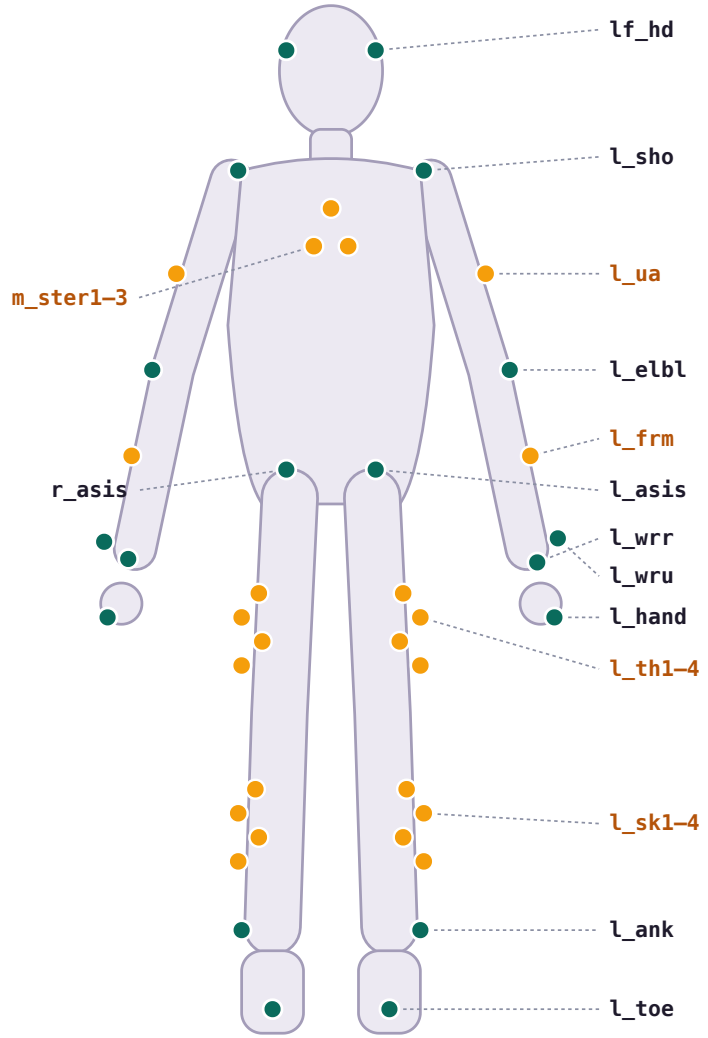
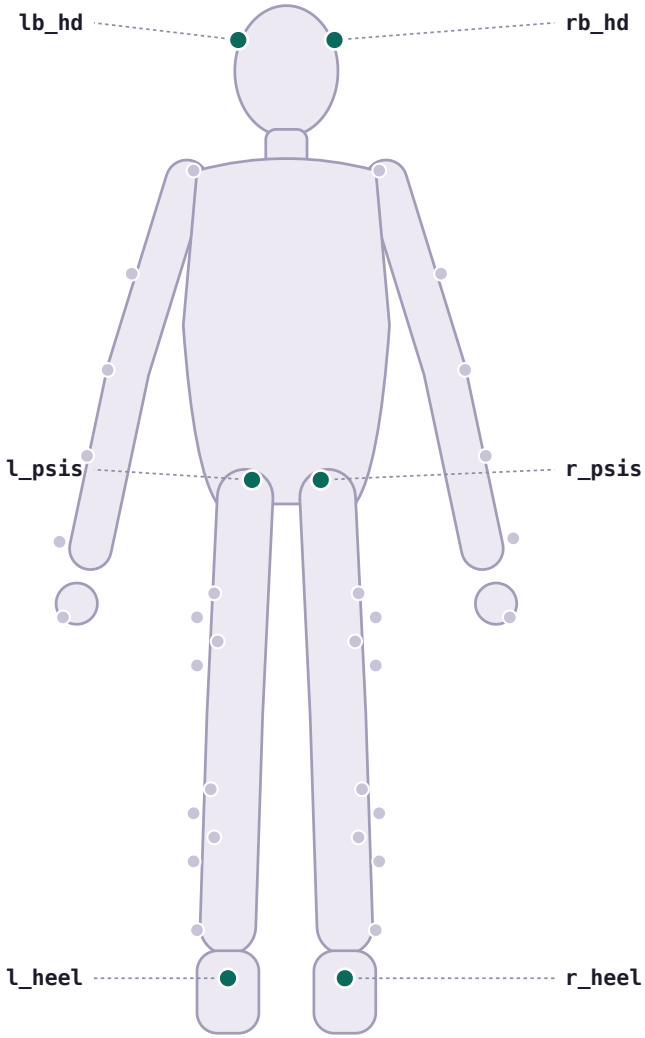
Warmerdam 2022 gait set

