

FlexWear-HD Data Card

<h2>FlexWear-HD</h2>	<p>This dataset includes high-density electromyography (HDEMG) data from 13 users without motor disabilities for 10 common gestures. Two sessions per user is available, with 8-10 gesture trials per gesture performed in the first session and 4-5 gestures trials per gesture performed in the second session. About one hour passes between sessions, and the sensor is kept on between the two sessions. The sensor used is an easy-to-wear reusable forearm device that uses 64 hydrogel electrodes.</p> <p>This data can be used to train EMG-based gesture classifiers for control of computers or robots. Additional information on the sensor and data collection is available at https://arxiv.org/abs/2312.07745, which is a paper that also uses this data for control of an 8 degree-of-freedom mobile manipulator.</p>
DATASET LINK	DATA CARD AUTHOR(S)
Hugging Face Link	<p>Jehan Yang, Carnegie Mellon University: (Contributor)</p> <p>Douglas J. Weber, Carnegie Mellon University: (Owner)</p> <p>Zackory Erickson, Carnegie Mellon University: (Manager)</p>

Authorship

Dataset Owners

TEAM(S)	CONTACT DETAIL(S)	AUTHOR(S)
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National Science Foundation	<i>The National Science Foundation funded this work as a part of the Graduate Research Fellowship program under Grant No. DGE2140739.</i>

Dataset Overview

DATA SUBJECT(S)	DATASET SNAPSHOT	CONTENT DESCRIPTION
Non-Sensitive Data about people	Size of Dataset	7.9GB
	Number of Instances	~13,000,000
	Number of Fields	64
	Labeled Classes	10
	Number of Labels	1
	Average Labels Per Instance	1
	Algorithmic Labels	10
	Human Labels	N/A
	Other Characteristics	N/A
	Above: Summary of FlexWear-HD Dataset	
FlexWear-HD Dataset is a dataset of time-series data from EMG with 64 electrodes and 10 gesture classes. Labels are automatically given during a cue-based data collection session. This dataset contains around 13,000,000 time steps of EMG data collected at 4000 Hz. Each timestep is associated with a gesture class.		

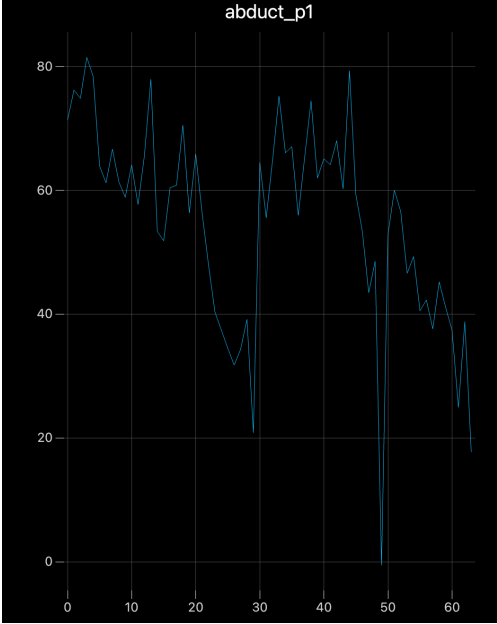
Sensitivity of Data

SENSITIVITY TYPE(S)	FIELD(S) WITH SENSITIVE DATA	SECURITY AND PRIVACY HANDLING
Anonymous Data	Intentionally Collected Sensitive Data No sensitive data was intentionally collected.	Data collected here is anonymized. Electromyography data from subjects is not expected to be sensitive information.

Dataset Version and Maintenance

MAINTENANCE STATUS	VERSION DETAILS	MAINTENANCE PLAN
Limited Maintenance (The data will not be updated, but any technical issues will be addressed.)	Current Version: 1.0 Last Updated: 06/2024 Release Date: N/A	FlexWear-HD is a dataset collected during a specific experiment and maintenance will be limited. Feedback: For feedback, reach out to emgbench@gmail.com

