

OptiTrack Motion Capture System



(주)두리시스템테크놀로지
박수빈

해당 자료의 저작권은 (주)두리시스템테크놀로지에 있으며 저작권자의 동의 없이 본 자료를 복제·전송·배포하는 등의 행위를 금합니다.

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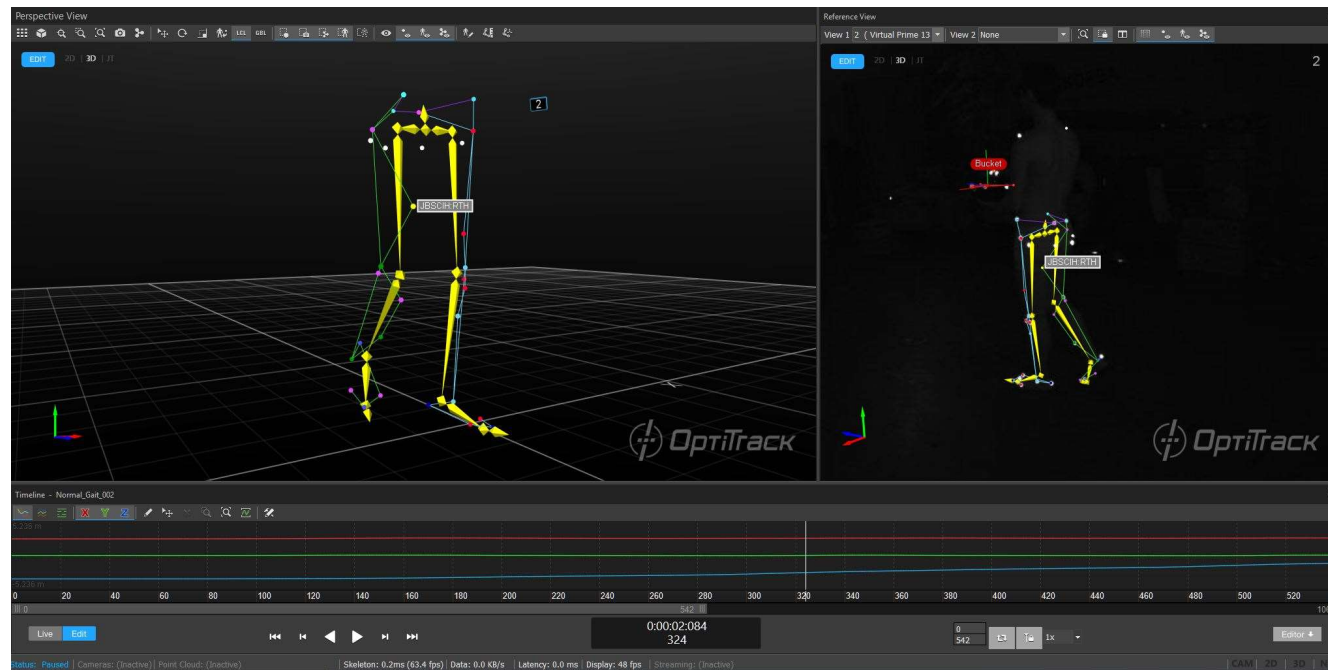
※ OptiTrack 참고자료



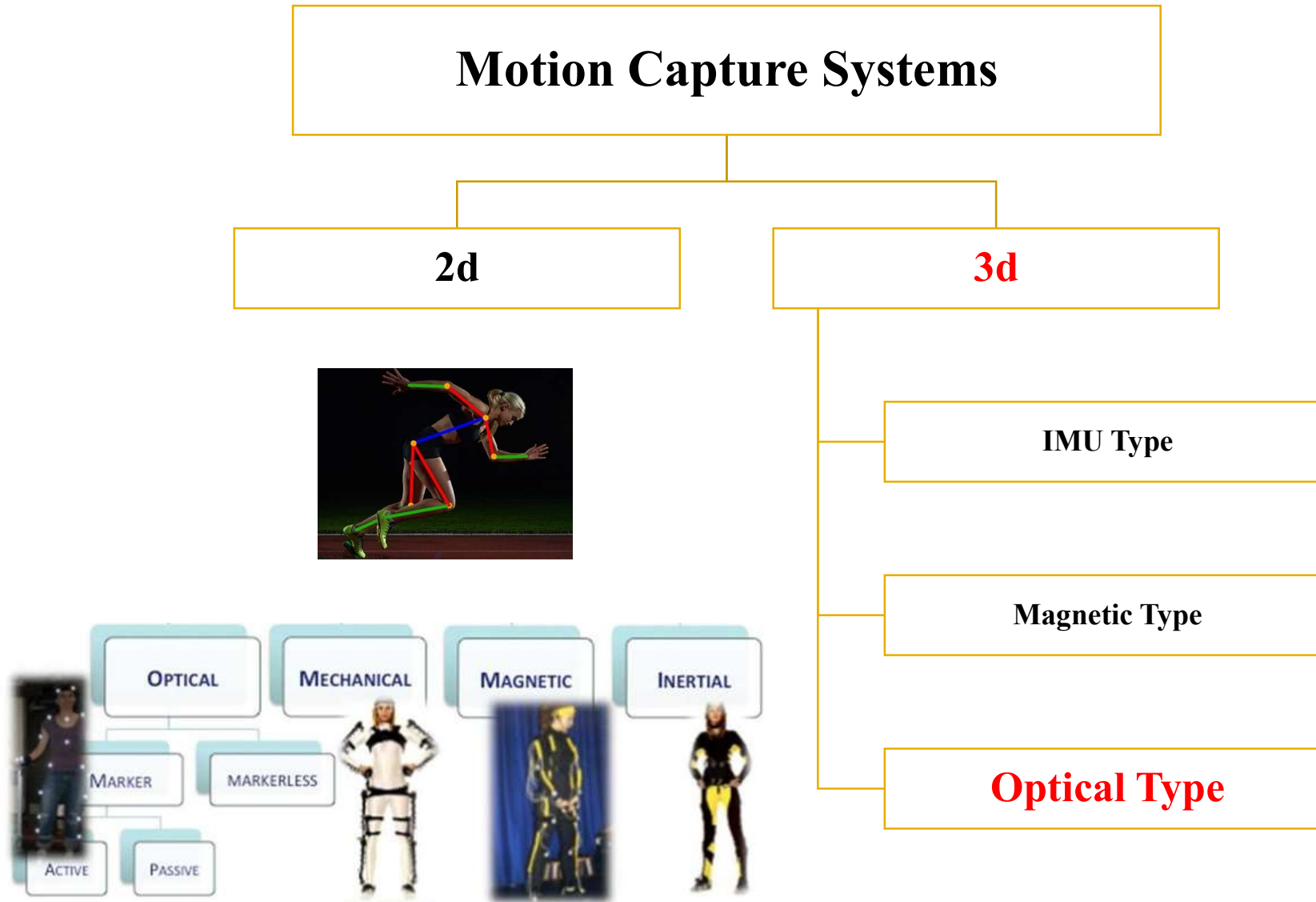
Introduction

1. What is Motion Capture System?

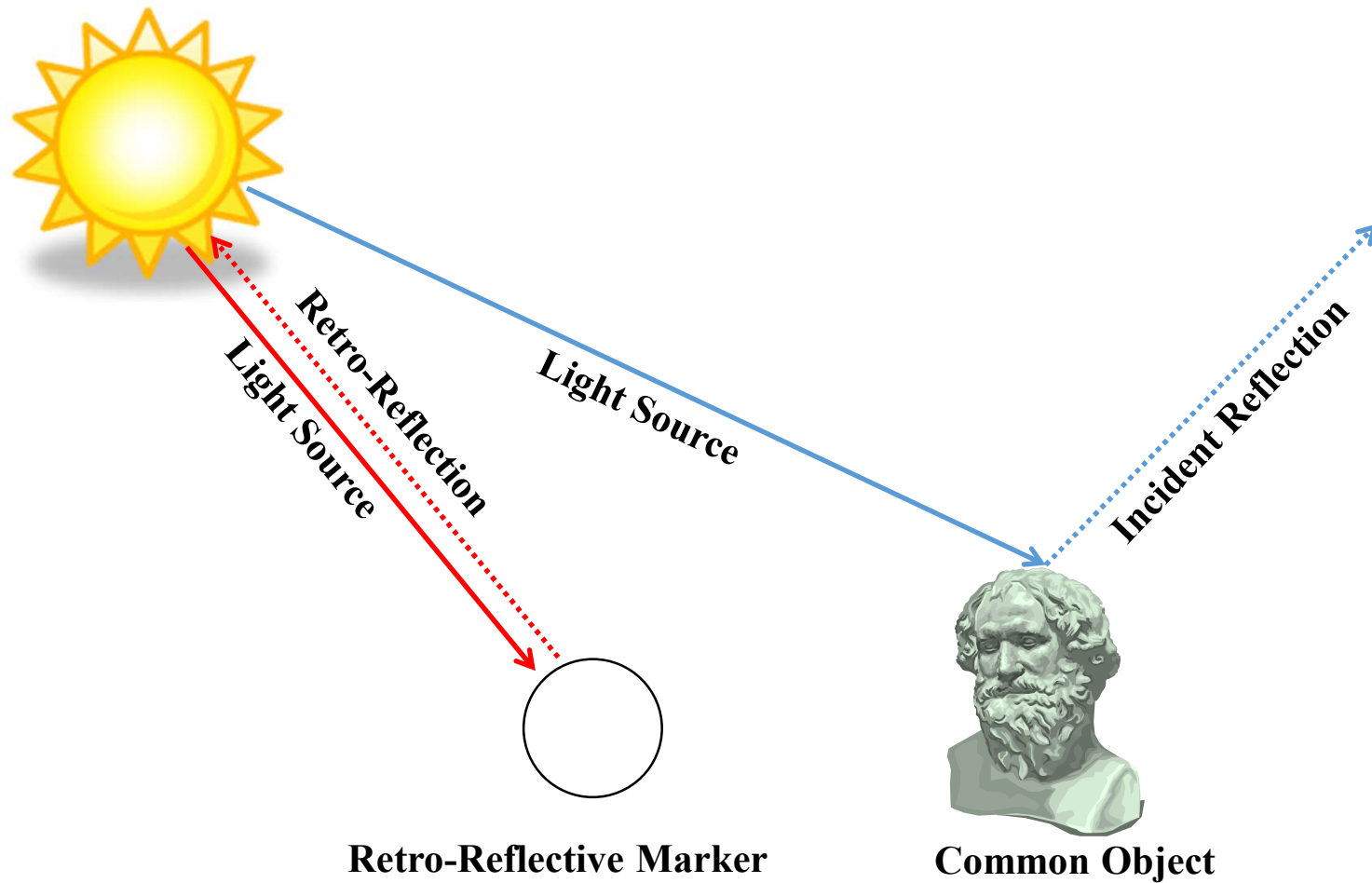
- 대상(인체, 동물, 기계 등)의 움직임, 관련된 정보(위치, 속도, 가속도)를 시간에 따라 기술하는 것
- 정보를 감지(Sensing), 수치화(Digitizing), 기록(Recording), 가시화(Visualization)하는 시스템



