Preprocessing Motion Capture Data for AudioMaze Project

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0. Watch the movie (819_F1) to compare before and after correction

- Signal loss is generally severe.
- The channel on the right knee is missing throughout the recording.

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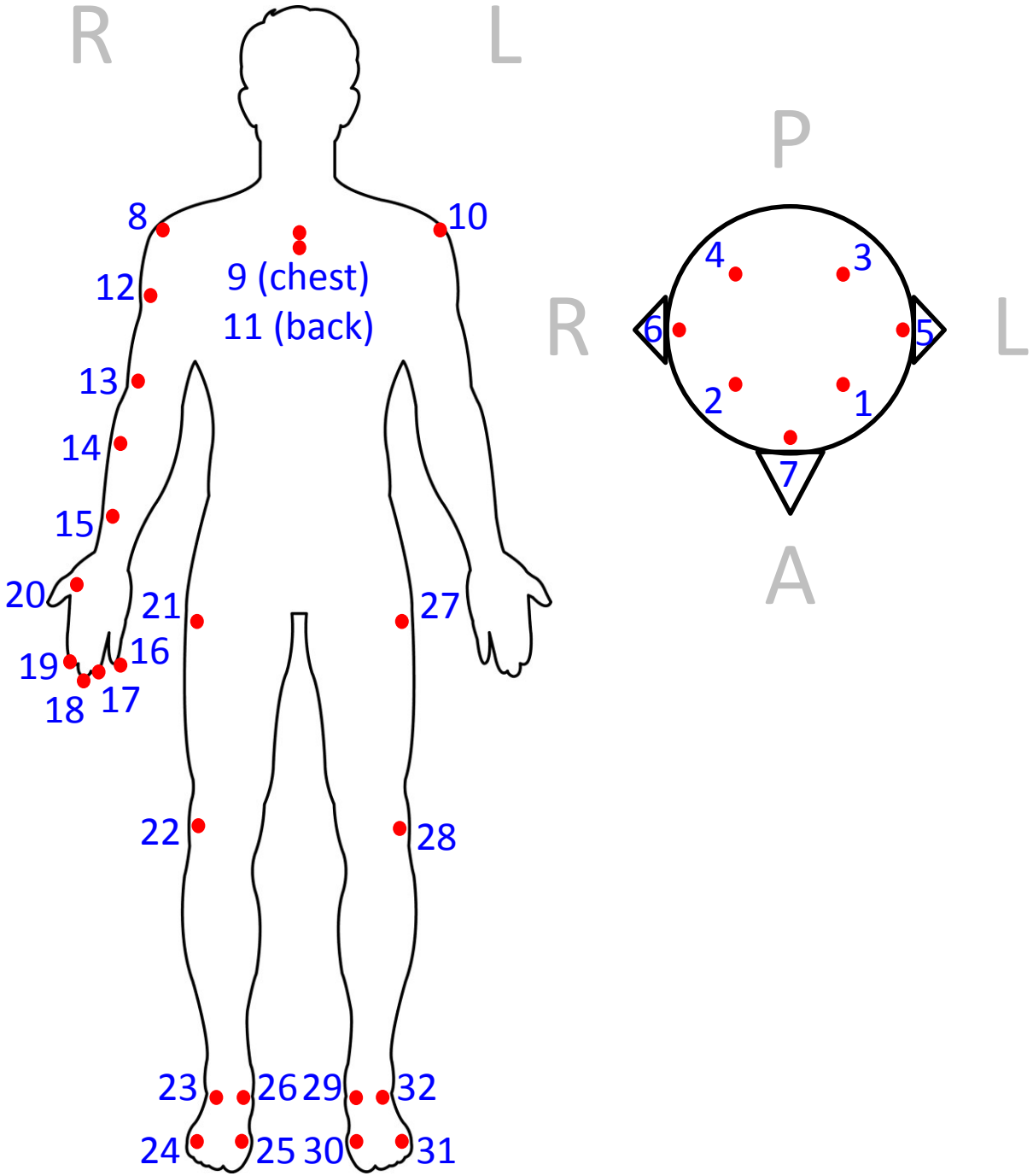
1. LED marker locations and indices


R
L
8
10
9 (chest)
11 (back)
12
13
14
15
20
21
27
19
16
18
17
22
28
23
26
29
32
24
25
30
31
P
R
L
A
4
3
6
5
2
1
7

