

Appendix of VRMotion

A Human Body Representation in MocapApi

The MocapApi system represents the human body as a hierarchical structure comprising 59 distinct body segments. This representation establishes the hip joint as the root node, with each subsequent joint connected to a parent node as specified in Table 2. The Joint-Velocity and Joint-Position data in the Calc dataset utilize this connectivity hierarchy. Importantly, each joint's definition corresponds to the connection point between the joint and its parent. For instance, the "RightForeArm" has "RightArm" as its parent, with their connection occurring at the right elbow joint. Consequently, the Position and Velocity of "RightForeArm" specifically reference the position and velocity of the right elbow joint.

Table 2: Hierarchical joint structure in the human body representation

Body Segment	Identifier	Index	Parent Index
Hips	Hips	0	Root node
Right Upper Leg	RightUpLeg	1	0
Right Lower Leg	RightLeg	2	1
Right Foot	RightFoot	3	2
Left Upper Leg	LeftUpLeg	4	0
Left Lower Leg	LeftLeg	5	4
Left Foot	LeftFoot	6	5
Lower Spine	Spine	7	0
Middle Spine	Spine1	8	7
Upper Spine	Spine2	9	8
Lower Neck	Neck	10	9
Upper Neck	Neck1	11	10
Head	Head	12	11
Right Shoulder	RightShoulder	13	8
Right Upper Arm	RightArm	14	13
Right Forearm	RightForeArm	15	14
Right Hand	RightHand	16	15
Right Thumb Proximal	RightHandThumb1	17	16
Right Thumb Medial	RightHandThumb2	18	17
Right Thumb Distal	RightHandThumb3	19	18
Right Index Metacarpal	RightInHandIndex	20	16
Right Index Proximal	RightHandIndex1	21	20
Right Index Medial	RightHandIndex2	22	21
Right Index Distal	RightHandIndex3	23	22
Right Middle Metacarpal	RightInHandMiddle	24	16
Right Middle Proximal	RightHandMiddle1	25	24
Right Middle Medial	RightHandMiddle2	26	25
Right Middle Distal	RightHandMiddle3	27	26
Right Ring Metacarpal	RightInHandRing	28	16
Right Ring Proximal	RightHandRing1	29	28
Right Ring Medial	RightHandRing2	30	29
Right Ring Distal	RightHandRing3	31	30
Right Pinky Metacarpal	RightInHandPinky	32	16
Right Pinky Proximal	RightHandPinky1	33	32
Right Pinky Medial	RightHandPinky2	34	33
Right Pinky Distal	RightHandPinky3	35	34
Left Shoulder	LeftShoulder	36	8
Left Upper Arm	LeftArm	37	36
Left Forearm	LeftForeArm	38	37
Left Hand	LeftHand	39	38
Left Thumb Proximal	LeftHandThumb1	40	39
Left Thumb Medial	LeftHandThumb2	41	40
Left Thumb Distal	LeftHandThumb3	42	41
Left Index Metacarpal	LeftInHandIndex	43	39
Left Index Proximal	LeftHandIndex1	44	43
Left Index Medial	LeftHandIndex2	45	44
Left Index Distal	LeftHandIndex3	46	45
Left Middle Metacarpal	LeftInHandMiddle	47	39
Left Middle Proximal	LeftHandMiddle1	48	47
Left Middle Medial	LeftHandMiddle2	49	48
Left Middle Distal	LeftHandMiddle3	50	49
Left Ring Metacarpal	LeftInHandRing	51	39
Left Ring Proximal	LeftHandRing1	52	51
Left Ring Medial	LeftHandRing2	53	52
Left Ring Distal	LeftHandRing3	54	53
Left Pinky Metacarpal	LeftInHandPinky	55	39
Left Pinky Proximal	LeftHandPinky1	56	55
Left Pinky Medial	LeftHandPinky2	57	56
Left Pinky Distal	LeftHandPinky3	58	57

Table 3: Data fields and their descriptions

Data Field Header	Description
Frame-No	Frame number
Hips-Sensor-Lost	Packet loss indicator for the hips sensor
Hips-Sensor-Quat-x	Hip sensor quaternion, x component
Hips-Sensor-Quat-y	Hip sensor quaternion, y component
Hips-Sensor-Quat-z	Hip sensor quaternion, z component
Hips-Sensor-Quat-w	Hip sensor quaternion, w component
Hips-Sensor-Gyro-x	Hip sensor angular velocity, x component
Hips-Sensor-Gyro-y	Hip sensor angular velocity, y component
Hips-Sensor-Gyro-z	Hip sensor angular velocity, z component
Hips-Sensor-Acce-x	Hip sensor acceleration, x component
Hips-Sensor-Acce-y	Hip sensor acceleration, y component
Hips-Sensor-Acce-z	Hip sensor acceleration, z component
Hips-Joint-Velo-x	Hip joint velocity, x component
Hips-Joint-Velo-y	Hip joint velocity, y component
Hips-Joint-Velo-z	Hip joint velocity, z component
Hips-Joint-Posi-x	Hip joint position, x component
Hips-Joint-Posi-y	Hip joint position, y component
Hips-Joint-Posi-z	Hip joint position, z component
Hips-Bone-Quat-x	Hip bone quaternion, x component
Hips-Bone-Quat-y	Hip bone quaternion, y component
Hips-Bone-Quat-z	Hip bone quaternion, z component
Hips-Bone-Quat-w	Hip bone quaternion, w component

B MocapApi Data Format Specification

B.1 Physical Quantities and Component Data

The MocapApi system captures and represents various kinematic properties using the following standardized quantities:

- **Quaternion (Quat):** Represents rotational quantities of both sensors and skeletal elements using standard quaternion format. Although sensor and bone rotations are consistent, they are represented differently due to distinct coordinate systems.
- **Angular Velocity (Gyro):** Measured in radians per second (rad/s)
- **Acceleration (Acce):** Measured in meters per second squared (m/s²)
- **Velocity (Velo):** Measured in meters per second (m/s)
- **Position (Posi):** Measured in meters (m)

B.2 Data Format and Examples

Data field headers in the dataset typically comprise four segments connected by hyphens. Each frame is sequentially numbered beginning from 0. The dataset includes a packet loss indicator ("Lost"), where a value of 1 indicates data loss (with values algorithmically derived), while 0 indicates normal sensor measurement data. Table 3 presents illustrative examples of the data format.

The complete dataset follows this pattern for all 59 body segments, with similar data fields for each segment capturing sensor data, joint kinematics, and bone orientations.