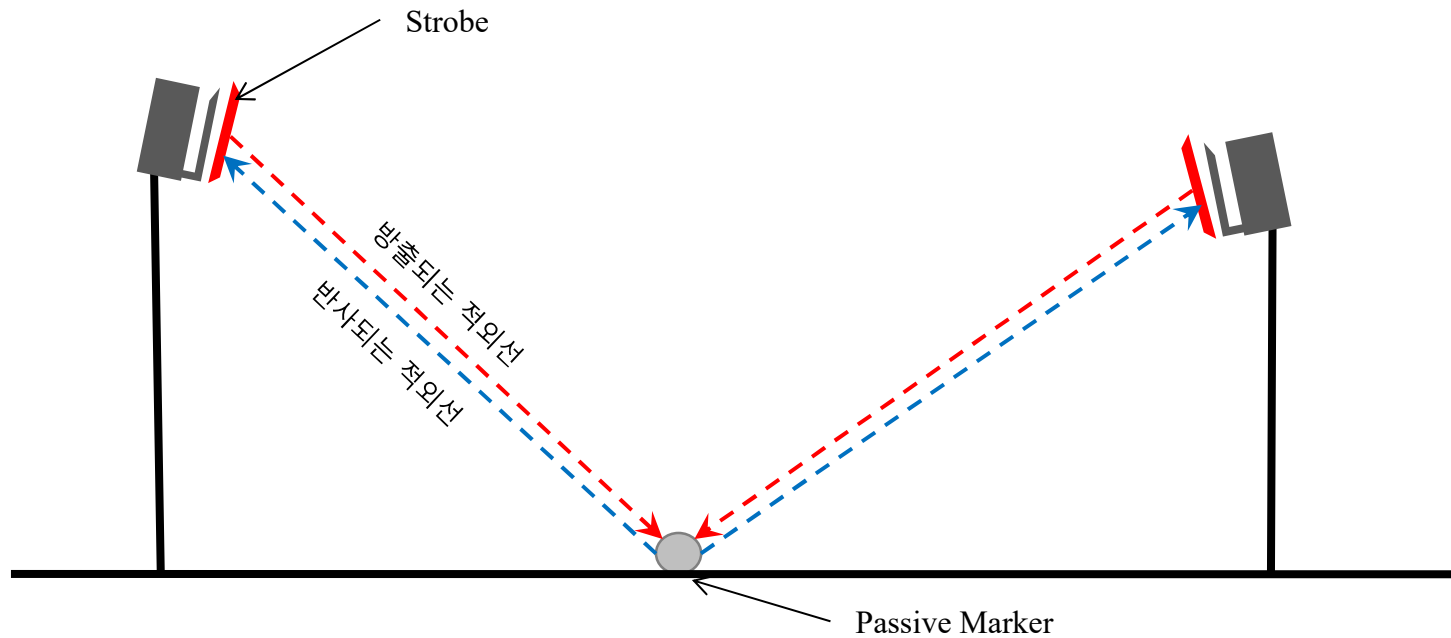
2. Type of Motion Capture System



3. Principle of Optical Motion Capture System

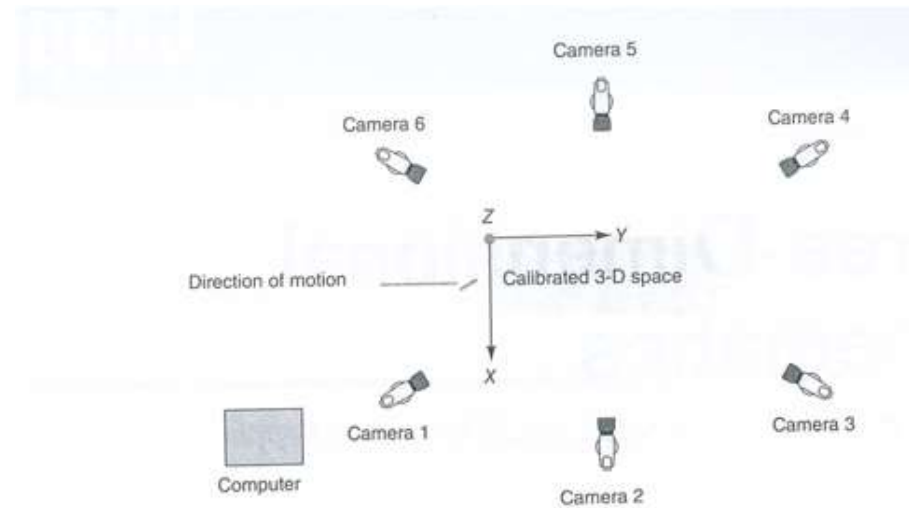


3. Principle of Optical Motion Capture System

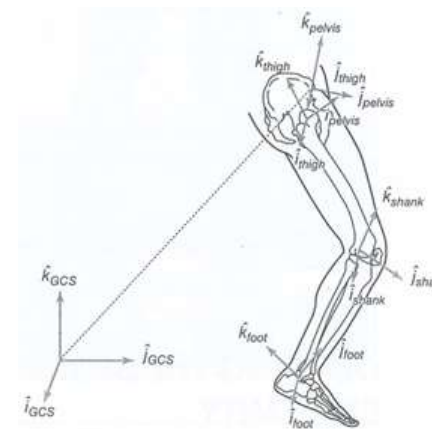


3. Principle of Optical Motion Capture System

- Typical multi-camera setup for a 3-D kinematics analysis



- Global coordinate system(GCS)
 - 3-D space of the motion-capture system
- Local coordinate system(LCS)
 - LCS fixed in the segment



4. Measure Factor in Motion Capture

- Motion in 3-D space without regard to the forces

- Position
- Velocity (v)
- Acceleration (a)
- Angle (θ)
- Angular Velocity (ω)
- Angular Acceleration (α)

Position on X/Y/Z

Format Version	1.22	Take Name	Rigid_Body_02_Simple_	Capture Frame Rate
		Rigid Body 1:Marker1	Rigid Body 1:Marker1	Rigid Body 1:Marker1
		8392B20CF49E3573100	8392B20CF49E3573100	8392B20CF49E3573100
		Position	Position	Position
Frame	Time (Seconds)	X	Y	Z
0	0	1918.725342	54.512104	-1288.905151
1	0.008333	1918.723755	54.505859	-1288.905762
2	0.016667	1918.723145	54.509613	-1288.904175
3	0.025	1918.721436	54.507214	-1288.90332
4	0.033333	1918.722534	54.507668	-1288.910034
5	0.041667	1918.715698	54.511219	-1288.907349
6	0.05	1918.71521	54.506104	-1288.90332
7	0.058333	1918.721191	54.504513	-1288.902954
8	0.066667	1918.718994	54.499847	-1288.905151
9	0.075	1918.718628	54.503941	-1288.909058
10	0.083333	1918.725342	54.511337	-1288.907959
11	0.091667	1918.717773	54.504215	-1288.904297
12	0.1	1918.712036	54.502724	-1288.897461
13	0.108333	1918.7229	54.496922	-1288.897827



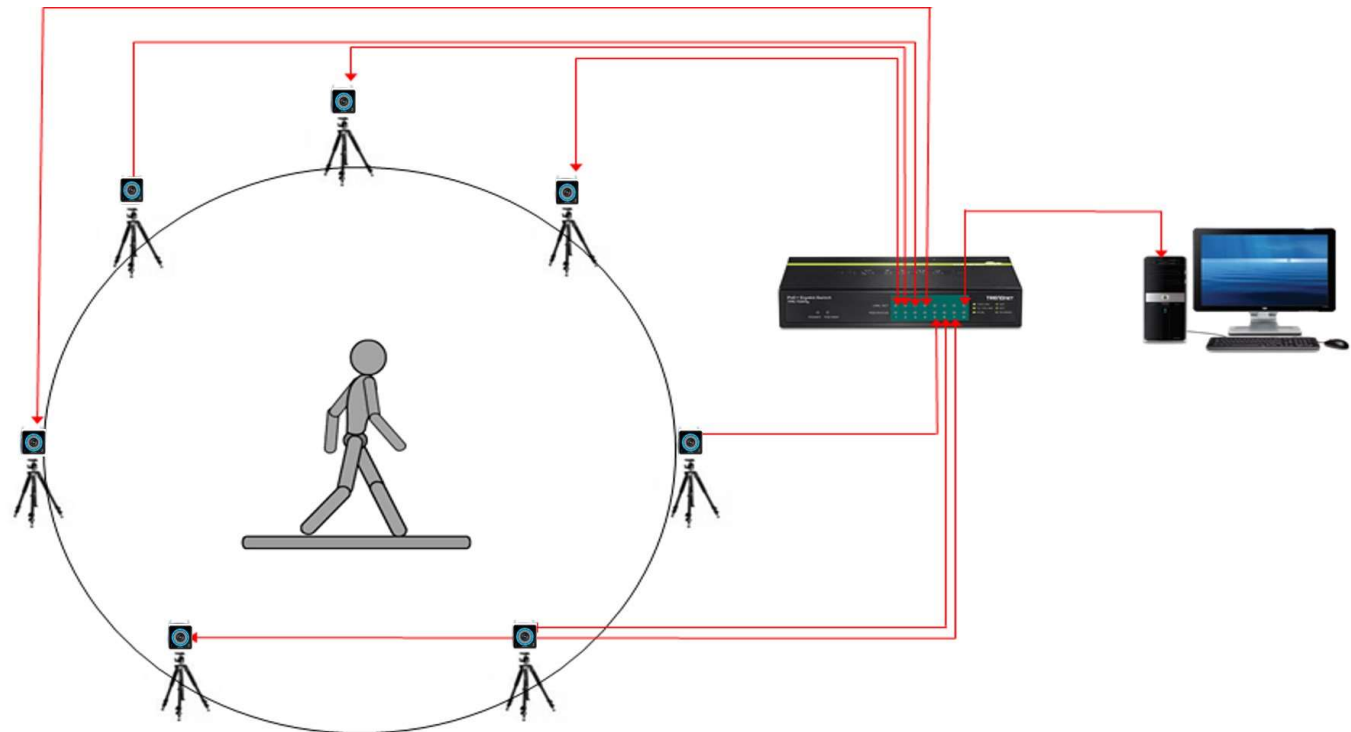
Optitrack Motion capture system 의 활용

※ OptiTrack System 의 구성

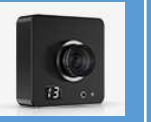
1. Camera
2. PoE or PoE⁺ Hub
3. PC

and

Calibration wand,
Calibration square,
Marker, · · · etc.



※ OptiTrack System 의 구성 - Camera

									
	Prime ^x 41	Prime ^x 22	Prime ^x 13W	Prime ^x 13	Slim ^x 13	Flex 13	Flex 3	V120:Trio	V120:Duo
Volume	Large	Med-Large, High Speed	Medium	Wide FOV	Medium, Active Cam	Medium, Passive Cam	Small, Passive Cam	Tracking Bar, Passive Cam	
Resolution	2048 x 2048	2048 x 1088	1280 x 1024				640 x 480	640 x 480 (x 3)	640 x 480 (x 2)
Frame Rate	180 Hz	360 Hz	240 Hz			120 Hz	100 Hz	120 Hz	120 Hz
Latency	5.5 ms	2.8 ms	4.2 ms			8.3 ms	10 ms	8.3 ms	8.3 ms
Accuracy (9m x 9m Tracking area)	±0.1 mm	±0.15 mm	±0.3 mm	±0.2 mm	±0.3 mm	±0.2 mm	±0.5 mm	±0.5 mm	±0.5 mm
Tracking Range (using a 14mm)	Passive: 30m Active: 45m	Passive: 21m Active: 30m	Passive: 9m Active: 15m	Passive: 16m Active: 25m	Active: 15m	Passive: 9m	Passive: 6m	Passive: 8m	Passive: 8m
Stock Lens	51° x 51° FOV	79° x 49° FOV	82° x 70° FOV	56° x 46° FOV	56° x 46° FOV	56° x 46° FOV	46° x 35° FOV	47° x 43° FOV	47° x 43° FOV
LED Ring	20 LEDs (UHP) 850 nm IR		10 LEDs (UHP) 850 nm IR			28 LEDs 850 nm IR	26 LEDs 850 nm IR	26 LEDs (x 3) 850 nm IR	26 LEDs (x 2) 850 nm IR
Connections	GigE data port Ethernet camera sync PoE or PoE+ power		GigE data port Ethernet camera sync PoE power			USB 2.0 data port USB 2.0 camera sync USB 2.0 power		USB 2.0 data port IO-X camera sync 12V @ 3A power	

※ OptiTrack System 의 구성 - PoE/PoE⁺ Hub

- PoE/PoE⁺ Hub
 - 카메라 각각의 정보를 하나로 모아 PC로 보내주는 Sync 장비



10port
8대 Prime^x 13/13W, 15 watts
6대 Prime^x 22/41, 30 watts



24port
23대 Prime^x 13/13W, 15 watts
12대 Prime^x 22/41, 30 watts

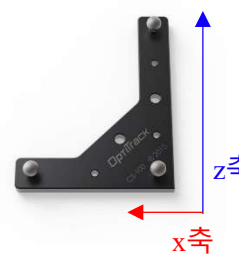
※ OptiTrack System 의 구성 - Wand, Square

- CW-500 Calibration Wand Kit
 - 공간 상의 좌표계 형성 도구
 - 카메라의 상대 위치 계산
 - 3 Marker 구성
 - ✓ A홀 : 500mm(15.9mm Marker 사용)
 - ✓ B홀 : 250mm(12.7mm Marker 사용)

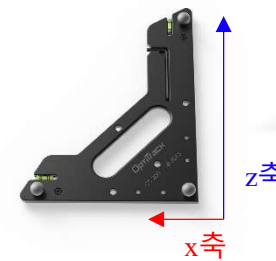


CW-500 Calibration Wand Kit

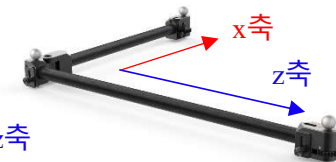
- Calibration Square
 - 공간 상의 원점 Origin 설정 도구
 - ✓ CS-100 : Vertical offset 11.5mm
 - ✓ CS-200 : Vertical offset 19mm
 - ✓ CS-400 : Vertical offset 45mm



CS-100



CS-200



CS-400

1. 하드웨어 설치

1. 캡처 공간 정리

- 주변 환경 정리
- 외부 빛, 바닥 반사 차단

2. 카메라 위치 선정

- 하나의 Marker를 최소 두 대 이상의 카메라가 볼 수 있도록 위치 조정

3. 카메라 선 연결

- 카메라와 PoE /PoE⁺ switch Hub의 거리 100m 이내
- Gigabit (1000 Mb/s) Ethernet port 이용
- 외부 Network 이용 시 다른 Network card 이용
- 방화벽, 안티바이러스 프로그램 실행 종료
- Cat6e, Cat6a, and Cat7 Lan 케이블 이용

