

## Data Export for Thrust 3 (Heni's Students)

About: This folder contains experimental sensor data collected with the origami device. The data sets were saved as MATLAB .mat files.

### Data Files:

- sensor\_data\_trial1\_LostMarkers.mat = useful for validation, but possibly NOT useful for training. This data set contains a few lost markers, which leads to jumps in the ground truth kinematics obtained from mocap.
- sensor\_data\_trial2.mat = good data set.
- sensor\_data\_trial3.mat = good data set.

### Variables within each data file:

- gyro\_speed{} = (deg/s) 1D angular rate of gyroscopes. Each *cell array* corresponds to a different gyroscope sensor; 3 gyroscope sensors in total:
  - gyro\_speed{1} = angular rate of link #1 ( $\omega_1$ )
  - gyro\_speed{2} = angular rate of link #2 ( $\omega_2$ )
  - gyro\_speed{3} = angular rate of link #3 ( $\omega_3$ )
- hall\_angle{} = (deg) angle measurement obtained from the hall effect sensors. Each *cell array* corresponds to a different hall effect sensor; 4 hall sensors were used in total, two hall sensors for each robot joint ( $\theta$ ):
  - hall\_angle{1} = angle of joint #1 ( $\theta_1$ )
  - hall\_angle{2} = angle of joint #1 ( $\theta_1$ )
  - hall\_angle{3} = angle of joint #2 ( $\theta_2$ )
  - hall\_angle{4} = angle of joint #2 ( $\theta_2$ )
- hall\_volt\_raw = (volt) voltage raw reading of the hall effect sensor. Included for reference only.
- time\_sensor = (sec) time stamp values. These are synchronized with the sensor measurements and the mocap angles.
- mocap\_angle{} = (deg) mocap joint angles, used as ground truth. The variable has 3 *cell arrays* which correspond to:
  - mocap\_angle{1} = angle of joint 1 ( $\theta_1$ )
  - mocap\_angle{2} = angle of joint 2 ( $\theta_2$ )
  - mocap\_angle{3} = orientation of end-effector ( $\phi$ )

### Details About the Experiment Setup:

- Check the illustration included below.
- A bench test was conducted (no human wearer). A random motion was induced in the robot. This robot measured the 1D joint angles (sagittal plane only).
- The origami robot consists of 3 links, and 2 internal joints. The  $\phi$  angle (mocap\_angle{3}) corresponds to the robot's end effector orientation / human torso angle.
- One Gyroscope is mounted on each link. A total of 3 gyroscopes were used to measure:
  - Gyro 1 (gyro\_speed{1}): angular rate of link #1 ( $\omega_1$ )

- Gyro 2 (gyro\_speed{2}): angular rate of link #2 ( $\omega_2$ )
  - Gyro 3 (gyro\_speed{3}): angular rate of link #3 ( $\omega_3$ )
- 2 hall effect sensors are mounted on each Joint (redundant sensors). A total of 4 hall sensors were used to measure the following joints:
  - Hall 1 (hall\_angle{1}): measures joint #1 angle ( $\theta_1$ )
  - Hall 2 (hall\_angle{2}): measures joint #1 angle ( $\theta_1$ )
  - Hall 3 (hall\_angle{3}): measures joint #2 angle ( $\theta_2$ )
  - Hall 4 (hall\_angle{4}): measures joint #2 angle ( $\theta_2$ )

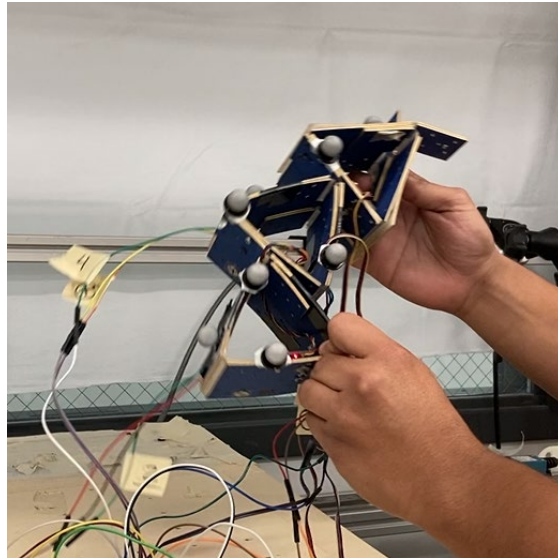
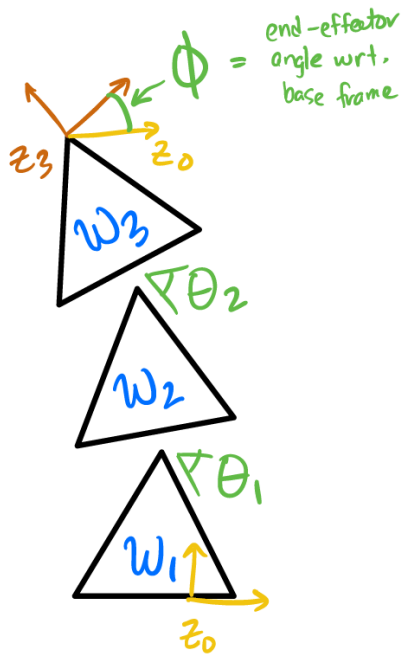


Figure: Illustration of Origami Robot and the corresponding state variables:

- $\omega_i$  = angular rate of link  $i$ , measured with gyro  $i$ .
- $\theta_i$  = angle of joint  $i$ .
- $\phi$  = robot end-effector orientation / human torso angle (mocap\_angle{3}).