many practical applications of EEG call for fur-ther developments in signal processing and machine learning to improve real-time (and online) measurement and classifica- tion of brain and behavioral states from small samples of noisy EEG data.

mobile wearable EEG settings must be fully automatable and capable of adapting to changes in measured data distributions. Robust statistical machine learn- ing approaches are required for modeling relationships between high-dimensional neuronal features and cognitive or behavioral states.

Finally, the integration of data acquisition, processing, classifi- cation, and visualization pipelines within a unified interoperable software framework is a key to reduce barriers to real-world ap- plication and reproducibility.

Of similar importance is the development of wearable (wire-less, lightweight, dry) EEG hardware capable of comparable signal quality to research-grade wet systems.

The objective of this paper is to describe and demonstrate

1. a novel high-density (64-channel) dry EEG hardware sys- tem, and 2) a software framework for real-time artifact re- jection, source localization and connectivity analysis, cogni- tive/behavioral state classification, and data visualization. Out- side a preliminary case study by our group [20], this is the first demonstration of such a framework applied to high-density dry wearable EEG data.

The software is made freely available within open-source toolboxes by the authors, including BCILAB [21] and SIFT [5]

There was a first version of a 64-c dry EEG but here we present an extended version with a detailed description of the complete headset system, includ- ing operational mechanics to minimize motion artifacts; system specifications and electronics, including analog front-end and shielding for obtaining high-quality signals from dry electrodes; and a wireless communications system, necessary for transmit- ting accurate time-marked data in a wireless environment.

EEG data are acquired from the wearable dry EEG sys- tem via the open-source Lab Streaming Layer (LSL) software1. The data stream feeds to a data analysis and classification pipeline consisting of preprocessing, source localization, dy- namical model fitting and connectivity estimation, and cognitive state classification. Supporting tools for 2-D and 3-D data vi- sualization augment this, allowing examination of task-relevant brain network dynamics and activity across time, frequency, and anatomical location

Cognionics has developed the HD-72 dry wire- less high-density EEG headset, shown in Fig. 2(a). The system features 64 EEG electrodes [see Fig. 2(d)] plus reference and ground. An additional eight recording channels are available providing ECG, EMG, respiration, and other physiological variables for mobile brain-body activity monitoring.

Obtaining high-quality EEG signals in real-world environments is challenging due to the various sources of electrical, mechanical, and physiological artifacts, especially in real-world environments. The EEG headset is designed to mitigate these challenges by optimizing electromechanical design in a single, integrated, and wearable form factor.

A practical wearable EEG system must not only be lightweight but also able to reject electrical interference and cope with variable and changing electrode con- tact qualities. External

To minimize the influence of external electrical fields, the headset utilizes an actively driven ground system to sense and cancel out common-mode potentials on the subject’s body. In addition, the internal wiring of the headset itself sits within a local Faraday cage-like enclosure formed by a conductive layer, spanning the headset, driven by the output of a reference amplifier

Signals are digitized at 300 samples/s with a bandwidth from dc to 50 Hz (80 Hz with impedance(allowing for improved automated channel rejection during recording) check off) and transmitted via an onboard Bluetooth transmitter.

. A dry-electrode system is critically dependent on a harness to hold the electrodes in place and maintain direct skin contact.

The entire system weighs only 350 g, including batteries, enabling it to be easily worn by a mobile subject.

2 tipos de sensors, um pra local com cabelo e um direto na pele.

The ASR (spatial filtering) filter operates online and is de- signed to detect and remove high-amplitude data components (for instance, stemming from eye blinks,muscle, and sensor mo- tion) of high amplitude relative to some artifact-free reference data, while recovering EEG background activity that lies in the subspace spanned by the artifact components

Missing or otherwise removed channels may then be spatially reconstructed from the activity of neighboring channels using a Gaussian spline function.