2. 소프트웨어 설치

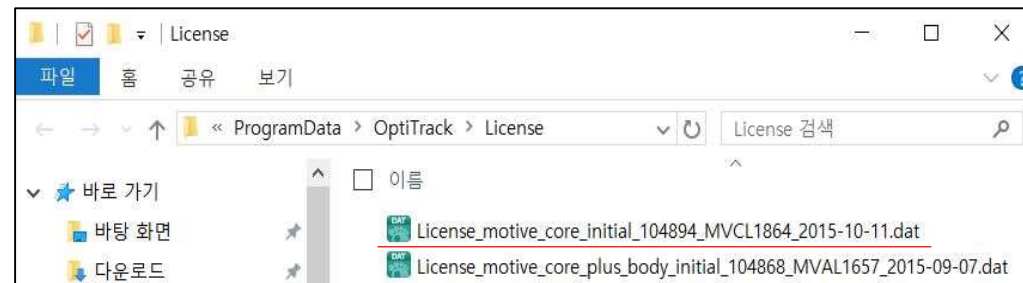
- Motive software 설치 및 License 활성화
 - 최신 Motive software 다운로드 및 설치
 - ✓ Motive 설치 (PC 인터넷 연결 필수)
 - ✓ www.optitrack.com/downloads
 - License 활성화 서비스
 - ✓ PC에 인터넷 연결하기
 - ✓ 시작 - 모든프로그램 - OptiTrack - Motive - License Tool 실행
 - ✓ 정보 입력 후 Activate 클릭

* 사용하고자 하는 PC에서 인터넷 사용이 불가할 경우,
인터넷이 연결된 PC에서 License 활성화 후 License folder 내의 .dat 파일 이동



※ License 갱신

- ✓ License Tool 실행
- ✓ 새로운 Hash code, Serial Number 입력 후 Activation



* 주의 : Initial license와 renew license 모두 License 폴더 안에 있어야 함

3. 카메라 캘리브레이션 - Cameras Properties

The screenshot displays the 'Devices' window in OptiTrack software. The interface is dark-themed and shows various camera settings. Red arrows and labels point to specific features:

- System Framerate:** Points to the '240 Hz' display at the top right.
- Device group expand/collapse:** Points to the expand/collapse icon next to the 'Reference' and 'Tracking' groups.
- Device groups:** Points to the 'Reference' and 'Tracking' group headers.
- Visible camera settings:** Points to the column headers of the 'Tracking' camera list: No, Enable, Mode, Exposure, LED, and Reconstruction.
- List of tracking cameras:** Points to the list of 84 cameras under the 'Tracking' group, showing details like No. (74-83, 59, 60), Enable status, Mode (clock icon), Exposure (250 μ s), LED status, and Reconstruction status.
- Color reference cameras (if available):** Points to the 'Color' section header.
- eSync synchronization hub (if available):** Points to the 'Synchronization' section header.

The 'Color' section shows one camera with the following details:

No.	Multipl.	Resolution	Mode	Exposure	Bit Rate
85	1x	1920x1080	[Color Icon]	2500 μ s	50 MB/s

The 'Synchronization' section shows one device:

Device	Serial
eSync 2	E5000494

3. 카메라 캘리브레이션 - Cameras Properties

1. Rate (Frame Per Second : 초당 프레임 수)

- 초당 촬영되는 화면 수

2. Continuous Calibration

- 지속적으로 캘리브레이션이 업데이트되는 기능

3. Exposure

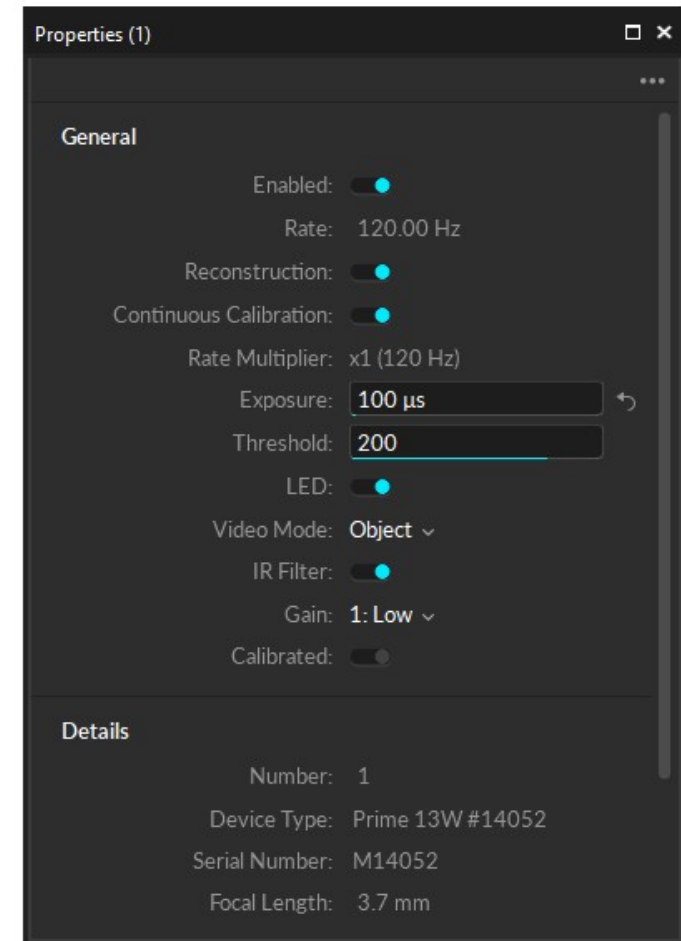
- 한 프레임 당 빛의 노출 시간
- 높은값 : 더 밝은 이미지 촬영, 작은 marker 측정 유리하지만, 인접한 marker들이 병합 될 수 있음

4. Threshold

- 카메라에서 허용하는 한 픽셀의 최소 밝기
- 높은값 : 빛의 간섭 감소
- 낮은값 : 작고, 멀리 있는 marker 인식

5. LED (LED Illumination)

- 적외선 LED On/Off



3. 카메라 캘리브레이션 - Cameras Properties

6. Video Mode

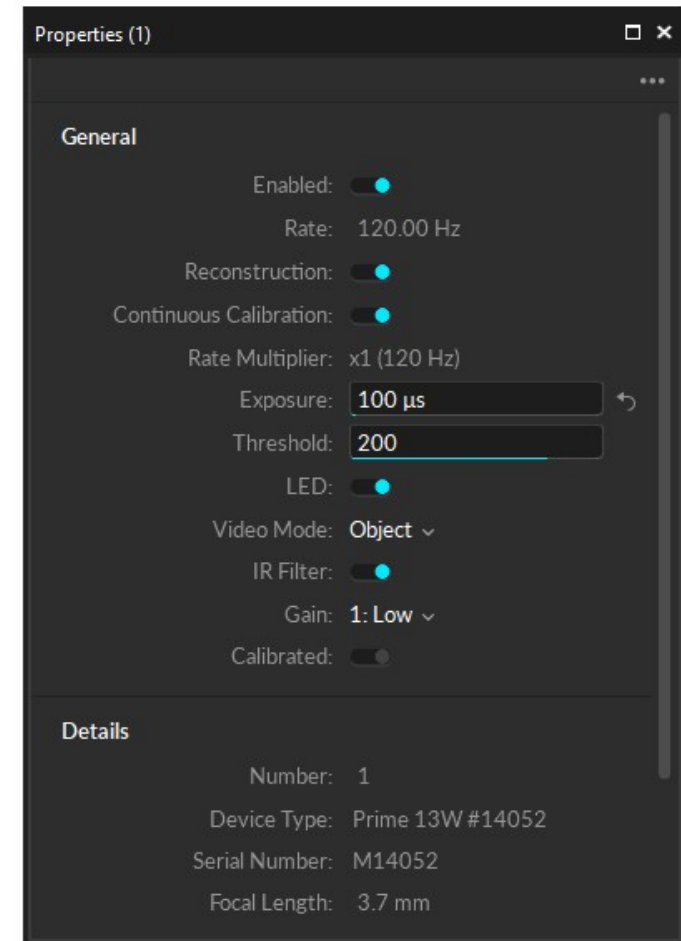
- Object : Tracking Mode
- Precision : Tracking Mode
- MJPEG : Reference Mode
 - ✓ Video 데이터 추출 가능
- Raw Grayscale : Reference Mode
 - ✓ 카메라 화각 조정 및 노이즈 제거 시 사용

7. IR Filter

- “On” : IR spectrum 캡처
- “Off” : Visible spectrum 캡처

8. Gain

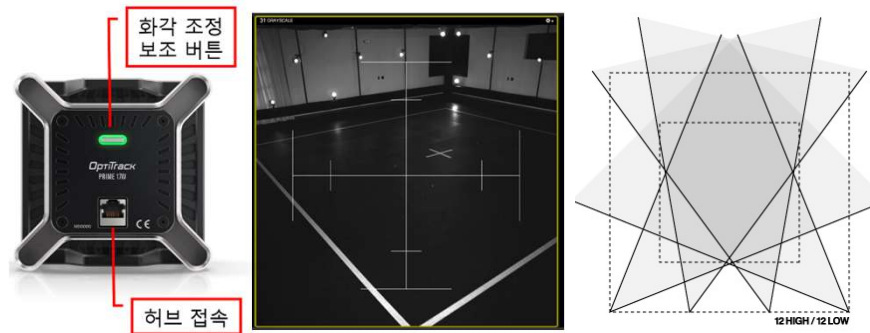
- 밝기 조절, 보통 “1:Low” 로 셋팅



3. 카메라 캘리브레이션

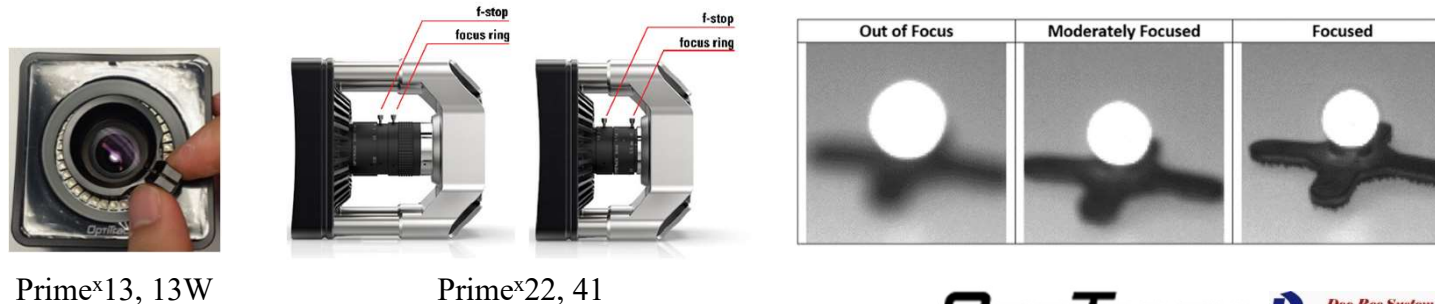
1. 카메라 Aiming

- Raw Grayscale Mode로 변경
- 물리적으로 제거 할 수 있는 노이즈 제거 및 카메라 화각 조정



※ 카메라 Focus setting

- ✓ Camera 모드 Raw Grayscale Mode 로 변경 후 조절
- ✓ Prime^X13, 13W : Focus tool 을 이용
- ✓ Prime^X22, 41 : 렌즈 조절



3. 카메라 캘리브레이션

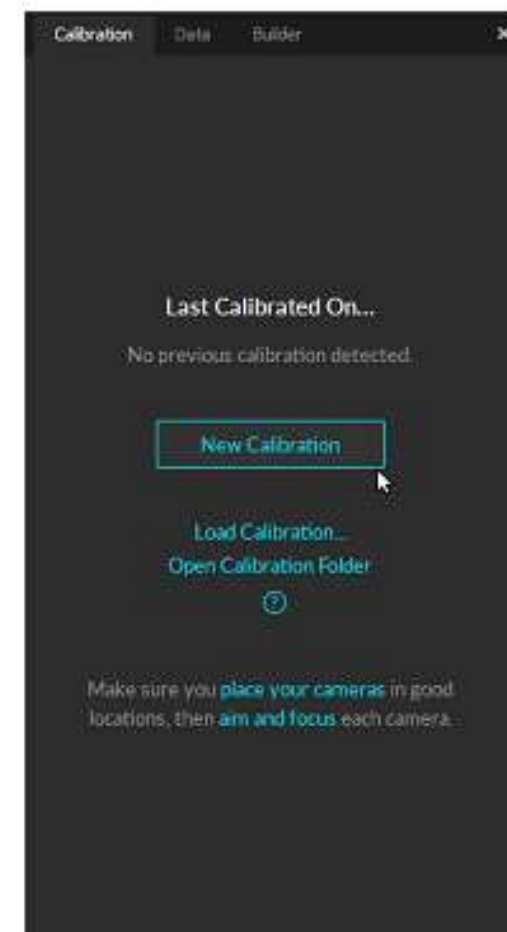
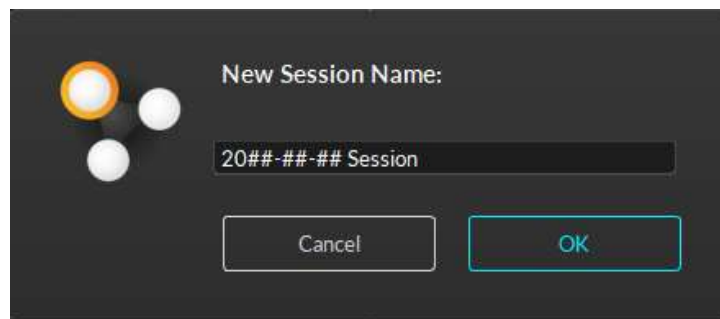
2. System Calibration 시작

