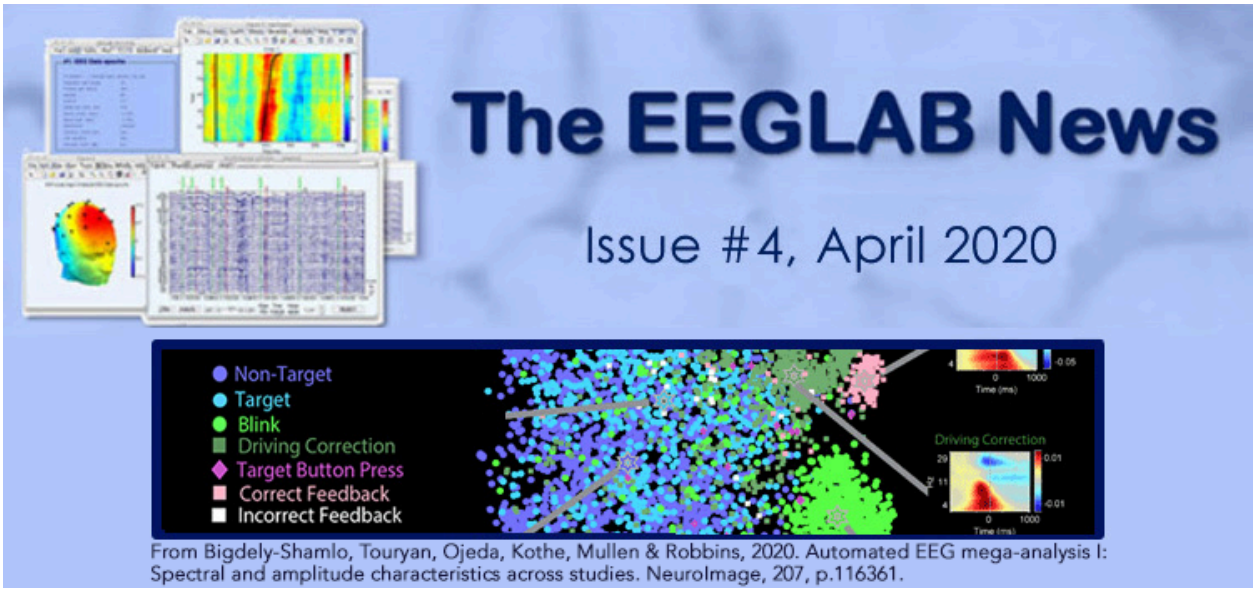


From Bigdely-Shamlo, Touryan, Ojeda, Kothe, Mullen & Robbins, 2020. Automated EEG mega-analysis I: Spectral and amplitude characteristics across studies. NeuroImage, 207, p.116361.

View this email in your browser

What's New

On performing EEG research during the COVID-19 pandemic

In the midst of world chaos caused by COVID-19, what can EEG researchers do? First, let us acknowledge the fortunate opportunity most of us academic or industry research staff have to keep our job by working remotely, while many others in other vocations are not so fortunate. Still, parts of our work, especially those parts associated with acquiring new data, are impacted, since it is imprudent to these days to continue to acquire data in laboratory settings. We can, instead, spend our time focused on processing and reporting on previously acquired data, and on designing new projects. Beyond this, how can we best find any benefit in the current state of affairs?

First, a comment: Remote, distributed EEG data collection in which participants or patients acquire their own data, is in its infancy. One of the main barriers remains the high cost of research-grade EEG systems; most pilot projects have been using inexpensive consumer-grade EEG systems whose data quality typically fails to match that of research grade systems. In addition, the fact that participants manage EEG data acquisition themselves does little to ensure good recorded data quality. Thus, it is a good time to reflect on how we might try to boost the quality, economy, and value of self-collected data. Success in this direction will also afford the opportunity to acquire, accumulate, and analyze larger amounts of data – as needed to take full advantage of recent advances in machine learning and artificial intelligence.

A major opportunity, during this difficult period, is to further analyze data posted on open data archives, in particular EEG BIDS-formatted data. BIDS (for 'Brain Imaging Data Standards') is a recently formed and rapidly expanding research community initiative to enable organizing, archiving, and sharing of human brain imaging data within and between laboratories. Currently, there are 19 available BIDS-formatted EEG datasets in the Openneuro archive; we are actively working with collaborators to add (much!) more data as part of our NEMAR data, tools and compute resource project – and welcome new or future collaborators in this effort!