47 body markers + 8 static-only · rigid clusters on sternum, thighs and shanks · the /mocap example trial

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FRONT



BACK

anatomical marker · cluster / tracking marker · same marker, labelled on the other view

Detailed marker description

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#	LABEL	REF[1]	SEGMENT	LOCATION	TYPE
1	**l_f_hd**	–	Head	Front of the head, approximately over the left temple.	anatomical
2	**r_f_hd**	–	Head	Front of the head, approximately over the right temple.	anatomical
3	**l_b_hd**	–	Head	Back of the head, left, roughly in the horizontal plane of the front head markers.	anatomical
4	**r_b_hd**	–	Head	Back of the head, right, in the same plane.	anatomical
5–7	**m_ster1–3**	–	Thorax	Mid sternum, just caudal of the sternoclavicular joints (cluster plate); m_ster2: Caudal and to the left of ster1; m_ster3: Caudal and to the right of ster1.	cluster (3)
8	**l_sho**	SAE	Shoulder	On the acromioclavicular joint.	anatomical
9	**r_sho**	SAE	Shoulder	On the acromioclavicular joint.	anatomical
10	**l_ua**	–	Upper arm	Between elbow and shoulder, left side closer to the elbow.	tracking
11	**r_ua**	–	Upper arm	Between elbow and shoulder, right side closer to the shoulder.	tracking
12	**l_elbl**	HLE	Elbow	Lateral epicondyle, approximating the elbow joint axis.	anatomical
13	**r_elbl**	HLE	Elbow	Lateral epicondyle, approximating the elbow joint axis.	anatomical
14	**l_frm**	–	Forearm	Between wrist and elbow, left side closer to the wrist.	tracking
15	**r_frm**	–	Forearm	Between wrist and elbow, right side closer to the elbow.	tracking
16	**l_wrr**	RSP	Wrist	On the wrist IMU, above the radial styloid.	anatomical
17	**l_wru**	USP	Wrist	On the wrist IMU, above the ulnar styloid.	anatomical
18	**r_wrr**	RSP	Wrist	On the wrist IMU, above the radial styloid.	anatomical
19	**r_wru**	USP	Wrist	On the wrist IMU, above the ulnar styloid.	anatomical
20	**l_hand**	HM2	Hand	Dorsum of the hand, just proximal of the head of the 2nd metacarpal.	anatomical
21	**r_hand**	HM2	Hand	Dorsum of the hand, just proximal of the head of the 2nd metacarpal.	anatomical
22	**l_asis**	IAS	Pelvis	Directly on top of the anterior superior iliac spine.	anatomical
23	**r_asis**	IAS	Pelvis	Directly on top of the anterior superior iliac spine.	anatomical
24	**l_psis**	IPS	Pelvis	Directly on top of the posterior superior iliac spine.	anatomical
25	**r_psis**	IPS	Pelvis	Directly on top of the posterior superior iliac spine.	anatomical
26–29	**l_th1–4**	–	Thigh	Rigid four-marker cluster on the lateral thigh.	cluster (4)
30–33	**r_th1–4**	–	Thigh	Rigid four-marker cluster on the lateral thigh.	cluster (4)
34–37	**l_sk1–4**	–	Shank	Rigid four-marker cluster on the lateral shank.	cluster (4)
38–41	**r_sk1–4**	–	Shank	Rigid four-marker cluster on the lateral shank.	cluster (4)
42	**l_ank**	FAL	Ankle	On the lateral malleolus.	anatomical
43	**r_ank**	FAL	Ankle	On the lateral malleolus.	anatomical
44	**l_heel**	FCC	Foot	On the calcaneus.	anatomical
45	**r_heel**	FCC	Foot	On the calcaneus.	anatomical
46	**l_toe**	–	Foot	On the shoe, around the 2nd middle phalanx.	anatomical
47	**r_toe**	–	Foot	On the shoe, around the 2nd middle phalanx.	anatomical
48	l_st_hem	HME	Elbow	Medial epicondyle of the humerus (static trial only).	static only
49	r_st_hem	HME	Elbow	Medial epicondyle of the humerus (static trial only).	static only
50	l_st_fem	FME	Knee	Medial epicondyle of the knee (static trial only).	static only
51	r_st_fem	FME	Knee	Medial epicondyle of the knee (static trial only).	static only
52	l_st_fel	FLE	Knee	Lateral epicondyle of the knee (static trial only).	static only
53	r_st_fel	FLE	Knee	Lateral epicondyle of the knee (static trial only).	static only
54	l_st_mm	TAM	Ankle	Medial malleolus (static trial only).	static only
55	r_st_mm	TAM	Ankle	Medial malleolus (static trial only).	static only