- New Calibration 선택

※ Calibration 후 CAL 파일 자동 저장

※ 카메라 위치 및 화각에 변화가 없다면, 저장된 “.cal” 파일 불러오기 가능

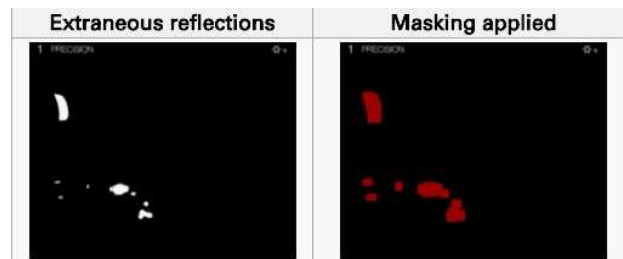
※ Calibration 전 Data Pane에서 Calibration 및 Take파일을 저장 할 session 폴더 생성 및 선택
Data →  → Session 네임 설정 후 OK



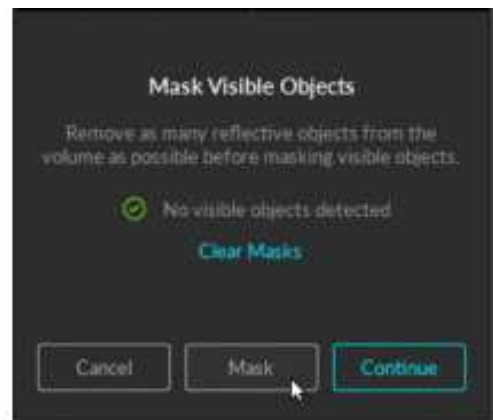
3. 카메라 캘리브레이션

3. Masking

- 물리적으로 제거 할 수 없는 noise 가리기



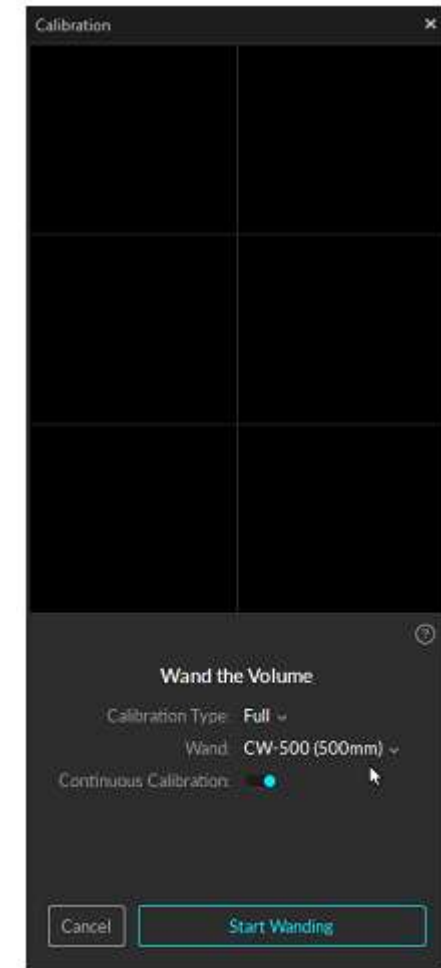
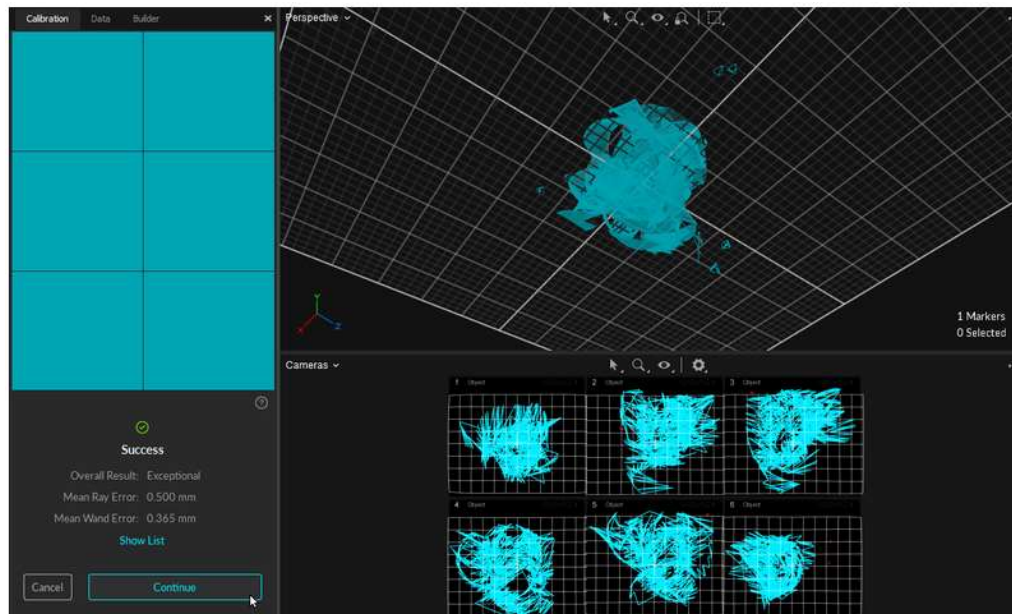
- 캡처 공간 정리 후 “Mask” 선택
 - ✓ 자동 masking
 - ✓ Noise가 없다면, “Continue” 선택



3. 카메라 캘리브레이션

4. Wandering (Dynamic Calibration)

- Data quality에 영향을 미침
- Wand 선택 : CW-500, CW-250 등
- “Start Wandering” 선택, 캡처 공간에 전체적으로 Wandering
- 카메라 당 최소 2000 Frame 이상 캡처 후 “Calculate” 선택
 - ✓ “Show List” 선택하여 카메라 당 캡처 되는 Frame 수 확인 가능



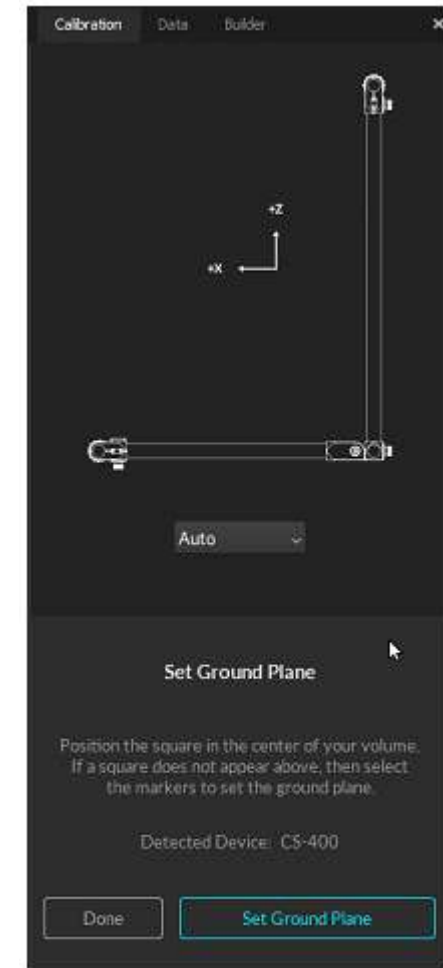
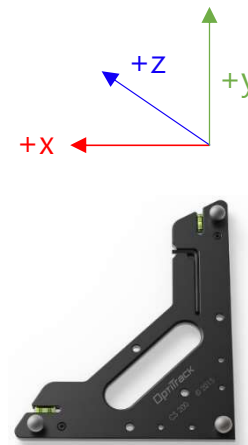
3. 카메라 캘리브레이션

5. Ground Plane and Origin

- Square를 최소 2대 이상의 카메라가 보이는 곳에 위치 후 “Set Ground Plane” 선택
 - ✓ CS-200, CS-400 등
 - ✓ Long arm: +z, Short arm: +x, +y up

6. Calibration File

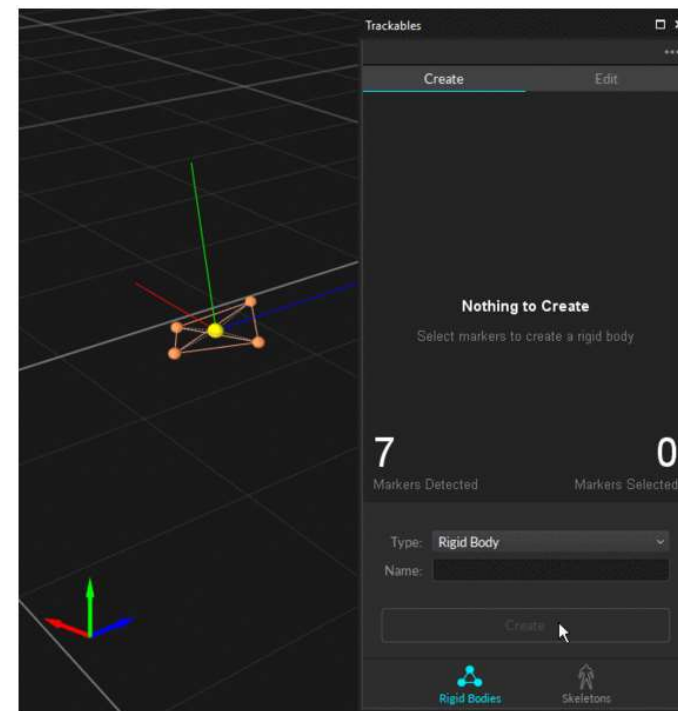
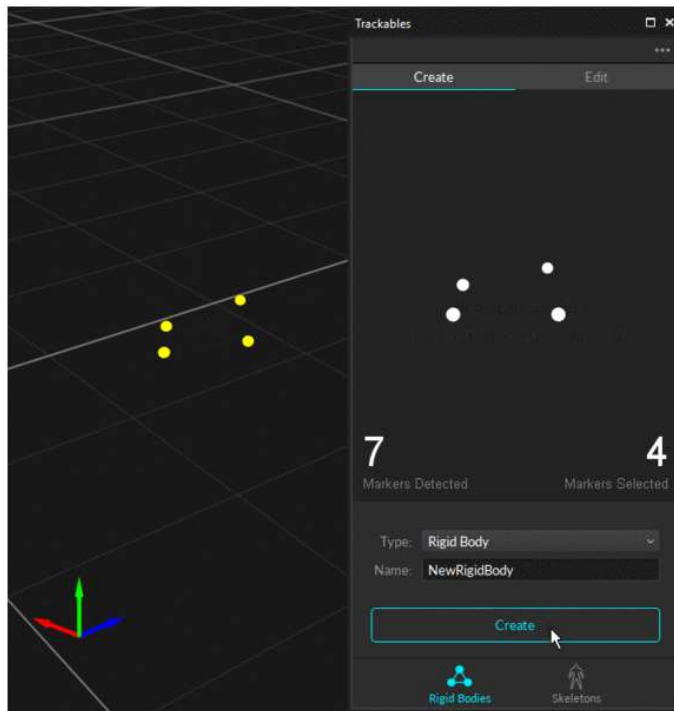
- “.cal” 파일, 지정 경로에 자동 저장



