

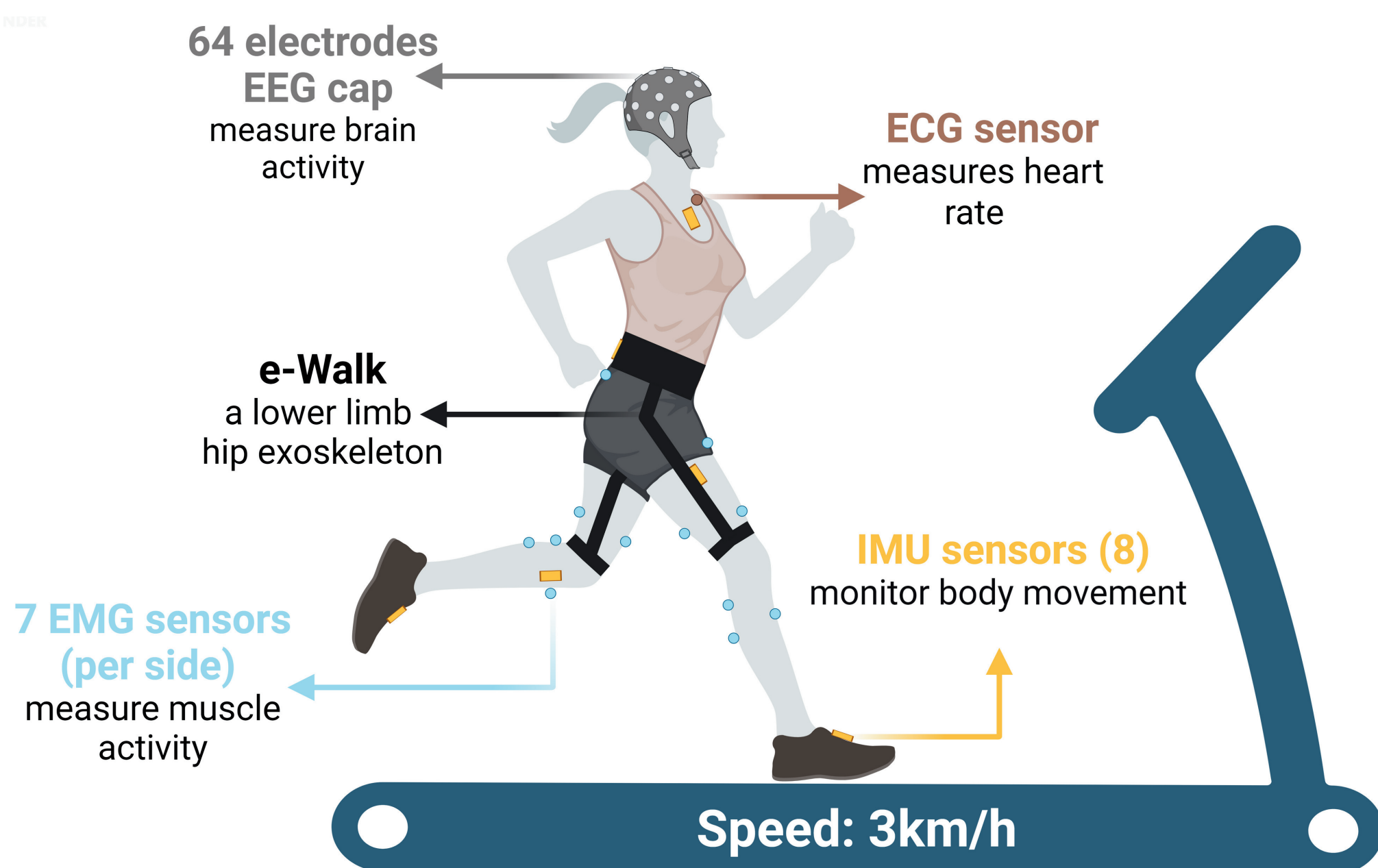
Multimodal Framework for Robot-Assisted Gait Rehabilitation : Brainwave Data Collection and Analysis

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Background and Aim:

Stroke impairs mobility, and robot-assisted rehabilitation holds promise for improving movement. In this study, we collect EEG data from healthy individuals during assisted walking and prepare it for robust analysis. This is an early step toward understanding how the brain and muscles work together during assisted walking.