2. Flow of preprocessing

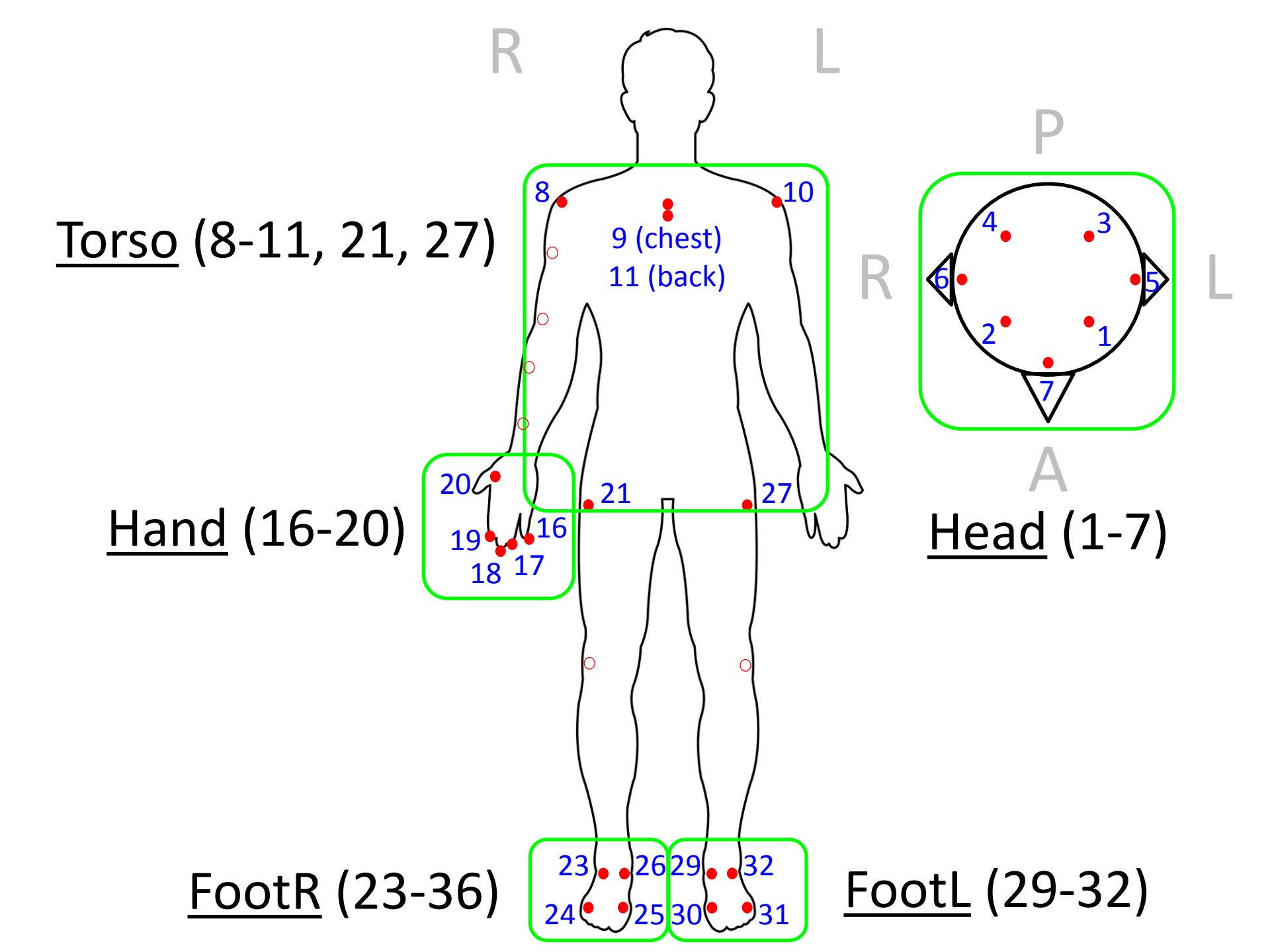
1. Fitting rigid bodies within a block.

2. Fitting rigid bodies within a subject if any marker is missing.

3. Fitting rigid bodies across subjects if any marker is missing.

4. Detect and interpolate outliers in non-rigid-body markers.

3. Definition of 5 rigid bodies


Torso (8-11, 21, 27)
Hand (16-20)
FootR (23-36)
FootL (29-32)
Head (1-7)
R
L
P
A
8
10
9 (chest)
11 (back)
20
21
27
19
16
18
17
23
26
24
25
29
32
30
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3
6
5
2
1
7

4. Algorithm for rigid-body fitting

Within-block correction:

1. Create a rigid-body template by taking *nanmedian()* across frames with >= 3 LED markers present.
2. Fit the rigid-body template to the frames with >= 3 LED markers present.
3. Interpolate missing datapoints in frames with < 3 LED markers using temporal filtering and spline interpolation, then fit the rigid body.