4. Rigid Body 정의

1. Builder → Create

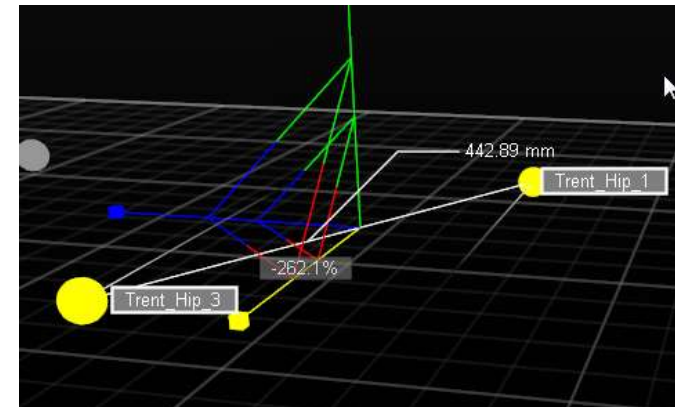
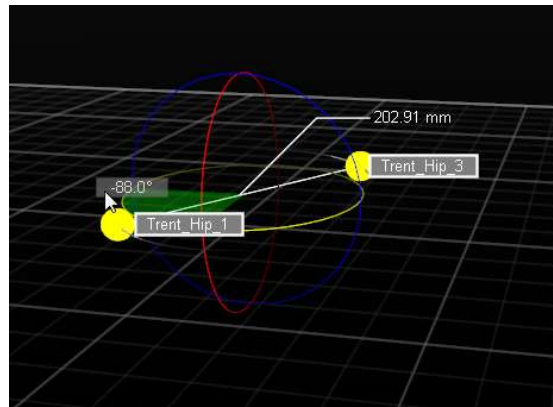
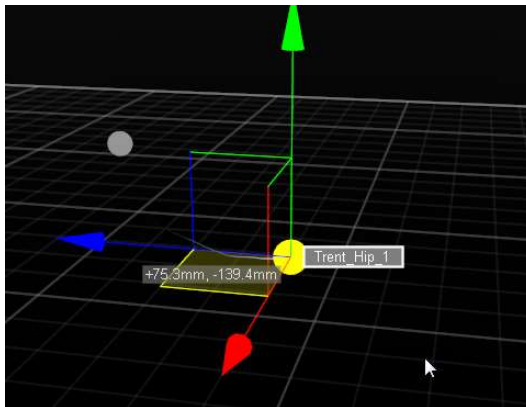
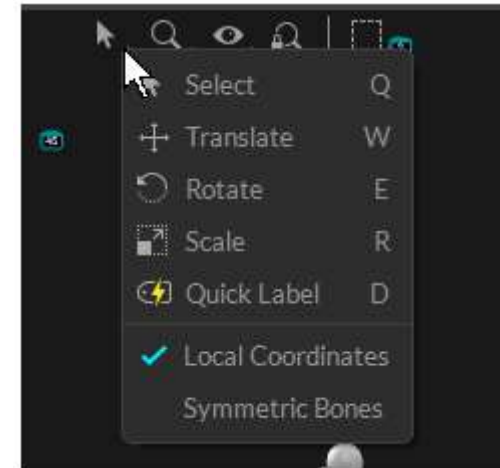
- 대상에 3개 이상의 marker 부착 (marker가 흔들리지 않게 부착)
- Perspective View 상에서 marker 선택
 - ✓ Type : Rigid Body
 - ✓ Name 입력
 - ✓ “Create” 선택



4. Rigid Body 정의

2. Modify Position and Orientation

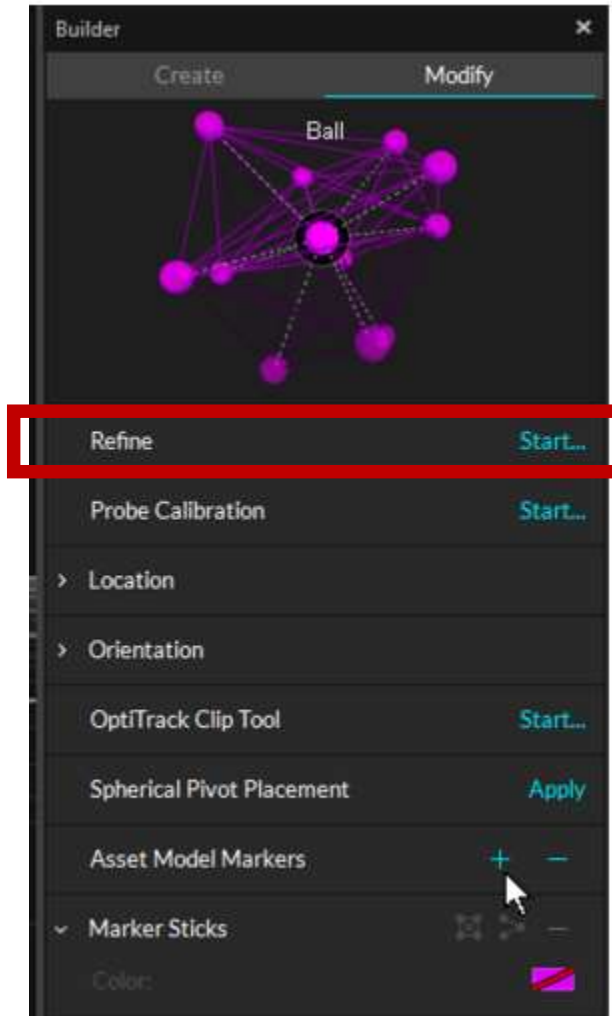
- Gizmo tool 또는 Modify Pane 이용
- Rigid Body의 Local Coordinate 편집 가능



4. Rigid Body 정의

3. Rigid Body Refinement

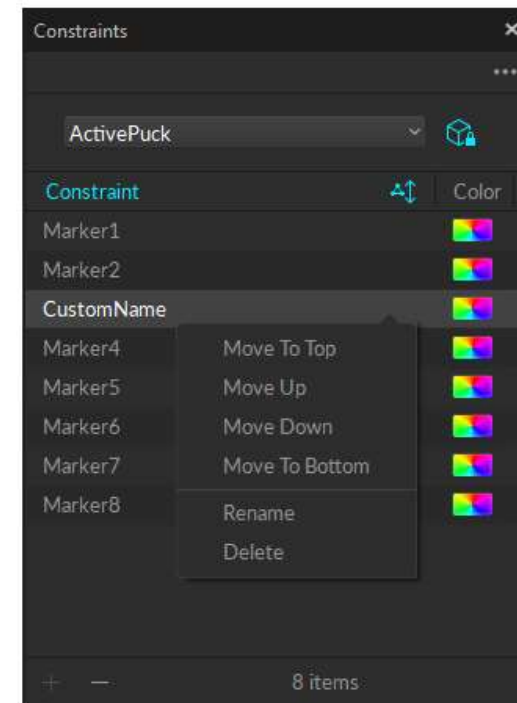
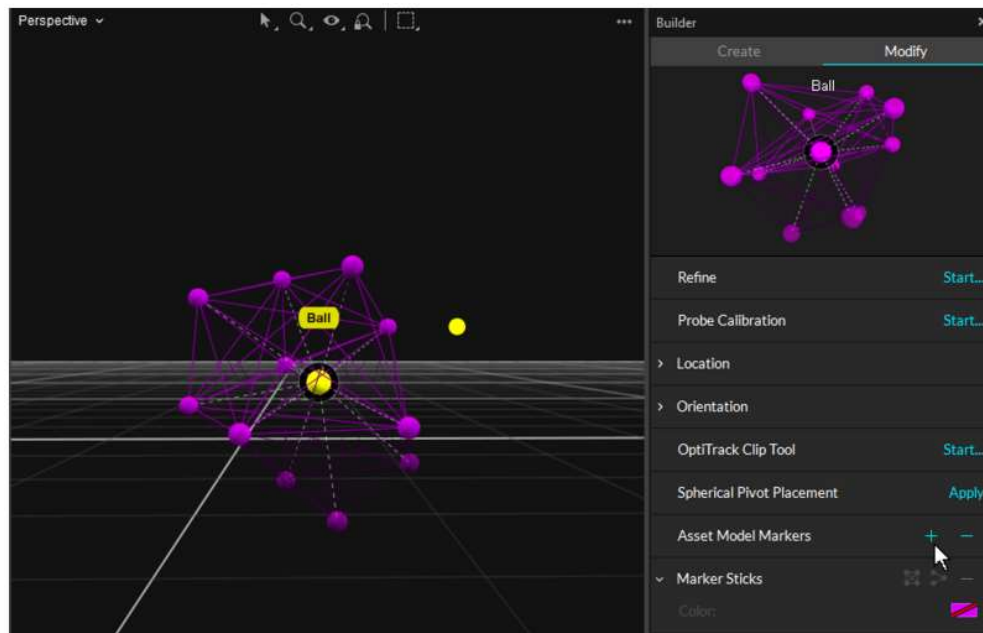
- Rigid body의 정확성 향상
- Live 모드에서 실행
- Rigid body 선택 → Builder “Modify”
→ Refine
- Refine Start 선택
- Rigid body를 회전시키면서 다양한 방향에서
데이터 수집
- “Yes” 선택



4. Rigid Body 정의

4. Adding or Removing Markers

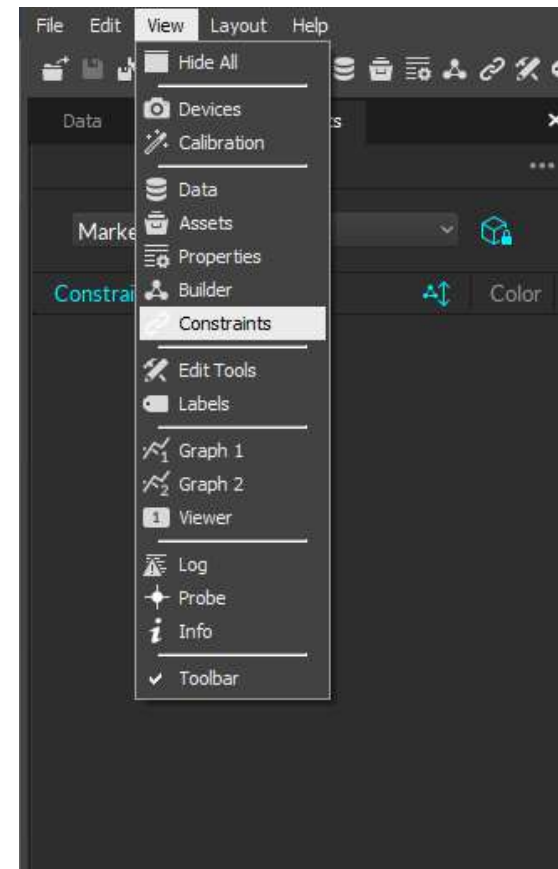
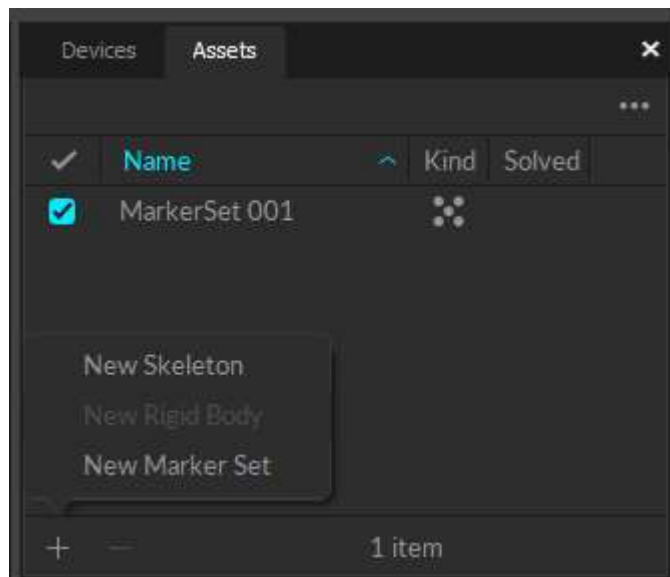
- Perspective View 상에서 Rigid body 선택
- 추가/제거 하려는 marker 선택 (CTRL + left click)
- Modify → Asset Model Markers → “+” (추가) 또는 “-”(제거) 선택
- Constraints Pane에서 marker 이름 및 색 변경 가능



※ Marker Set 이용

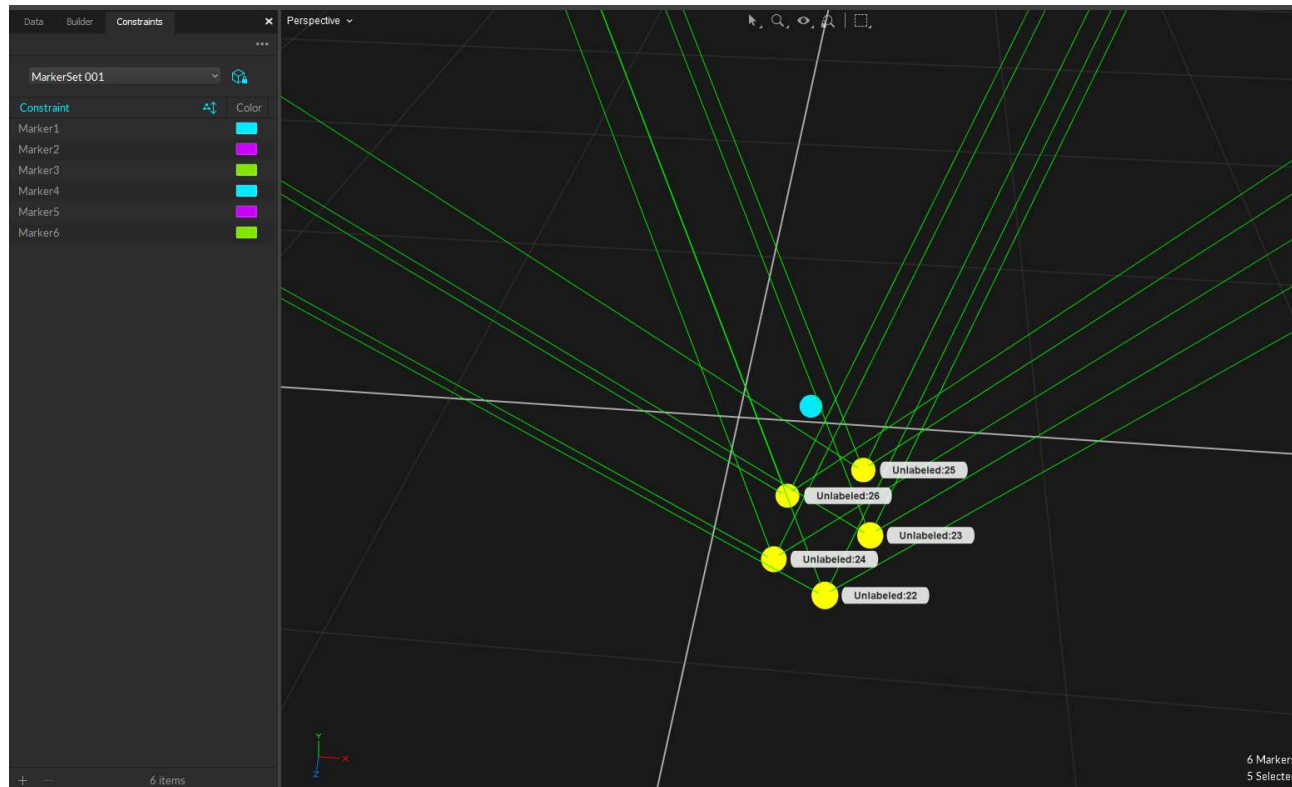
- Rigid Body, Skeleton 외 새로운 Asset 추가 구성