[1] Nearest van Sint Jan (2007) landmark code where the placement matches one; – for cluster, head and shoe markers. Amber = cluster; grey = static calibration only. Placements: Supplementary Table S1, Warmerdam et al. (2021).

Additional information

Source

Warmerdam E, Hansen C, Romijnders R, Hobert MA, Welzel J, Maetzler W (2022). Full-Body Mobility Data to Validate Inertial Measurement Unit Algorithms in Healthy and Neurological Cohorts. *Data* 7(10):136, doi:10.3390/data7100136. Dataset: doi:10.6084/m9.figshare.20238006. The /mocap example trial is one overground walk (participant pp013, gait1) from this dataset, converted to Qualisys TSV with no gap-filling, so the real dropouts are kept.

Dataset licence is CC BY-NC-SA (the paper is CC BY). Confirm that hosting one converted trial as a teaching example on biomex.studio is within that licence.

Capture, as described in the paper

- Qualisys optical motion capture at 200 Hz; at least three 19 mm reflective markers per body segment; 47 markers on the body.
- Markers on the sternum, thighs and shanks were fixed as rigid clusters; the others on the skin or tight-fitting clothing, as far as possible on bony landmarks.
- Eight static markers (medial humeral epicondyles, medial and lateral femoral epicondyles, medial malleoli; labels `l/r_st_*`) were worn only during the static calibration in a neutral pose and are not in the walking trials. The 2022 data paper says six; the protocol lists eight.
- Data were labelled in Qualisys Track Manager and otherwise left raw: no gap filling, no filtering. Placements in the table are from Supplementary Table S1 of the protocol (Warmerdam et al. 2021, *Sensors* 21:5833).
- start_1/2 and end_1/2 in the file are walkway markers on the floor, not on the body.

What biomex derives from it

- **Hip joint centres** from the ASIS pair and the PSIS midpoint by the Bell, Pedersen & Brand (1990) regression.
- **Wrist centres** as the midpoint of the radial and ulnar wrist markers; **head centre** as the centroid of the four head markers; **cluster centroids** for sternum, thigh and shank.
- **Knee centre is estimated**: the set has no knee marker, so /mocap uses the centroid of the eight thigh and shank cluster markers (the midpoint of the two cluster centroids) for display. Treat knee angles from this set as indicative only.
- **Skeleton**: 29 bones through 16 derived points (HEAD_C, SHO_C, STER_C, PELV_C, PSIS_C, L_HJC (regression), R_HJC (regression), L_WJC, R_WJC, L_TH_C, R_TH_C, L_SK_C, R_SK_C, L_KNEE_est, R_KNEE_est, HEAD_F); 16 body segments for the Bones view (skull, pelvis, ribcage, spine, upperarm L, upperarm R, forearm L, forearm R, hand L, hand R, thigh L, thigh R, shank L, shank R, foot L, foot R).

Limits

Elbow and knee are lateral or estimated, the hands carry one marker, and about 15% of marker samples are missing in the example trial. That is what makes it a good teaching file for the gap-fill and merge tools, and a poor one for publishable joint kinematics without the static calibration.

Using it in /mocap

- Load example gait trial → the labels are recognised and the skeleton is fitted automatically (Tools → Skeleton model).
- Switch Lines / Solid / Bones under Skeleton model; the Bones view poses stylised bones from the marker frames.
- Try Gap-fill (Markers tab) and the merge suggestions on the dropouts before measuring.

Reading the clusters

Each thigh and shank cluster is a rigid plate of four markers on the lateral side; the sternum cluster is a three-marker plate with ster1 at the top. The wrist markers sit on the wrist IMU rather than on the skin, so they stand a little proud of the styloids.

Warmerdam, E. et al. (2022). Data 7(10):136 · Warmerdam, E. et al. (2021). Sensors 21:5833 · Bell, A.L., Pedersen, D.R. & Brand, R.A. (1990). J Biomech 23(6):617–621.