Within-subject, between-block correction:

1. Load all within-subject blocks and check if block-wise dead LED markers.
2. Create a rigid-body template by taking average across blocks.
3. Apply the rigid-body template to interpolate only the missing LED markers.

Across-subject correction:

1. Load all data to check if subject-wise dead LED markers.
2. Create a rigid-body template by taking average across subjects.
3. Apply the rigid-body template to interpolate only the missing LED markers.

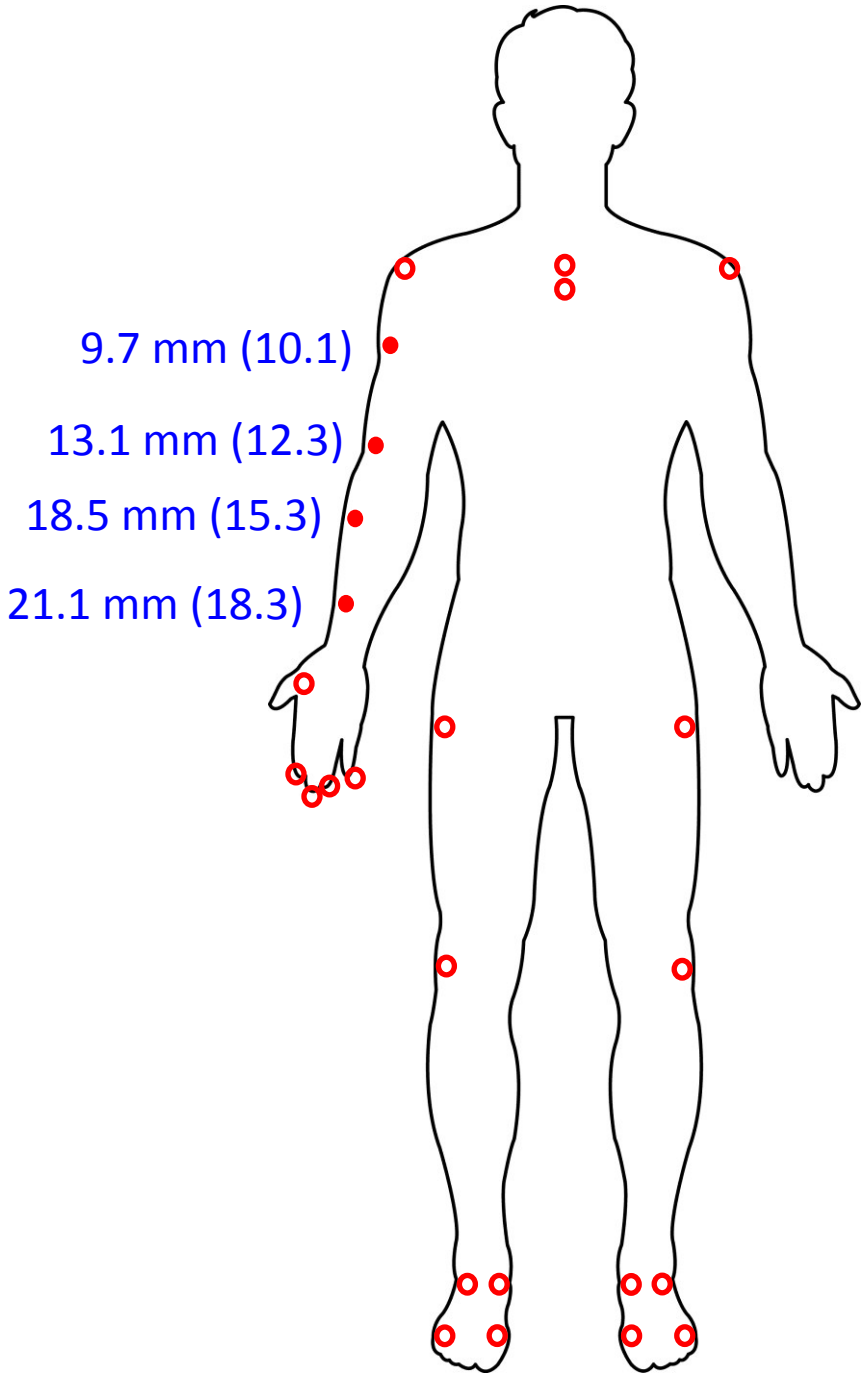
5. Algorithm for non-rigid-body interpolation