Experimental Setup



IMU and EMG sensors are placed on key body parts.

See flyer for details

Experimental Protocol

After the Inertial Measurement Unit (IMU) calibration, do the following tasks:



- **Resting State Standing:** Eyes Open/Closed, 2min each*



- **Walking** without the exoskeleton: 6 min



- **Exo familiarization:** 10 min then **3 treadmill conditions***: 6 min each (Exo off, Low, High assistance)

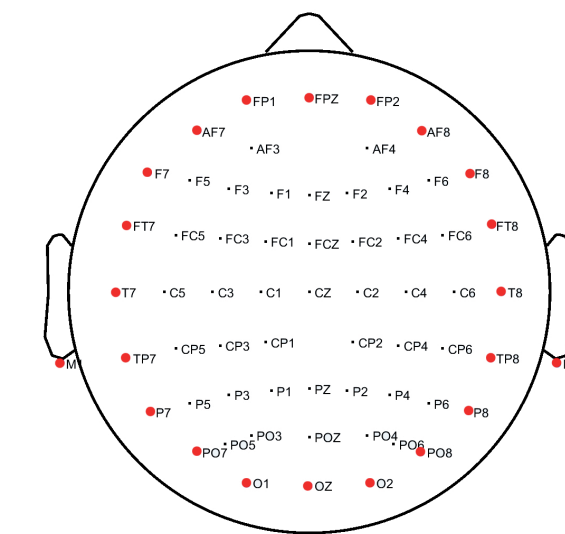


- **Resting State Standing:** Eyes Open/Closed, 2min each*

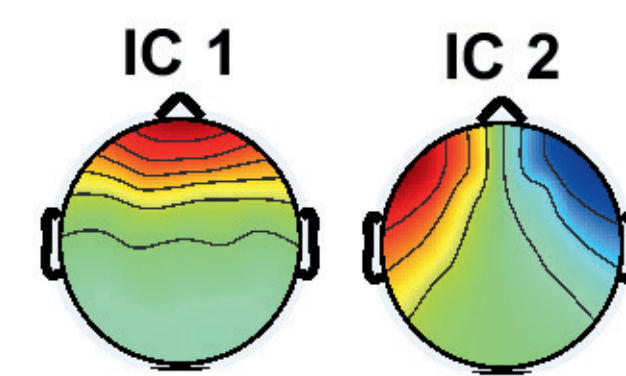
Tasks with * were presented in randomized order

Preprocessing Pipeline

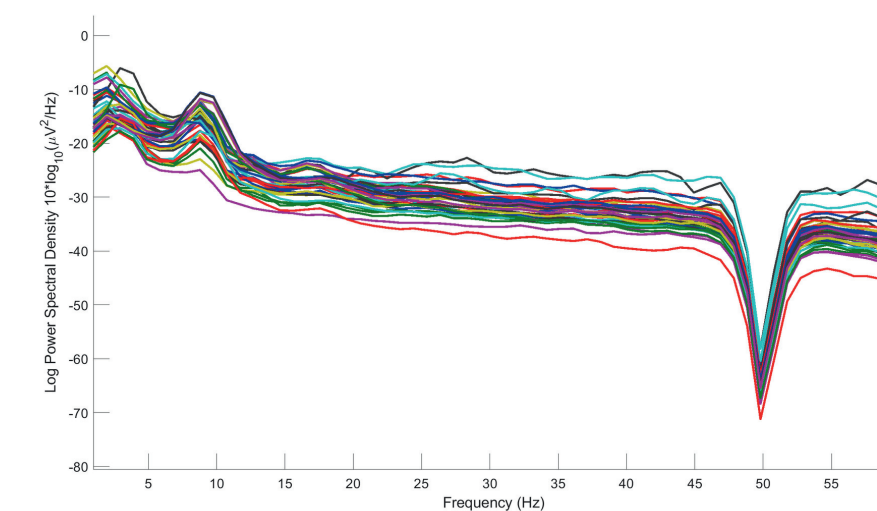
Apply these steps to the raw EEG signals on **EEGlab**:



1. **Remove Noisy Data:** Removing outer circumference (from 64 to 41 channels) and bad data.