1. Asset Pane에서 “+” 클릭
2. New Marker Set 클릭
3. View → Constraints Pane 선택



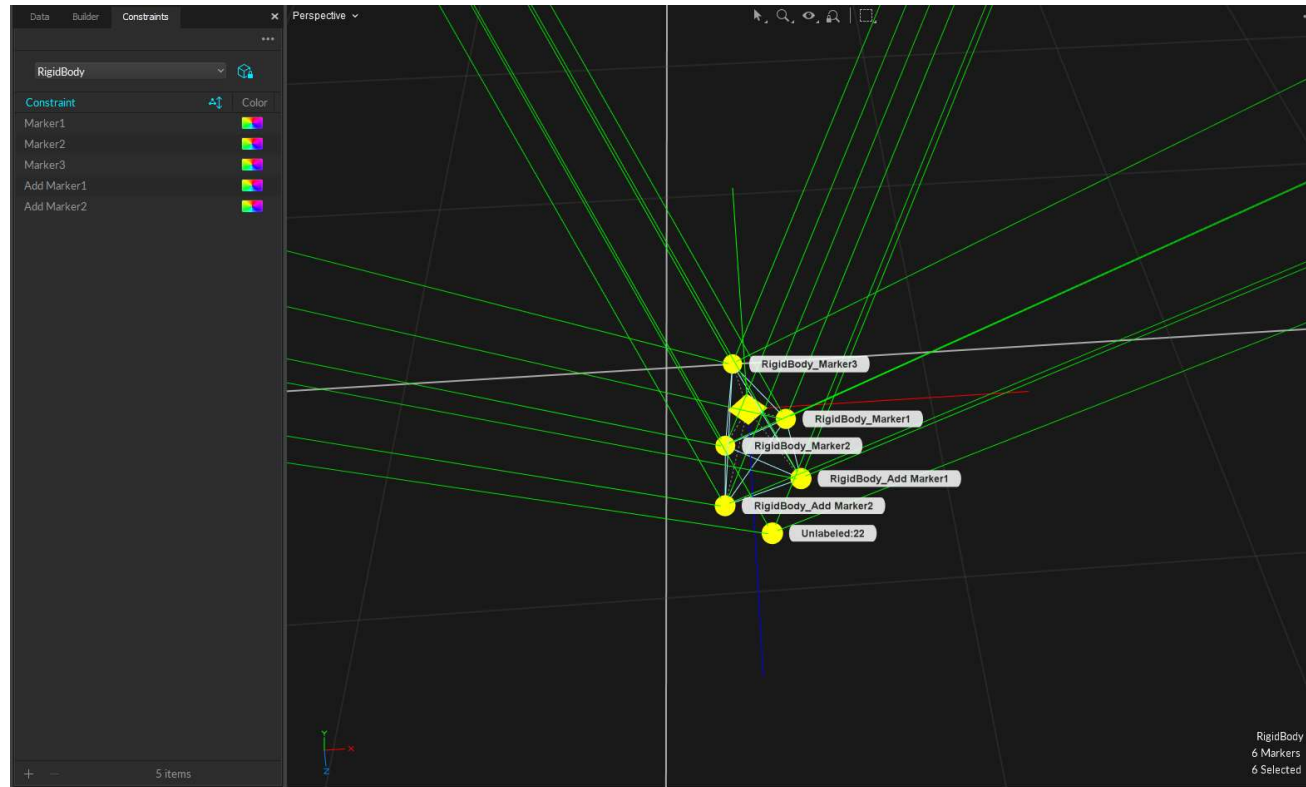
※ Marker Set 이용

- Rigid Body, Skeleton 외 새로운 Asset 추가 구성
4. Perspective View 상에서 marker 선택
 5. Constraints Pane에서 “+” 클릭 (marker label 생성)
 6. Recording 후 Manual Labeling



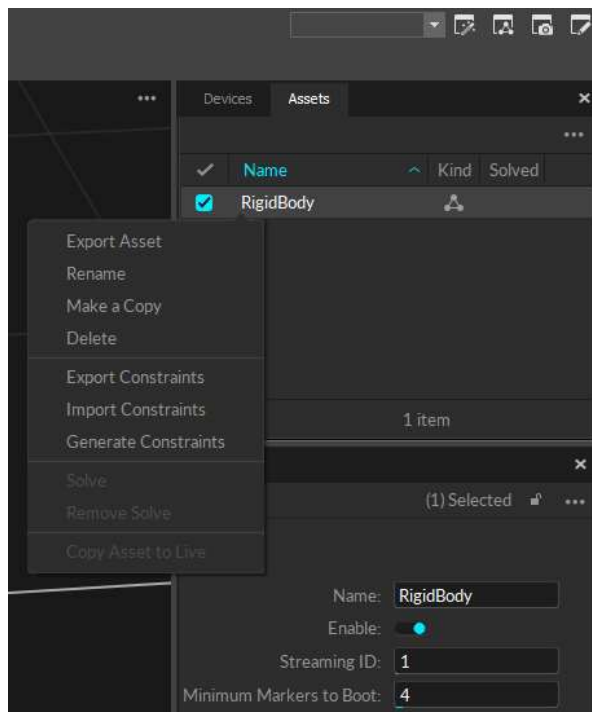
※ Add/Remove Markers

- Constraints Pane에서 기존 Asset에 새로운 marker 추가 또는 제거 가능
 1. View → Constraints Pane 선택
 2. 추가 하려는 Marker와 Asset 선택 (CTRL + left click)
 3. “+” 클릭 하여 기존 Asset에 marker 추가 또는 marker 선택 후 “-” 클릭하여 제거



※ Customize Marker Labels

- Constraints Pane 또는 Asset “Export Constraints” 이용하여 Customize Marker가능
 1. Asset 마우스 우 클릭 후 “Export Constraints” → “.XML 파일” 추출
 2. .XML 파일 메모장으로 Open
 3. Marker Name/Color/Sticks 수정 → 저장
 4. Asset 마우스 우 클릭 후 “Import Constraints” → 수정한 .XML 파일 Import



```
<asset version="1.0">
  <marker_names reorder_markers="true">
    <!--To rename markers, modify the value in the "name" tag.-->
    <marker name="NewName" old_name="WaistLFront"/>
    <marker name="WaistRFront" old_name="WaistRFront"/>
    <marker name="WaistLBack" old_name="WaistLBack"/>
    <marker name="WaistRBack" old_name="WaistRBack"/>
    <marker name="BackTop" old_name="BackTop"/>
  </marker_names>
</asset>
```

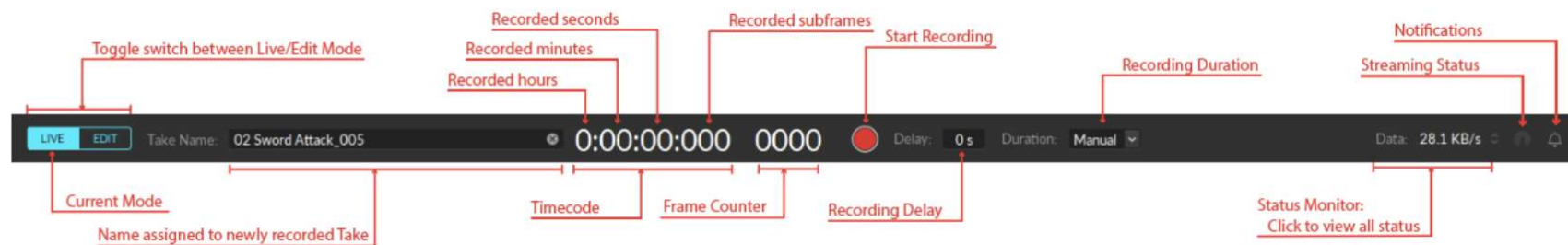
< XML 파일 >

5. Data Recording

1. Capture Layout 으로 화면 전환 
2. Take Name 에 Trial 이름 (Take name_####) 입력
3. 빨강색 녹화 버튼 눌러 녹화 하기 (자동 저장)

* Tip

- Biomechanical analysis
 - ✓ 두 가지 타입의 영상 Recording : ①Static Trial (T-Pose 또는 A-Pose) ②Motion Trial



6. Data Management

Rows are sorted by the highlighted category: Name

Selected table layout

Pane Options

Selected session folder: Highlighted

List of session folders/subfolders

Currently opened session folder

Currently opened Take file

Cyan dot: Indicates unsaved changes

Gray circle: Indicates empty Takes

Show/Hide list of session folders

Add a session folder

List of Takes in selected session folder

Search loaded database

The screenshot shows the OptiTrack Data Management window. On the left is a tree view of session folders. The 'Third Session' folder is selected and highlighted. Below it, a list of takes is displayed for the selected session. The takes are sorted by name. The 'Running_003' take is currently opened, indicated by a cyan dot. The interface includes a search bar at the bottom right and a button to add a session folder at the bottom left.

Name	2D	3D	Date Recorded	Duration	Total Frames
Dribble Basket Ball ...	✓	✓	06/30/2015 12:37AM	00:00:10:058	1271
Dribble Basket ...	✓	✓	06/30/2015 12:37AM	00:00:10:055	1267
Jumping Jacks_001	✓	✓	06/30/2015 12:32AM	00:00:05:072	688
Jumping Jacks_002	✓	✓	06/30/2015 12:32AM	00:00:05:085	703
Rigid_Body_01	✓	✓	05/15/2015 03:26PM	00:00:40:035	4844
Rigid_Body_02_Simp...	✓	✓	06/03/2015 11:51AM	00:00:17:018	2063
Rigid_Body_03_Simp...	✓	✓	06/03/2015 11:49AM	00:00:17:040	2089
Running_001	✓	✓	06/30/2015 12:33AM	00:00:05:075	692
Running_002	✓	✓	06/30/2015 12:33AM	00:00:05:065	679
Running_003	✓	✓	06/30/2015 12:34AM	00:00:05:089	708
Shooting a Gun_001	✓	✓	06/30/2015 12:39AM	00:00:10:085	1303
Shooting a Gun_002	✓	✓	06/30/2015 12:39AM	00:00:10:064	1278
Swinging a Golf Club--	✓	✓	06/30/2015 12:41AM	00:00:05:055	667
Swinging a Golf Club--	✓	✓	06/30/2015 12:42AM	00:00:05:060	674
Walk_Jog					

6. Data Management

Take Information [edit]

Category	Description
Best	The star mark  , allows users to mark the best <i>Takes</i> . Simply click on the star icon and mark the successful <i>Takes</i> .
Health	The health status of the <i>Takes</i> indicates status of the takes  : Good capture  : Average capture  : Poor capture
Progress	The progress indicator can be used to track the process of the <i>Takes</i>. Use the indicators to track down the workflow specific progress of the <i>Takes</i>. - Ready - Recorded - Reviewed - Labeled - Cleaned - Exported
Name	Shows the name of the Take.
2D	Indicates whether 2D data exists on the corresponding <i>Take</i>
3D	Indicates whether the reconstructed 3D data exists on the corresponding <i>Take</i>. If 3D data does not exist on a <i>Take</i>, it can be derived from 2D data by performing the reconstruction pipeline. See Reconstruction page for more details.
Video	Indicates whether reference videos exist in the <i>Take</i> . Reference videos are recorded from cameras that are set to either MJPEG grayscale or raw grayscale modes.
Solved	Indicates whether any of the assets have solved data baked into it.
Audio	Indicates whether synchronized audio data have been recorded with the <i>Take</i> . See: Audio Recording in Motive
Analog	Indicates whether analog data recorded using a data acquisition device exists in the <i>Take</i> . See: NI-DAQ Setup page.
Data Recorded	Shows the time and the date when the <i>Take</i> was recorded.
Duration	Time length of the <i>Take</i>
Total Frames	Total number of captured frames in the <i>Take</i>
Notes	Section for adding commenting on each <i>Take</i> .