Single-channel correction based on distance to rigid body:

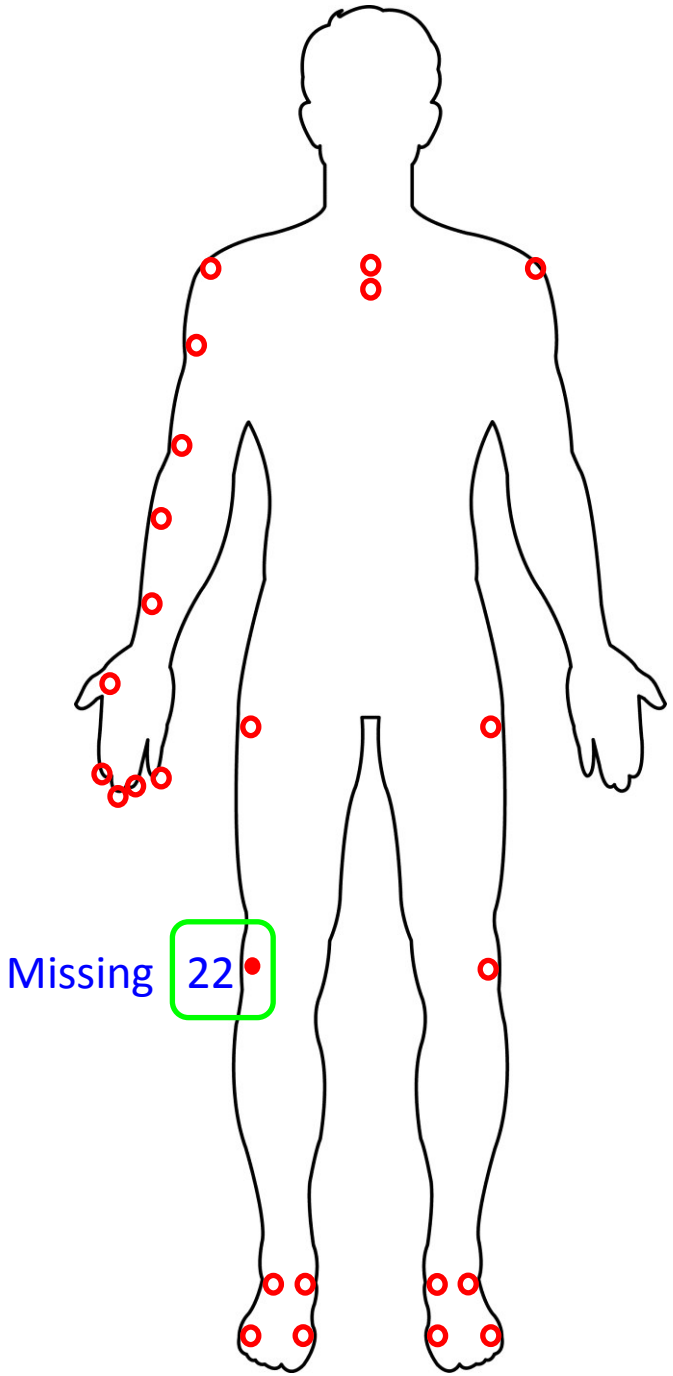
1. Measure distance between a rigid-body and non-rigid-body markers.
2. If the distance goes beyond median*1.5, spline-interpolate them.

Single/multiple-channel correction using ‘same posture’ interpolation:

1. Measure distances to two connecting LED markers.
2. Take geometric mean of the two distances: If both go large, the LED marker position is wrong; if only one of the two goes large, one of the two neighboring LED marker positions is wrong—in this case, geometric mean suppresses values than arithmetic mean.
3. Convert the geometric mean distances into Z-scores.
4. Define Z-score > 1.5 as bad channels & frames, while Z-score < 90 percentile as good channels & frames used for interpolation.
5. Find ‘same posture’ frames where target rigid body locations are close (i.e., within 1 percentile distance) to the current frame.
6. Obtain the non-rigid-body channel locations in these frames.
7. Compute weighted mean depending on distance.