2. **Perform Independent Component Analysis (ICA):** Separate brain signals from artifacts like eye movement.



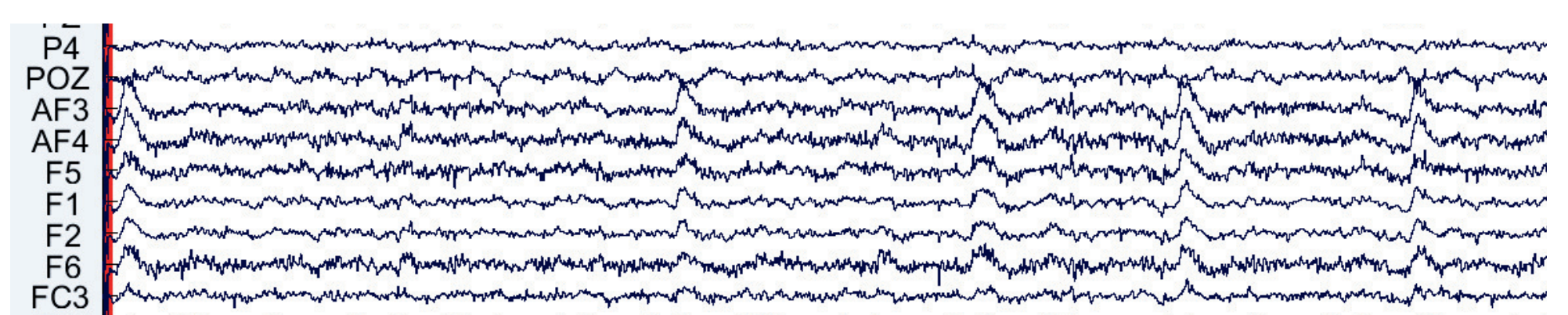
3. **Fix Bad Channels:** Interpolate noisy channels identified via *Kurtosis* (outlier detection).

$$V_i^{CAR}(t) = V_i(t) - \frac{1}{41} \sum_{j=1}^{41} V_j(t)$$

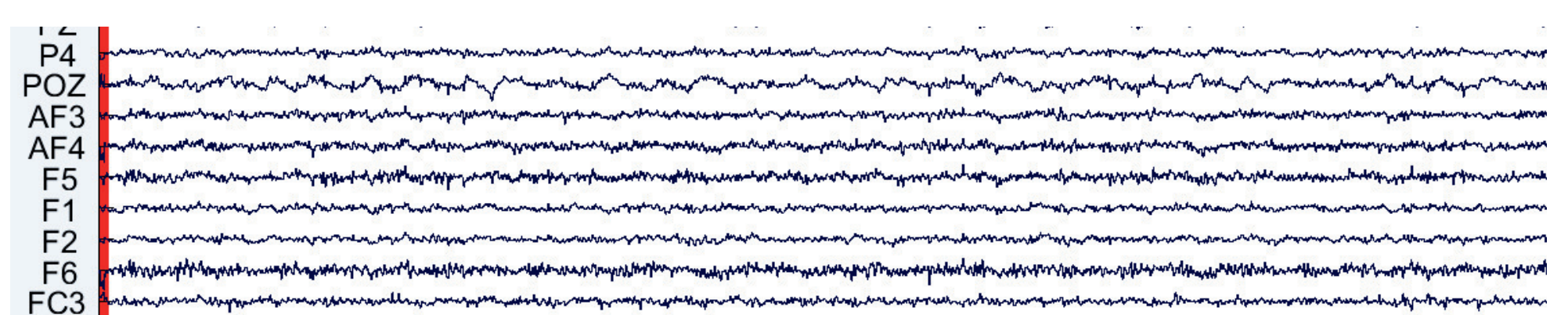
4. **Re-reference to Common Average Reference (CAR):** Apply CAR to reduce shared artifacts across channels.

Results

Participant 5: That's me in the Exo off condition !



Before Preprocessing



After Preprocessing

→ Preprocessing reduced noise and improved signal clarity for further analysis.