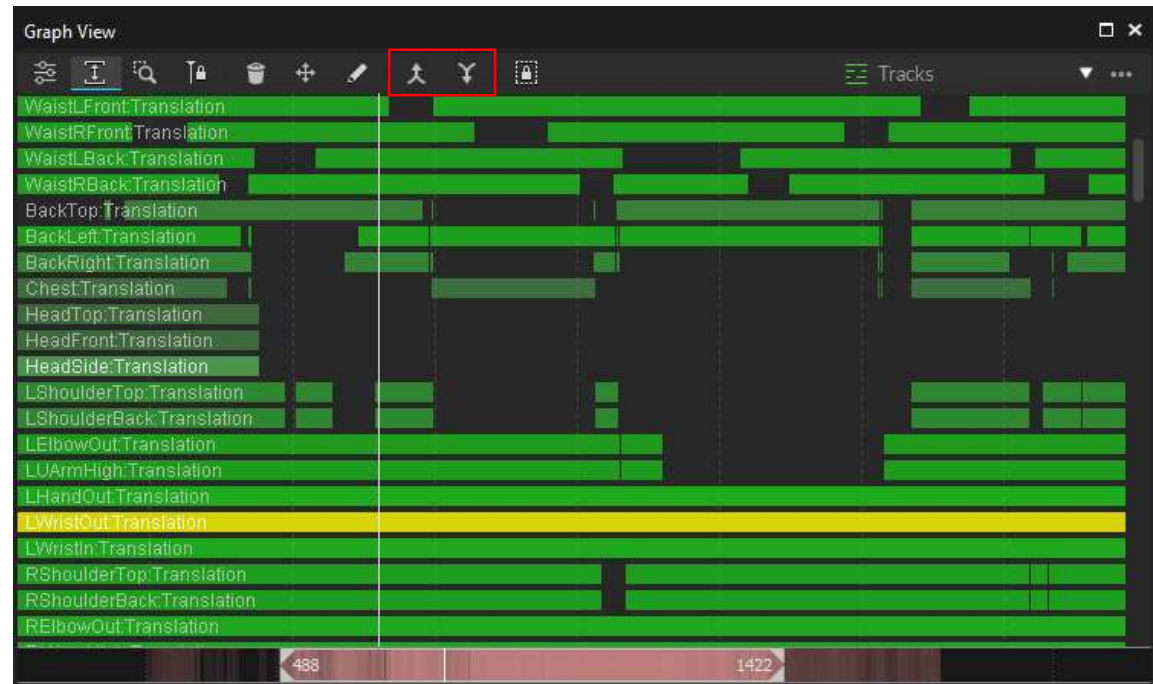
7. Data Labeling

- Marker 에 이름을 지정하는 과정

- 방법

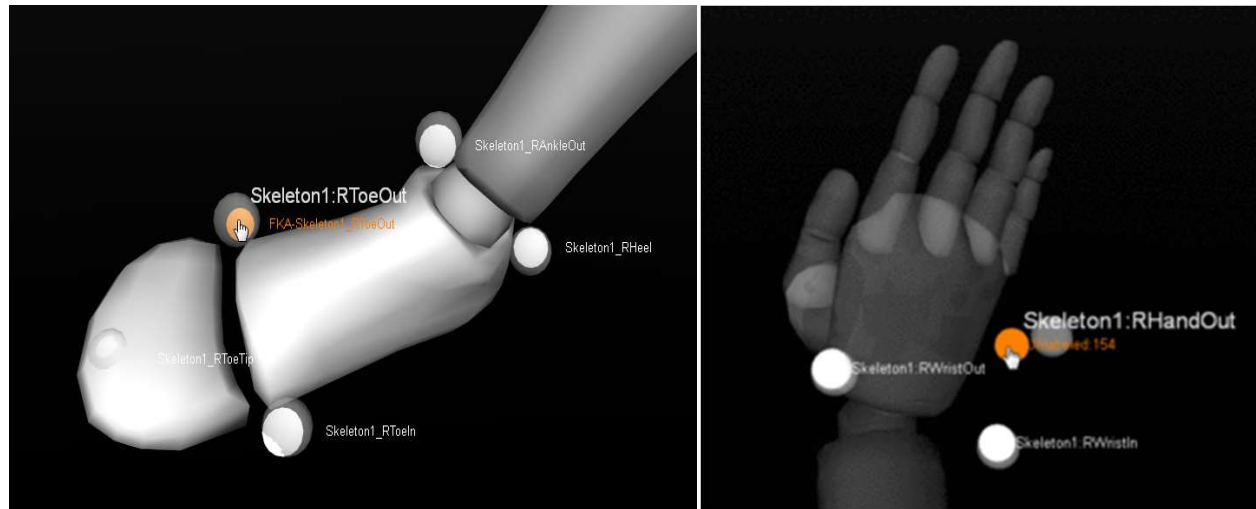
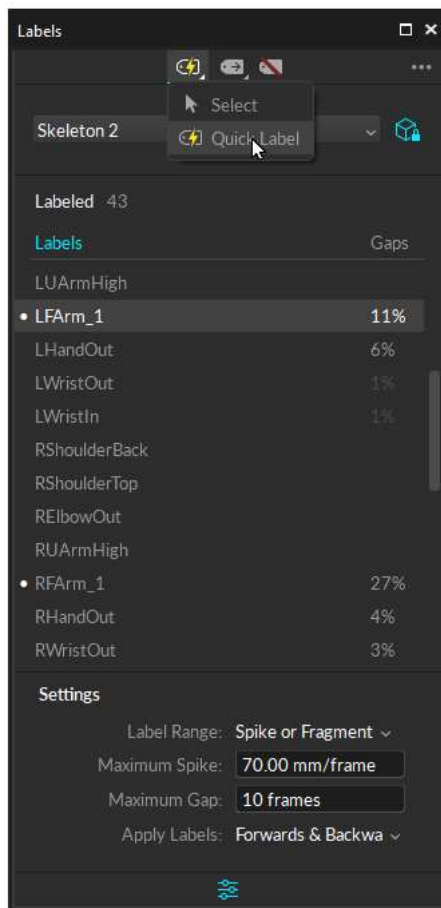
- ① Auto Labeling (기본)
- ② Manual Labeling

1. Edit Layout 선택 
2. 데이터 목록
더블 클릭하여 불러오기
3. Graph view의 Tracks에서
데이터 모니터링
4. 연결 가능한 Marker 꺾적
선택 후 Merge Marker



7. Data Labeling

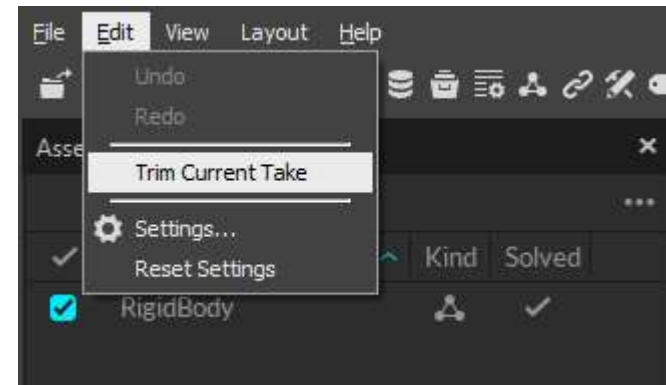
5. Labeling Pane에서 Assets 선택
6. 수정할 Marker 선택 후 Quick Label 모드로 전환 (단축키 D)
7. Perspective View에서 Marker 선택



8. Data Editing

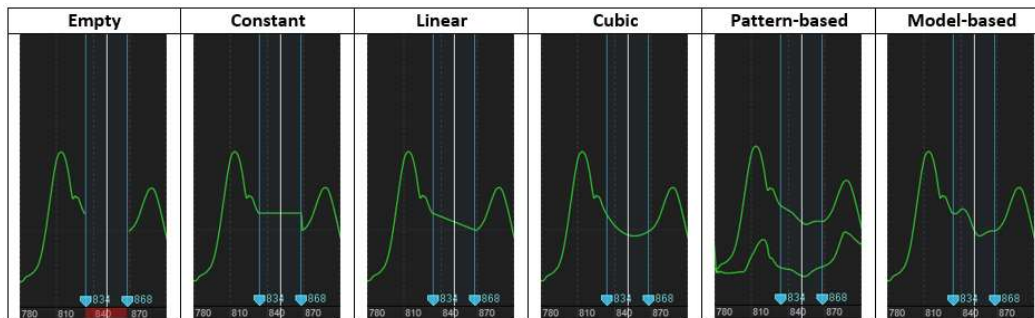
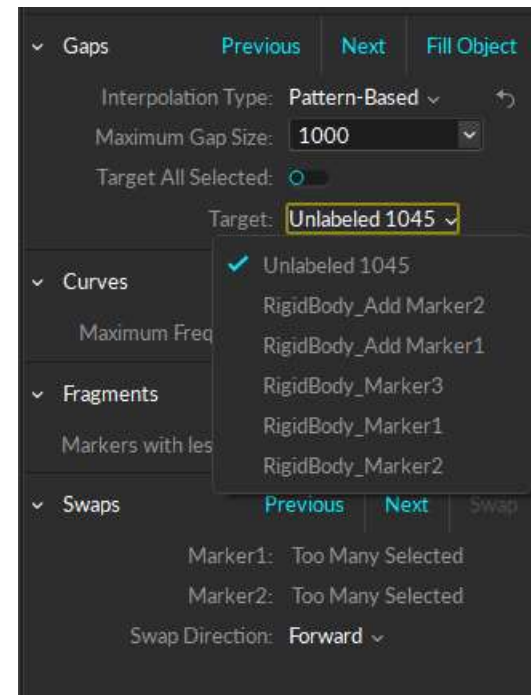
● Data Trimming

- 원하는 프레임 영역 범위 잘라내기
- 원본 데이터는 별도의 Session 폴더에 백업
 - Control deck에서 원하는 범위 지정
 - Edit → Trim Current Take 선택 후 OK



● Labeling 오류 확인 후 Fill Gaps

- 끊어진 궤적 채우기
 - Marker 선택 후
 - Previous 혹은 next 클릭
 - Interpolation Type 선택
 - ✓ Cubic : 3차 다항식 보간법
 - ✓ Pattern-base : 같은 분절의 marker 패턴 이용
 - Fill Object 선택



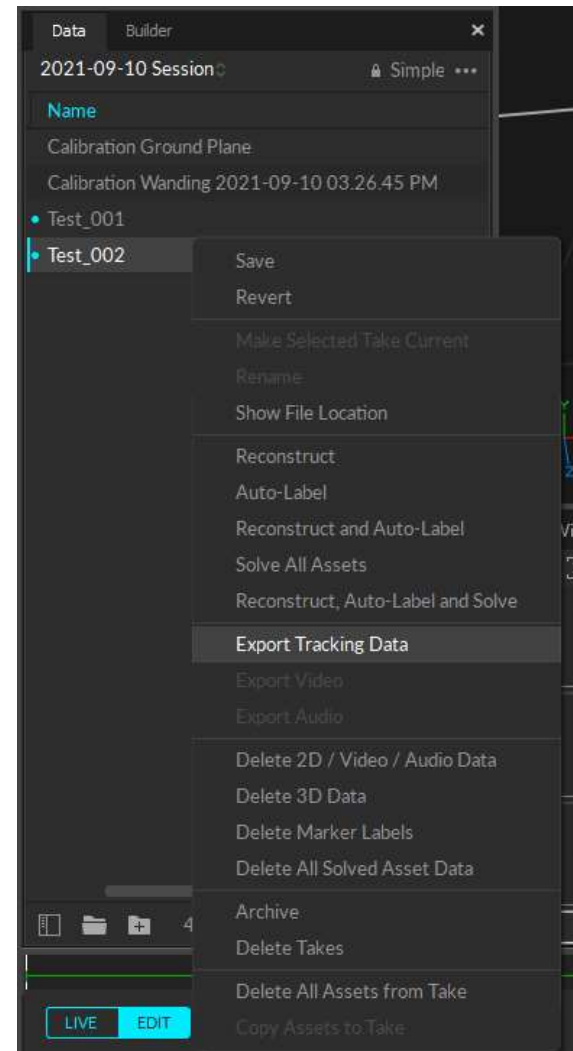
9. Data Export

● 파일 Format

- Motive Tracker : CSV, C3D
- Motive Body : CSV, C3D, FBX, BVH, TRC
 1. Data management에서 원하는 take 선택
 2. 마우스 우 클릭 → Export Tracking Data 선택
 3. File Name/ Type 설정 후 Export

● 그 외 Export 할 수 있는 데이터

- Calibration data : .cal
- Device data : C3D, CSV
- Reference video data : AVI



9. Data Export - C3D file

- 생체역학, 동작분석 연구에서 사용하는 이진법 파일 Format
- Global Axis 변환 : Motive Y-Up 에서 일반적인 Z-Up
- Axis 옵션을 Visual3D/MotionMonitor 또는 MotionBuilder 로 변경 가능

C3D Export Options	
Options	Descriptions
Frame Rate	Number of samples included per every second of exported data.
Start Frame	Start frame of the exported data. You can either set it to the recorded first frame of the exported <i>Take</i> or to the start of the working range, or scope range, as configured under the Control Deck or in the Graph View pane.
End Frame	End frame of the exported data. You can either set it to the recorded end frame of the exported <i>Take</i> or to the end of the working range, or scope range, as configured under the Control Deck or in the Graph View pane.
Use Zero Based Frame Index	C3D specification defines first frame as index 1. Some applications import C3D files with first frame starting at index 0. Setting this option to true will add a start frame parameter with value zero in the data header.
Export Unlabeled Markers	Includes unlabeled marker data in the exported C3D file. When set to False, the file will contain data for only labeled markers.
Export Finger Tip Markers	Includes virtual reconstructions at the finger tips. Available only with skeletons that support finger tracking (e.g. Baseline + 11 Additional Markers + Fingers (54))

9. Data Export - C3D file

C3D Export Options	
C3D Options	Descriptions
Use Timecode	Includes timecode.
Rename Unlabeled As _000X	Unlabeled markers will have incrementing labels with numbers _000#.
Units	Sets which unit is used in exported data.(Exported unit maybe rescaled to a standard unit when imported into another software.)
Axis Convention	Sets the axis convention on exported data. This can be set to a custom convention, or preset conventions for exporting to MotionBuilder or Visual3D/MotionMonitor.
X Axis	Allows customization of the axis convention in the exported file by determining which positional data to be included in the corresponding data set.
Y Axis	
Z Axis	
Scale	Apply scaling to the exported tracking data.
Marker Name Syntax.	Choose whether the marker naming syntax uses ":" or "_" as the name separator. The name separator will be used to separate the asset name and the corresponding marker name in the exported data (e.g. AssetName:MarkerLabel or AssetName_MarkerLabel or MarkerLabel).

