

# Theia

[Theia's markerless motion capture technology](#) integrates with Visual3D and Sift by exporting C3D files, allowing users to process, analyze, and visualize their data. Visual3D recognizes these C3D files as Theia3D output and automatically creates a model and assigns the associated motion file during import.

A standing (static) trial is generated virtually based on the parameters found within the movement trial, rather than requiring a separate static capture. Model segments and landmarks are created automatically based on the Theia data. It's important to note that Theia3D stores [ROTATION signals](#), not traditional TARGET signals. These ROTATION signals include the full six degrees of freedom (6 DOF) for each segment, as a 4x4 transformation matrix. When a ROTATION signal is selected for a segment location, only the position component is used unless further configuration is specified. Unless there is a specific need to modify the coordinate system, the ROTATION signal is directly assigned to the pose of the model segment without further processing. The ROTATION folder in **Signals and Events** displays all the ROTATION signals exported by Theia3D.

Each ROTATION signal consists of 17 float values per frame: sixteen values represent the 4x4 transformation matrix, and the seventeenth is a reliability metric. These signals are stored sequentially in the C3D file. This data type is used in practice because if a segment's origin is defined at the proximal end, the ROTATION matrix provides a description of both the position and orientation of that segment. This eliminates the need for additional calculations to estimate pose and makes data management easier, since the pose is a single signal.

This integration supports all Theia3D software versions including [Theia Axiom v2025](#), [Theia Apollo v2024](#), [Theia 2023](#), Theia 2022, and Theia 2021.

## Automatic Model-building

Visual3D will automatically build a model for [C3D files](#) output by Theia3D. The model has 17 body segments, two lab coordinate systems (global and [virtual lab](#), and 4 shadow segments. Visual3D also builds model segments for Theia's baseball bat and ball tracking.

|                |               |                     |                         |                        |
|----------------|---------------|---------------------|-------------------------|------------------------|
| 1. Lab         | 6. Right Toes | 11. Thorax          | 16. Left Upper Arm      | 21. Left Foot (Shadow) |
| 2. Pelvis      | 7. Left Thigh | 12. Head            | 17. Left Forearm        | 22. Thorax/Ab (Shadow) |
| 3. Right Shank | 8. Left Shank | 13. Right Upper Arm | 18. Left Hand           | 23. Head (shadow)      |
| 4. Right Thigh | 9. Left Foot  | 14. Right Forearm   | 19. Virtual Lab         | 24. Baseball Bat       |
| 5. Right Foot  | 10. Left Toes | 15. Right Hand      | 20. Right Foot (Shadow) | 25. Baseball Ball      |

## Kinetic But No Force Assignment

The Right and Left Foot segments are defined as kinetic segments but are not allowed to have forces assigned to them. This ensures that forces are assigned always assigned to the Right/Left Toes segments which are the most distal segments in the kinetic chain.

## Shadow Segments

The shadow segments defined to model Theia3D and their underlying purpose are:

- Right/Left Foot: Make joint angles easier to interpret
- Thorax/Ab: Invert proximal/distal; place origin at pelvis
- Head: Place origin at proximal head; account for CoM

## Version Requirements

Theia releases newer, more advanced, models over time and users must make certain that their version of Visual3D supports automatic model-building for their version of Theia3D. Different versions of Theia will produce different model / segment definitions.

| Theia3D Version    | Notes/Description                                                                                                                    | Visual3D Version |
|--------------------|--------------------------------------------------------------------------------------------------------------------------------------|------------------|
| v2025.2.2          | Added Ball Modelling to automatic model                                                                                              | v2026.04.1       |
| v2025.2.2          | Implemented Bat and Ball modelling using multiple subjects, allowing multiple balls and bats to be modelling within a single session | v2026.04.1       |
| v2025.2.0          | Introduced Bat Tracking feature                                                                                                      | v2026.01.1       |
| Axiom (v2025.1.0)  | Separate inertial parameters for male and female participants.                                                                       | v2025.03.2       |
| Apollo (v2024.1.0) | Introduction of new model.                                                                                                           | v2024.08.4       |
|                    | Model 10                                                                                                                             | v2024.02.1       |
|                    | Initial Model                                                                                                                        | v2020.03.16      |

## Merging Theia3D Files

Typically, users want to merge Theia3D's motion capture output and analog signals such as force platform recordings.

The [Manage\\_File\\_Merge](#) command is designed to merge multiple files that recorded data from the same motion capture trial. This command merges data types from each .c3d file into one trial in the Visual3D workspace. This command was originally called **Manage\_Theia3D\_Merge**, but since has been updated to be used for file types other than from Theia3D.

This pipeline command makes it simple to merge markerless motion capture files from Theia with marker-based motion capture files from [Qualisys QTM](#).

The following [sample data](#) can be used to follow along with the outlined steps in [Merge Theia with QTM Analog Data](#)

## Loading Theia C3D Files into Sift

Users wanting to import Theia C3D files into Sift can use the Theia Builder to build CMZ files from the Theia3D outputs and merge these with analog data if desired. Sift's tutorials include a walkthrough of

how to use the [Theia Builder](#) feature.

## Batch Reprocessing Theia Files

If your reprocessing workflow involves going back to your raw video data and rerunning Theia's pose estimation, e.g., when a new model is released, then you can incorporate this into your Sift console script. The [-RunTheiaBatch](#) console command tells Sift to call to Theia3D with an instruction file for batch processing.

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