Example of Data Points

PRIMARY DATA MODALITY	SAMPLING OF DATA POINTS	DATA FIELDS
Time Series	 <p data-bbox="349 1056 789 1213">Above: Example datapoint of EMG data from a single timestep for the `abduct_p1` gesture. Notice that there are 64 indices, one for each time electrode.</p>	<p data-bbox="865 409 1468 472">The ten categories of gestures are labeled with the following keys in the HDF5 file:</p> <ol data-bbox="865 499 1484 1087" style="list-style-type: none"> 1. `abduct_p1` (wrist abduction), 2. `adduct_p1` (wrist adduction), 3. `extend_p1` (finger abduction and extension), 4. `grip_p1` (fist), 5. `pronate_p1` (wrist pronation), 6. `rest_p1` (rest), 7. `supinate_p1` (wrist supination), 8. `tripod_p1` (thumb, index, and middle finger pinch), 9. `wextend_p1` (wrist extension), 10. `wflex_p1` (wrist flexion). <p data-bbox="865 1115 1484 1213">These above variables contain the EMG data. These variables include data in a 3D array format of dimensions (trial, electrode, timestep).</p> <p data-bbox="865 1241 1484 1430">EMG data from each session is saved as a different HDF5 file. Each user's data is saved in a separate folder, with participant folders labeled from `p001` to `p013`. The first session has the suffix `initial` and the second session has the suffix `recalibration`.</p> <p data-bbox="865 1457 1468 1745">Additional keys include `SNR` and `Impedance_p0`. `SNR` includes a single float64 that is calculated from the root-mean-squared (RMS) of maximum voluntary contraction during a fist gesture divided by the RMS of the rest gesture. `Impedance_p0` includes 64 float64 numbers based on the measured impedance from the separate electrodes to ground.</p>

Provenance

Collection

METHOD(S) USED	METHODOLOGY DETAIL(S)	SOURCE DESCRIPTION(S)
Collected from In-Person Experiments	<p>Source: Subjects recruited during study involving control of a mobile manipulator using EMG signals. Paper link here.</p> <p>Platform: Intan RHD Recording Controller</p> <p>Is this source considered sensitive or high-risk? [Yes / No]</p> <p>Dates of Collection: 05/2023-06/2023</p> <p>Primary modality of collected data: Time Series</p> <p>Update Frequency for collected data: Static</p>	Subjects were recruited for an in-person study. The study protocol was approved by the Carnegie Mellon University Institutional Review Board, protocol 2021.00000121.768 20.
COLLECTION CADENCE	DATA INTEGRATION	DATA PROCESSING

Static

(Data was collected once from single or multiple sources.)

Static Included Fields

(Data fields that were collected and are included in the dataset.)

Field Name	Description
`abduct_p1`	EMG data in the form [TRIAL, ELECTRODE, TIME STEP] for the “wrist abduction” gesture. In the original paper, this gesture is described as “Wrist Up”. In units of microvolts.
`adduct_p1`	EMG data in the form [TRIAL, ELECTRODE, TIME STEP] for the “wrist adduction” gesture. In the original paper, this gesture is described as “Wrist Down”. In units of microvolts.
`extend_p1`	EMG data in the form [TRIAL, ELECTRODE, TIME STEP] for the “fingers extend and abduct gesture”. In the original paper, this gesture is described as “Fingers Open”. In units of microvolts.
`grip_p1`	EMG data in the form [TRIAL, ELECTRODE, TIME STEP] for the “fingers extend and abduct gesture”. In the original paper, this gesture is described as “Fingers Close”. In units of microvolts.
`pronate_p1`	EMG data in the form [TRIAL, ELECTRODE, TIME STEP] for the “wrist pronation” gesture. In the original paper, this gesture is described as “Palm Down”. In units of microvolts.
`rest_p1`	EMG data in the form [TRIAL, ELECTRODE, TIME STEP] for the “rest” gesture. In units of microvolts.
`supinate_p1`	EMG data in the form [TRIAL, ELECTRODE, TIME STEP] for the “wrist supination” gesture. In the original paper, this gesture is described as “Palm Up”. In units of microvolts.
`tripod_p1`	EMG data in the form [TRIAL, ELECTRODE, TIME STEP] for the “pinch index, middle, and thumb” gesture. In the original paper, this gesture is described as “Pinch Fingers”. In units of microvolts.
`wextend_p1`	EMG data in the form [TRIAL, ELECTRODE, TIME STEP] for the “wrist extension” gesture. In the original paper, this gesture is described as “Wrist Right”. In units of microvolts.
`wflex_p1`	EMG data in the form [TRIAL, ELECTRODE, TIME STEP] for the “wrist flexion” gesture. In the original paper, this gesture is described as “Wrist Left”. In units of microvolts.
`impedance_p0`	Impedance from electrode to ground for all 64 electrodes in units of Ohms.

Description: EMG data is collected from each subject. SNR is derived from EMG data and impedance is collected separately using Intan RHD function.

Methods employed: A visual cue-based system is used to show when a participant should start and stop performing a gesture.

Tools or libraries: Intan RHD Recording Controller with Intan RHX software.

	<p>`SNR`</p>	<p>Ratio of root-mean-square of maximum voluntary contraction (MVC) during fist gesture over root-mean-square of rest gesture at beginning of data collection session. Raw data for MVC and rest used for generating SNR is not provided in dataset.</p>	
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