BIDS-formatted data can now be readily imported as an EEGLAB STUDY using the *BIDS-matlab-io* tools available through the EEGLAB extension manager or through Github. As well, processing of data formatted as EEGLAB studies can now leverage the data processing capabilities of the UCSD 'Comet'

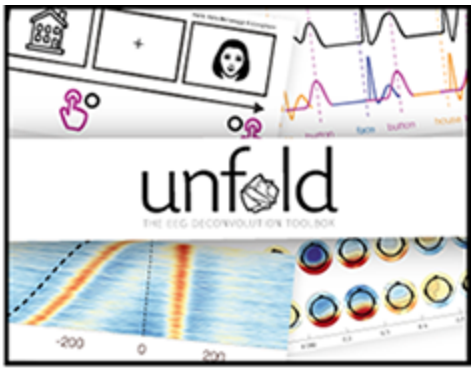
high-performance computing environment using the new *nsgportal* EEGLAB plug-in created through a collaboration with the Neuroscience Gateway project. This might be a good time to explore how best to use this freely available resource, which we aim to continue to enhance in the NEMAR project.

So – even in these hard times there is still plenty to do (while staying personally as safe as possible), and we hope that this time "on our own" may push researchers to explore making use of (and extending) some of the many new tools for EEG data analysis (on smaller and ever larger scales) that have continued to emerge through the past 20 years we have worked together.

Arnaud Delorme & Scott Makeig

Plug-ins

Here we highlight new EEGLAB plug-ins of possible wide interest to EEGLAB users. Please send descriptions of new plug-ins for consideration. These should have a brief lead introduction, and further text and images to be published on a continuation page.



Unfold – an integrated toolbox for overlap correction, non-linear modeling, and regression-based EEG analysis by Benedikt Ehinger and Olaf Dimigen (see Profiles below). If we want to record EEG data in naturalistic situations – for example while reading a book, looking at a piece of art, or walking around in a (possibly virtual) city – one problem is immediately apparent: Many things happen at the same time. The recorded EEG will typically reflect brain processes supporting a complex, overlapping sequence of sensory input and motor actions. Even in traditional, well-controlled experiments, EEG measures often sum temporally overlapping brain activity associated with multiple events (stimulus onsets, microsaccades, button presses, etc.). If we want to separate out event-related processes to individual events, and as we move towards more ecologically valid designs, it makes sense to use a new analysis approach developed in recent years: deconvolution based on multiple linear regression. The ***unfold*** toolbox offers an EEGLAB-compatible analysis framework for such designs that can disentangle the overlapping (linear or nonlinear) effects of many predictors on event-related brain activity.

There are three reasons why unfold is easy to adopt into an EEGLAB workflow: (1) ***unfold*** documentation has many tutorials (of increasing complexity) to help you get started, (2) ***unfold*** makes use of the popular Wilkinson Formulas (used in R, Python, and Matlab statistics) to specify linear models, and (3) ***unfold*** is based on the EEGLAB ecosystem with which you are already familiar. ***Unfold*** is available as open-source software at http://www.unfoldtoolbox.org.

GPU computation in Matlab. Performing GPU (Graphical Processing Unit) based processing using MATLAB is promising. Currently, the EEGLAB default route is the Matlab-supported solution. Computing using a GPU usually only involves recasting variables and making minor changes to MATLAB scripts or functions. We have recently run some tests on our server (Quad Core Intel™ Xeon W3550 3GHz, 8M L3, 4.8GT/s, Turbo) with one nVidia GTX Titan GPU (2,688 CUDA cores). When we first ran tests of GPU processing in 2010 (using a different server), we were relatively disappointed with the results, as we only observed speed-ups of 3x or less. This is far from the 100x increases sometimes realizable using optimized native GPU programming. As of 2020, however, GPU processing within MATLAB has been much more optimized; we now see speed-ups ranging from 10x to 50x for standard EEGLAB signal processing functions. See this page for more information. Also, see our Neuroscience Gateway Portal wiki on using EEGLAB to process data on the U.S. XSEDE high-performance computing network without charge.

Profiles

This section contains personal profiles of EEGLAB developers and/or users, with a description of how they use EEGLAB in their research.

