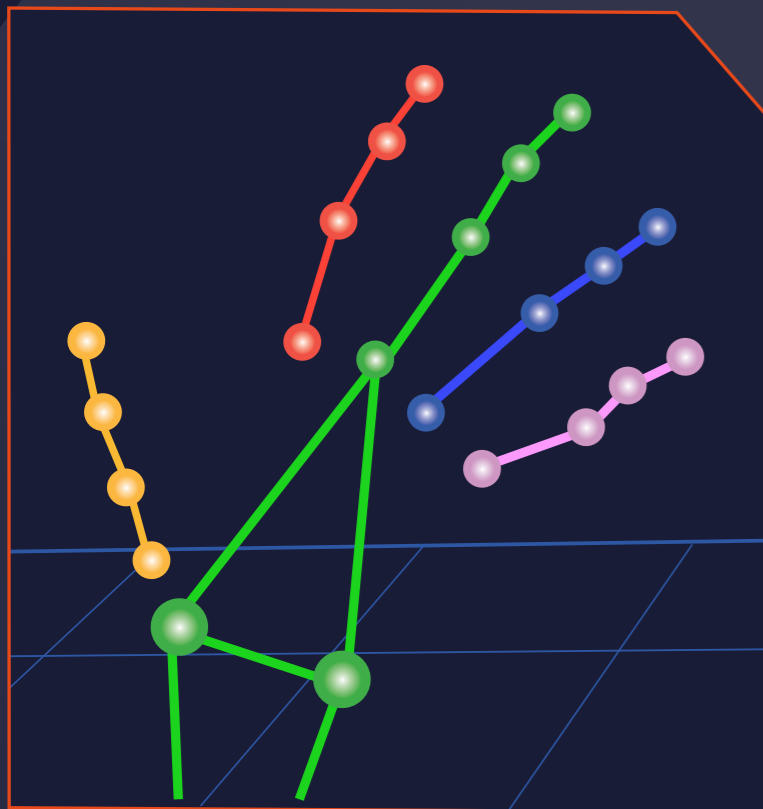We typically recommend three markers per segment but understand this may not be possible in the case of fingers.

## STEP 4: LINK FINGER SEGMENTS

Link segments in order from proximal to distal.

# ADAPTING A CUSTOM VST (INC. FINGERS)



## STEP 5:

### MANAGE MARKER LIST AND TEMPLATE STICKS

Customize the look of your VST.

## STEP 6:

### OPTIMIZE YOUR LABELING SKELETON

Functionally calibrate the subject and update its parameters.

## STEP 7:

### SAVING YOUR VST

Save the Labeling Skeleton as a template so that it can be used to automatically label future subjects wearing the same marker set. The VST is now ready.

## STEP 8:

### CALIBRATED SUBJECT

For use with future subjects to capture and calibrate a static trial. Collect dynamic trials and process using Reconstruct and Label.

On the pipeline tab calibrate the labeling template. Run to calibrate, save, and process dynamic trials.

Use the pipeline shortcut to reconstruct and label data. And now the reaching task is automatically labeled using the VST.
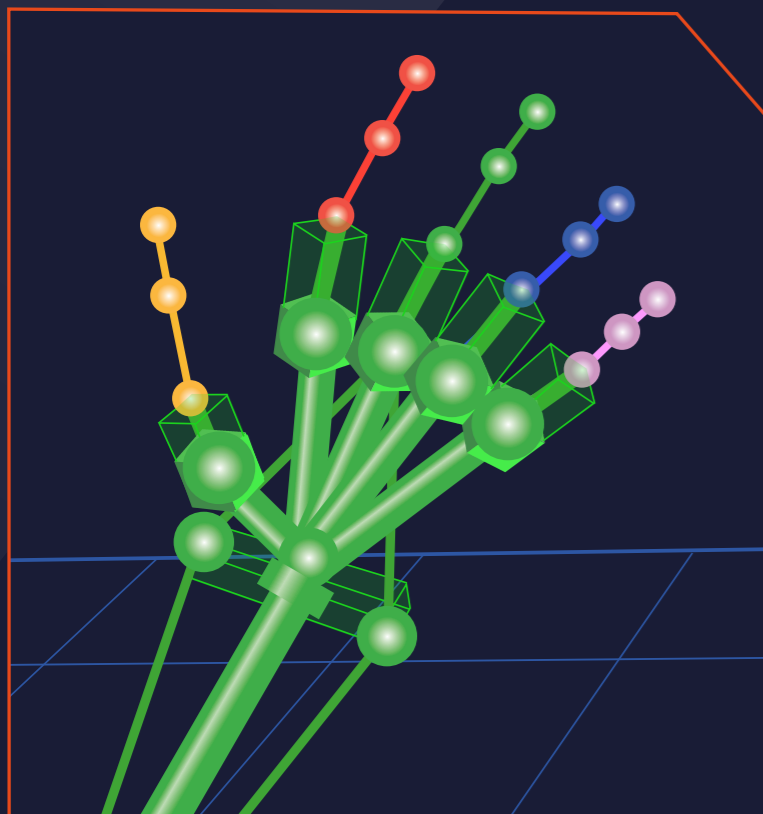
# USEFUL INFORMATION

### THINGS TO REMEMBER

- Sticks are only used for visualization purposes and do not affect labeling performance. They can be extremely useful for helping to identify marker labels quickly.

- If your segment names begin with left or right, the markers and sticks will be automatically colored red and green, respectively.

- See all assigned marker labels in the 3D Perspective view, press CTRL+space bar, to check that all the required markers are present and correctly labeled

- A labeling skeleton template (VST) defines a marker set and enables Nexus to perform automatic labeling. It is not a biomechanical model that will output valid joint angles or other kinematic/kinetic variables. To compute valid kinematics or kinetics, you must either use a native biomechanical model (such as Vicon Plug-in Gait, which involves running specific pipelines in Nexus) or create your own model using Vicon ProCalc , MATLAB, or Python.

### RESOURCES AVAILABLE

- Online docs (models, scripts, sample data)
- Video tutorials
- Live support
- YouTube

### TROUBLESHOOTING / FAQS

- Be sure to stay on the same frame of the trial if you're editing an existing model.

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