9.7 mm (10.1)
13.1 mm (12.3)
18.5 mm (15.3)
21.1 mm (18.3)

6. Neural network for missing channels (ongoing)

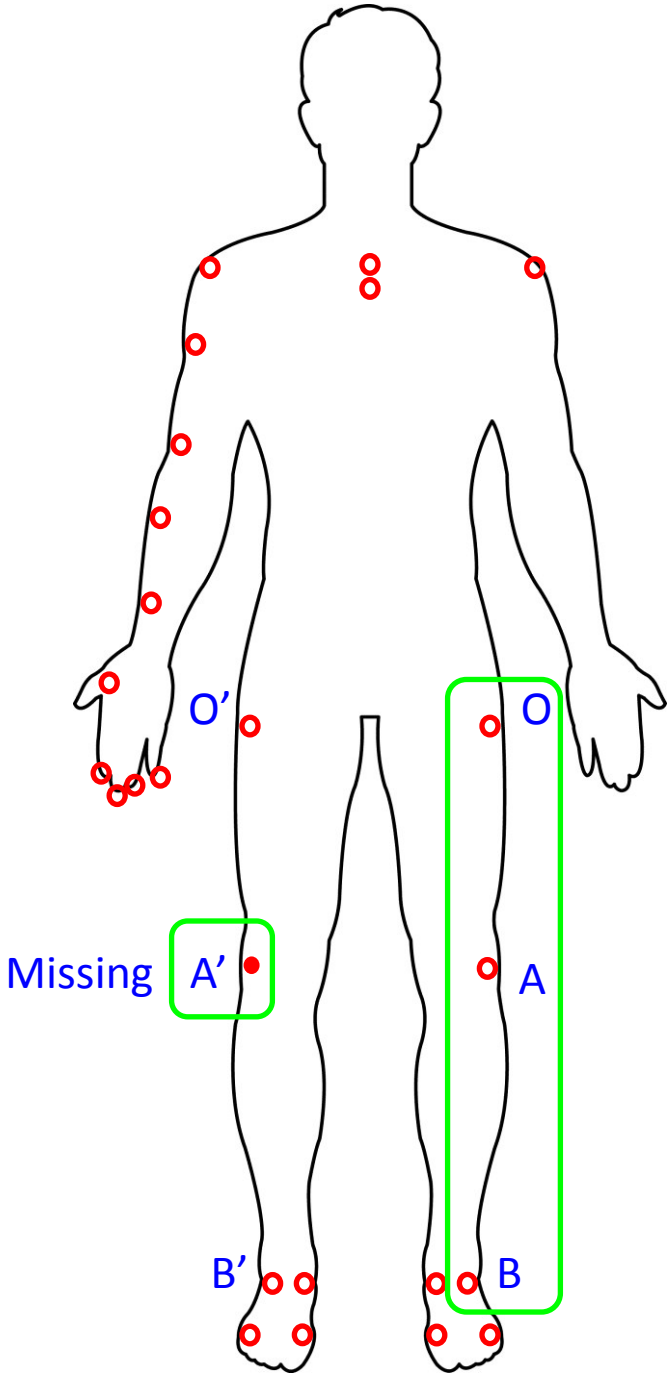

Missing 22

Train neural network on the left leg so that when B is input, A is output.

1. Measure coordinates of A and B relative to O.
2. Select those data points whose distance to O is within 90%-tile of its distribution.
3. Train neural network so that when B is input, A is output.

Recover the right knee by feeding the right foot to the trained neural network.

1. Measure coordinates for B’ relative to O’.
2. Feed B’s coordinate to the learned neural network to obtain that of A’.
3. Mirror-reverse the A’s coordinate.



Comparison

	Time	Accuracy
Same-posture interpolation	Slow (24h) for 1 subject	Good 1-2 cm for the arm
Neural network	Fast (10 min) Just learning time.	Not confirmed But looks promising

7. EEGLAB Plugin project

Load motion tracking data from EEG.etc.audiomaze.phaseSpaceData Movie

Store processed data to EEG.etc.audiomaze.phaseSpaceCorrected Movie

Rigid-body correction (overwrites .set files)

Rigid-body marker indices 1:7

Within-block rigid-body correction

Between-block rigid-body correction

Non-rigid-body correction (overwrites .set files)

Marker indices for correction (Sandwiched between two rigid-bodies) [8 12:15 20]

Posture-defining rigid-body marker 20

Torso marker indices [8:11 21 27]

Non-rigid-body correction