Data Info

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February 2025

This folder contains preprocessed trajectory data, where idle time has been removed, and relevant motion segments have been extracted according to the dataset structure outlined in "Bianchin F., et al, Human-Centered Geodesics for Motion Planning, in Proceedings of the International Conference On Rehabilitation Robotics (ICORR) 2025".
A board with twelve targets was positioned at a fixed distance from the subjects, ensuring unrestricted arm movement. Target (3) was aligned with the robotic shoulder's center of rotation. The experiment was conducted using the right arm, as it was the dominant side for all subjects. Due to the mirrored kinematic structure of the upper limbs, data from either side is applicable to the study's objectives.
The selected tasks involve predefined motion sequences designed to explore various joint coordination patterns in 3D space. A distinction is made between tasks, which consist of structured sets of movements, and individual motions, which correspond to specific trajectory segments between two postures (i.e., a task typically comprises multiple motions). Task segmentation was implemented to facilitate repetition. Our evaluation focuses on individual motions (Motions 1-30), as these exhibit distinct acceleration and deceleration phases while targeting specific 3D workspace objectives. The goal of our study is to develop a motion planning algorithm capable of generating human-like trajectories, given an initial joint configuration and a predefined 3D workspace objective.
The notation for movement postures is as follows: R: rest position on the side; K: rest position on the knee; M: mouth; S: contralateral shoulder; (1)-(12): numbered board targets. Figure 1 illustrates the experimental setup, while Figure 2 shows target placements.

The selected tasks are as follows:

- **Task 1 (Motions 1-6)**: Target reaching and diagonal planar motions
  R → (1) → (12) → R → (4) → (9) → R
- **Task 2 (Motions 7-12)**: Target reaching and top-bottom, left-right motions
  R → (2) → (10) → R → (9) → (11) → R
- **Task 3 (Motions 13-18)**: Bottom-up and right-left planar motions
  R → (10) → (2) → R → (11) → (9) → R
- **Task 4 (Motions 19-26)**: Pointing at board targets
  R → (1) → R → (3) → R → (9) → R → (11) → R
- **Task 5 (Motions 27-28)**: "Drinking" motion
  K → M → R
- **Task 6 (Motions 29-30)**: Shoulder touch
  K → S → K

1 Subject Data

For each subject (see 'S0i' folders), a .mat file contains the recorded trajectory data as a 10×6 cell array. The first dimension corresponds to the 10 repetitions performed for each task, while the second dimension represents the 6 tasks conducted during the experiment. Each cell contains a variable number of arrays, corresponding to motion data (e.g., Task 1 includes 6 arrays for motions 1-6, while Task 5 contains 2 arrays for motions 29-30).
Example: Upon loading "S07_trajs.mat," the variable `trajs` appears in the workspace, containing all

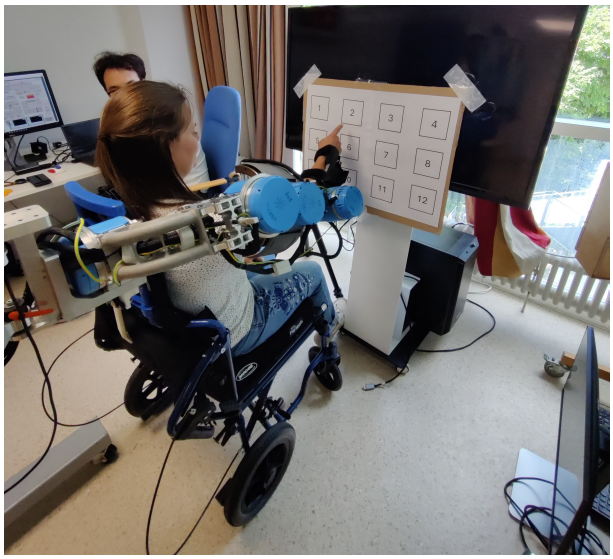

Figure 1: Experimental setup: A subject performing free-motion tasks using a target board while wearing the NESM-γ exoskeleton in transparent mode.

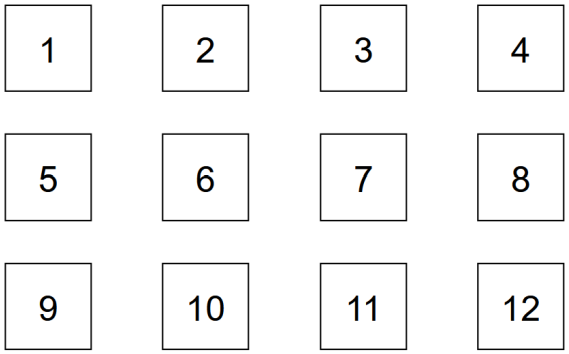

Figure 2: Target board used as a visual aid for free-motion tasks.

trajectory data for subject 7. The object `trajs`{4,2} stores the trajectory data for the 4th repetition of Task 2. The element `trajs`{4,2}{3,1} holds vector data for the 3rd motion of Task 2 (i.e., Motion 9, (10) $\rightarrow$ R). Single-motion arrays are structured as $4 \times N$ double arrays:

- The first dimension corresponds to the 4 measured joints, following the structure shown in Figure 3.
- The second dimension represents the number of samples in the motion trajectory, indexed by time. Data collection occurred at 100 Hz, meaning that two consecutive samples are spaced 0.01s apart.

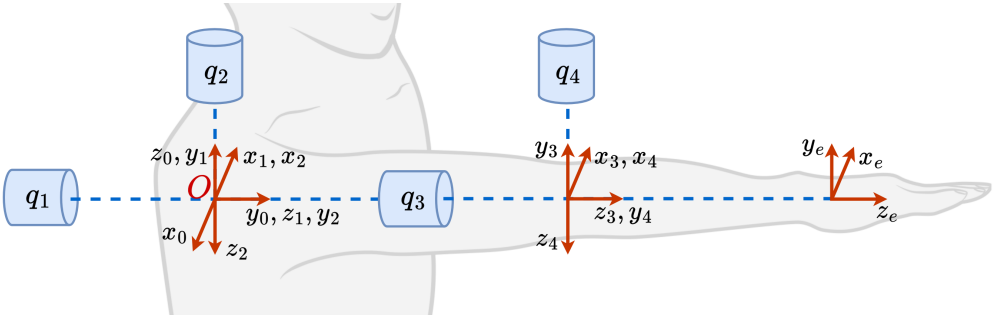

Figure 3: Kinematic chain model for the 4DoF human arm and exoskeleton supporting system [**?**]. Joint variables q_1, q_2, q_3 represent the shoulder's adduction/abduction, flexion/extension, and internal/external rotation DoFs, respectively, while q_4 represents the elbow's flexion/extension DoF.