

Gaitech BCI

Bringing Brain Computer Interfacing to ROS

Ali Bin Wahid

Project Engineer (R&D), Gaitech Robotics, China MS Robotics and Intelligent Machine Engineering, NUST, Pakistan ali@gaitechrobotics.com

Project Team:

Prof. Anis Kouba (Lead) Alex Ni Kevin Ardian Usama Siraj Ali bin Wahid



ROS What is BCI? GaiTech Signal aquisition Signal features Translation Device and processing algorithm commands

BCI: Brain-Computer-Interface

Reads brainwaves, translates it to signals computers can understand.

How it

workollect brainwaves

- Extract features
- Translate to intentions
- Map intentions to commands
- Execute commands

2



Salient Features:

- Comprehensive and high quality software and hardware platform for performing BCI experiments
- Handy software tools for managing EEG Experiments, automatic creation of Labeled EEG datasets
- EEG Datasets are saved in rosbag format
- Conversion of recorded rosbag EEG data-sets into other popular formats such as Matlab, csv, mne
- Demo BCI application for getting start with Brain Robot Interfacing research.
- Open-source contribution Source code: https://github.com/gaitechrobotics/gaitech-bci



EEG Headset 'H10C'



Features

ROS

GaiTech

- High-quality data
- Good ergonomics
- Easy to setup and use

Top of head reference eliminates muscle artifacts

Advanced signal processing and purification chipset

Soft foam sensor for forehead comfort and easy wearing

Flexible, dry pogo sensor to tap scalp through hair without gel

Human safe, high-quality polymer shell protects electronics and easy to clean

BEG Headset 'H10C'

- aesthetically pleasing design
- Comfortable to wear
- Dry spring loaded sensors (for hairy scalp)
- Dry foam sensor for forehead (bare skin)
- Adjustable and variable sizes (small, medium, large)
- Good battery life
- Bluetooth 2.1 + Enhanced Data Rate
- Good Sampling frequency for BCI applications (1024 Hz)
- High Quality EEG Data which is comparable to Clinical devices
- Human safe, high-quality polymer shell protects electronics and easy to clean
- Low price as compare to other good quality headsets
- Easy setup within One minute
- ROS support





ROS Packages

1. Bringup Package

- Manages H10C device via ROS service calls
- Acquiring real time EEG signals and information via ROS topics
- Apply digital filtering
- ROS Launch files for easy startup
- Multiple nodes can be created to manage multiple H10C devices on same computer
- Creation of labeled datasets in roshad format





ROS Packages

1. gaitech_bci_bringup

		gaitech_bci	_bringup (ROS Package)				
ROS node	ſ	rostopic list			gaitech_bci_bringup ROS Messages		
		/gaitech_bci_device/data_avgref	gaitech_bci_bringup::AverageReference		AverageReference	Longitudinal Bipola	
gaitech_bci_device]	/gaitech_bci_device/data_comref	gaitech_bci_bringup::CommonReference			Longraama bipola	
		/gaitech_bci_device/data_lb	gaitech_bci_bringup::LongitudinalBipolar		CommonReference	TransverseBipolar	
ROS parameters		/gaitech_bci_device/data_tb	gaitech_bci_bringup::TransverseBipolar		DeviceInfo	EEGEvent	
nodeid		/gaitech_bci_device_1/info	gaitech_bci_bringup::DeviceInfo				
adapter	L						
filter_high		rosservice list			gaitech_bci_bringup ROS Services		
fillers laws		/gaitech_bci_device/scan	gaitech_bci_bringup::DeviceScan				
niter_low		/gaitech_bci_deviœ/connect	gaitech_bci_bringup::DeviceConnect		DeviceScan	DeviceConnect	
fliter_notch_nign		/gaitech_bci_deviœ/disconnect	gaitech_bci_bringup::DeviceConnect				
filter_notch_low		/gaitech_bci_device/get_filter	gaitech_bci_bringup::FilterInfo	FilterInfo	FilterInfo	FilterUpdate	
device start_connected		/gaitech_bci_deviœ/set_filter	gaitech_bci_bringup::FilterUpdate		LicenceInfo	LicenceUpdate	
		/gaitech_bci_device/get_licence	gaitech_bci_bringup::LicenceInfo				
Launch File		/gaitech_bci_deviœ/set_licence	gaitech_bci_bringup::LicenceUpdate		DeviceStatus		
start_driver.launch		(mitach hei davira/rat status	raited, hci hringun: DeviceStatus				



2. GAITECH_BCI_TOOLS

- This package contains group of useful ROS programs to help in doing EEG based BCI experiments in an efficient way
- It has several very powerful ROS based programs for successfully managing BCI experiments

N 0.	Tool name	Function
1	view_bci_data	User interface for managing EEG devices and live data
2	view_bci_experiment	User interface for visualizing recorded EEG datasets
3	video_experiment_buil der	To build annotated videos for collecting labeled EEG data
4	view_psd	Viewing power spectral density of EEG signals
5	view_image	Viewing flickering images on screen at desired frequency and color. Useful for SSVEP experiments
6	rosbag_mne	Converting recorded rosbag dataset into mne format
7	rosbag_matlab	Converting recorded rosbag dataset into matlab format
8	rosbag csv	Converting recorded rosbag dataset into csv format



2. GAITECH_BCI_TOOLS



Viewing live EEG data and adding markers for creating labeled EEG dataset Interface for managing the device and monitoring the EEG data



3. GAITECH_BCI_TELEOP

SSVEP: "In neurology and neuroscience research, steady state visually evoked potentials (SSVEP) are signals that are natural responses to visual stimulation at specific frequencies."



The program detects where the user is looking at screen by monitoring frequency of signal*



User looking at the screen to control simulated robot in ROS



3. GAITECH_BCI_TELEOP





3. GAITECH_BCI_TELEOP - DEMO

Gaitech H10C Device : Avertus H10C-A003			📺 🏠 🧧 🗐 🚔 💷 🐠 01:15 🕸
Move Robot Configure H10C Device Setting	gs		
	S S TurtleSim		
	*	Fp1 Fp2 Fp2 Fp2 Fp2 Fp Fp2 Fp2 Fp2 Fp2 Fp2	250 300
	s	top Robot Operate Robot	

You are now operating robot

3. GAITECH_BCI_TELEOP - DEMO