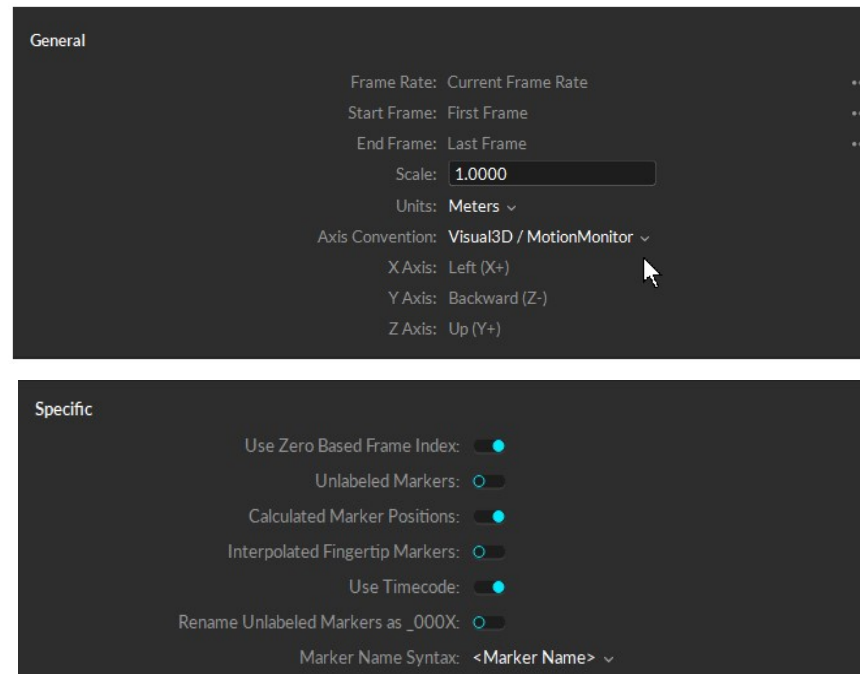
9. Data Export - C3D file

- Data를 Visual3D에서 사용하기 위한 옵션

1. C3D Axis 변환

- ✓ X axis converted into **positive X**
- ✓ Y axis converted into **negative Z**
- ✓ Z axis converted into **positive Y**

2. Marker name syntax : <Marker Name>



9. Data Export - CSV file

- Marker data, Rigid body data, Skeleton data

CSV Export Options	
CSV Options	Descriptions
Frame Rate	Number of samples included per every second of exported data.
Start Frame	Start frame of the exported data. You can either set it to the recorded first frame of the exported <i>Take</i> or to the start of the working range, or scope range, as configured under the Control Deck or in the Graph View pane.
End Frame	End frame of the exported data. You can either set it to the recorded end frame of the exported <i>Take</i> or to the end of the working range, or scope range, as configured under the Control Deck or in the Graph View pane.
Scale	Apply scaling to the exported tracking data.
Markers	Enabling this option includes X/Y/Z reconstructed 3D positions for each marker in exported CSV files.
Unlabeled Markers	Enabling this option includes tracking data of all of the <i>unlabeled</i> markers to the exported CSV file along with other labeled markers. If you just want to view the <i>labeled</i> marker data, you can turn off this export setting.
Quality Statistics	Adds a column of Error per marker values for each rigid body position data. Adds a column of Marker quality values after each rigid body marker data.

9. Data Export - CSV file

CSV Export Options	
CSV Options	Descriptions
Rigid Bodies	When this option is set to true, exported CSV file will contain 6 Degree of Freedom (6 DoF) data for each rigid body from the Take. 6 DoF data contain orientations (pitch,roll, and yaw in the chosen rotation type as well as 3D positions (x,y,z) of the rigid body center.
RigidBodyMarkers	Enabling this option includes 3D position data for each expected marker locations (not actual marker location) of rigid body assets.
Bones	When this option is set to true, exported CSV files will include 6 DoF data for each bone segment of skeletons in exported Takes. 6 DoF data contain orientations (pitch, roll, and yaw) in the chosen rotation type, and also 3D positions (x,y,z) for the center of the bone.
BoneMarkers	Enabling this option will include 3D position data for each expected marker locations (not actual marker location) of bone segments in skeleton assets.
Header information	Includes detailed information about capture data as a header in exported CSV files. Types of information included in the header section is listed in the following section.
Rotation Type	Rotation type determines whether Quaternion or Euler Angles is used for orientation convention in exported CSV files.
Unit	Sets units for positional data in exported CSV files
Export Device Data	When set to True, separate CSV files for recorded device data will be exported. This includes force plate data and analog data from NI-DAQ devices. A CSV file will be exported for each device included in the <i>Take</i> .
Use World Coordinates	This option decides whether exported data will be based on world(global) or local coordinate systems.

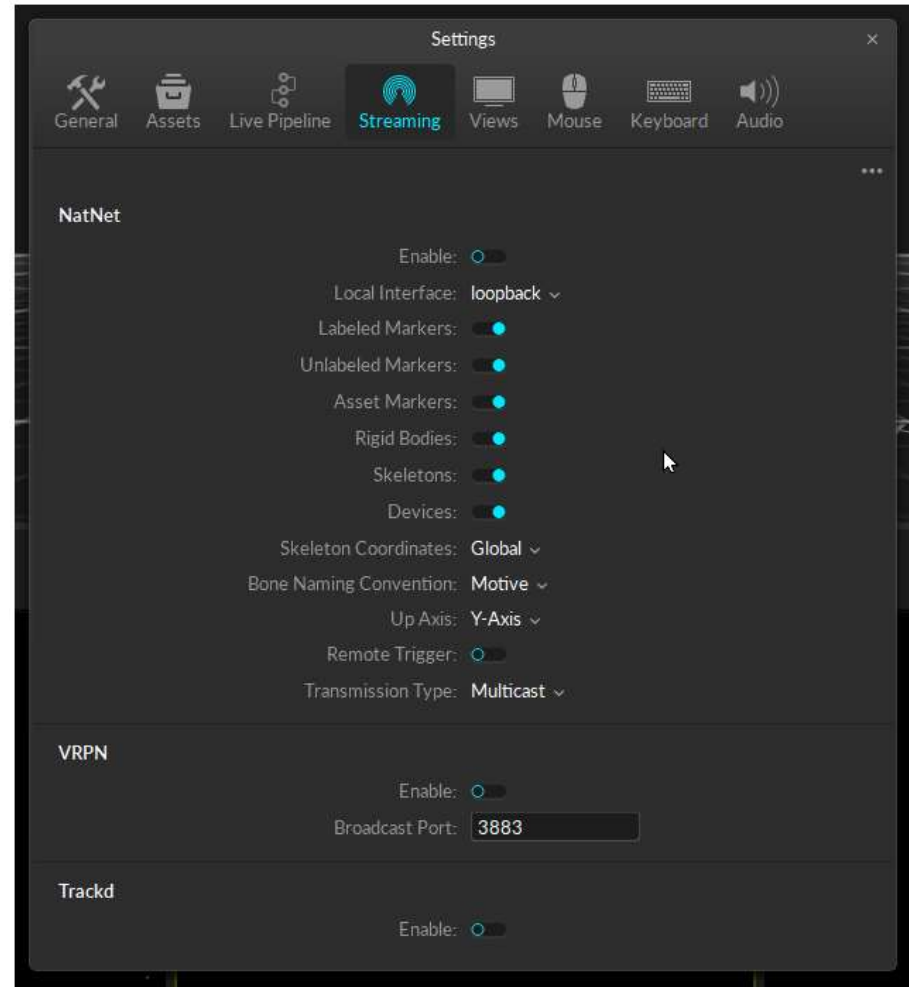
9. Data Export - CSV file

CSV Headers	
Row	Description
1st row	General information about the Take and export settings. Included information are: format version of the CSV export, name of the TAK file, the captured frame rate, the export frame rate, capture start time, number of total frames, rotation type, length units, and coordinate space type.
2nd row	Empty
3rd row	Displays which data type is listed in each corresponding column. Data types include raw marker, rigid body, rigid body marker, bone, bone marker, or unlabeled marker. Read more about Marker Types.
4th row	Includes marker or asset labels for each corresponding data set.
5th row	Displays marker ID.
6th and 7th row	Includes header label on which data is included in the column: position and orientation on X/Y/Z.

Format Ver	1.21	Take Name	back roll3	Capture Frame	120	Export Frame	120	Capture S	2014-12-0	Total Fran
		Bone	Bone	Bone	Bone	Bone	Bone	Bone	Bone Mar	Bone Mar
		SkeletonA_H	SkeletonA_H	SkeletonA_Hip	SkeletonA	SkeletonA_H	SkeletonA	SkeletonA	SkeletonA	SkeletonA
		1	1	1	1	1	1	1	10005	10005
		Rotation	Rotation	Rotation	Rotation	Position	Position	Position	Position	Position
Frame	Time	X	Y	Z	W	X	Y	Z	X	Y
0	0	0.037632	-0.021128	0.003814	-0.999061	1.31038	0.930015	1.346092	1.462953	1.032686
1	0.008333	0.037632	-0.021128	0.003814	-0.999061	1.31038	0.930015	1.346092	1.462953	1.032686
2	0.016667	0.034949	-0.021491	0.003548	-0.999152	1.311624	0.930398	1.345122	1.464207	1.032758
3	0.025	0.03377	-0.021751	0.003643	-0.999186	1.31195	0.930369	1.344616	1.464594	1.032527
4	0.033333	0.03377	-0.021751	0.003643	-0.999186	1.31195	0.930369	1.344616	1.464594	1.032527
5	0.041667	0.031602	-0.022188	0.003592	-0.999248	1.312765	0.929816	1.343577	1.46547	1.031669
6	0.05	0.030537	-0.022328	0.003553	-0.999278	1.313097	0.929259	1.342992	1.46582	1.030967
7	0.058333	0.030537	-0.022328	0.003553	-0.999278	1.313097	0.929259	1.342992	1.46582	1.030967
8	0.066667	0.028394	-0.02246	0.003283	-0.999339	1.313734	0.92748	1.341799	1.466431	1.028955
9	0.075	0.028394	-0.02246	0.003283	-0.999339	1.313734	0.92748	1.341799	1.466431	1.028955

10. Data streaming

1. Edit → Settings → Streaming
2. Enable : On
3. Network interface 선택
 - Loopback 또는 IP address
4. Data type 선택
5. Coordinate System Convention
 - 기본 Y-up
 - Z-up 변환 가능
6. Software Development Kit 제공
 - Camera SDK
 - NatNet SDK



※ OptiTrack 참고자료

1. Tutorial 동영상

- Youtube : “OptiTrack” 채널

<https://www.youtube.com/playlist?list=PLdKrdVGpQ5OZSlQDCyYFT-iOo1Qmfzl7Z>

- Vimeo : “OptiTrack” 채널

<https://vimeo.com/user15736845>

2. Motive 매뉴얼 Wiki

http://wiki.optitrack.com/index.php?title=OptiTrack_Documentation_Wiki

- OptiTrack website : <http://www.optitrack.com>
- The Helpdesk : <http://help.naturalpoint.com>
- NaturalPoint Forum : <https://forums.naturalpoint.com>