Kay Robbins, Ph.D.

Kay Robbins, Ph.D., Professor Emeritus, Department of Computer Science, University of Texas at San Antonio, is a strong EEGLAB enthusiast. She uses the toolbox for many aspects of her work, and is an avid tool developer. "I am a big fan of open-source science," she shares emphatically. "We write a lot of scripts and tools in my lab."

She and her students at the Visualization and Modeling Laboratory (VML) at UTSA have developed a long list of open source EEGLAB-plugins, including the "PREP Pipeline," a standardized preprocessing pipeline for EEG data, the HED (Hierarchical Event Descriptor) event tagging system for identifying the exact natures of experimental events, along with CTAGGER, a toolset for adding managing HED tags, and BLINKER, a tool for automatically detecting and annotating blinks in EEG data. Read more »

Benedikt Ehinger, Ph.D.
Olaf Dimigen, Ph.D.

Dr. Benedikt Ehinger (now a postdoctoral fellow at the Donders Institute for Brain, Cognition and Behaviour in Nijmegen, The Netherlands) and **Dr. Olaf Dimigen** (Visiting professor at Humboldt-University in Berlin) recognized that recorded EEG typically sums time-limited brain processes associated with a complex overlapping sequence of sensory inputs and motor actions. They saw the need for a framework to separate the temporally overlapping effects of the EEG responses time-locked to (possibly many) different events occurring in rapid succession. Thus, they developed the ***Unfold*** toolbox which offers an EEGLAB-compatible framework to model and disentangle event-related brain potentials to different events. Read more »

Upcoming Events

This section contains announcements of future events of possible interest to EEGLAB users. Please submit brief descriptions.

ALL IN-PERSON WORKSHOPS HAVE BEEN POSTPONED TO 2021 BECAUSE OF THE CURRENT COVID-19 OUTBREAK.

The proposed long-format 31st EEGLAB Workshop has been postponed to June, 2021. This workshop, to be presented at SCCN, will be the first to feature a two-day Pre-Workshop Course on the basics of EEG and using MATLAB, and on the basics of using EEGLAB to load and begin to process EEG data. Workshop attendees who might otherwise not be able to keep up with the main Workshop are encouraged to attend these sessions. The main EEGLAB Workshop, beginning with an Open House reception and poster show, will follow the format of previous workshops at UCSD, with new material

incorporated as time and need permit. Following the Workshop, we will offer another new feature, **a two-and-a-half day Data Collaboratory** in which attendees with data to analyze will work with Workshop faculty to build analysis pipelines to process their data (limited to 20 participants).

The Second Hands-on LSL Workshop has also been postponed to June, 2021, as has the **Fourth International MoBI Conference** and a **Group-EEG Recording Workshop** led by John Iversen (jiversen@ucsd.edu) on recording and analysis of group EEG and other data streams.

The 32nd EEGLAB Workshop in Lublin, Poland is likewise being postponed to 2021. For more information, contact Dariusz Zapała (d.zapala@gmail.com).

From the eeglablist

This section contains brief questions and answers from the eeglablist archives or elsewhere.

Q: ***I found some papers recommending not using average reference and using the REST reference (note: these papers mainly talked about ERPs). I will do a power spectral analysis. We are using a Cognionics Mobile 64 device to collect data during a physical task (Isometric exertion). So what should be my re-referencing method ? Initially I was planning for average reference, but now I've gotten confused by those papers.***

A: If you use 64 electrodes, you can try both REST and average reference, and decide for yourself. There is no "this is the best reference" (for all purposes) answer, if there was something like,"this is the best referencing method EVER", we wouldn't need to fill pages and papers on that question ;). From my experience: If you use fixed electrode sites (such as linked earlobes) as reference(s), ERP waveforms and total power may be higher in absolute terms than if you use average Reference or REST. This can be good (especially when studying ERP waveforms) or bad (perhaps giving higher noise in the raw EEG). REST and average reference performed similarly in my experiments, so usually I decided to go with average reference, as the REST integration in EEGLAB has some disadvantages (I usually have to re-reference every dataset manually, since I haven't found a way to write scripts that do it). Read more »

In Print

Here we list recent papers highlighting EEGLAB function and plug-in capabilities. Please submit suggested papers, with a brief summary description.

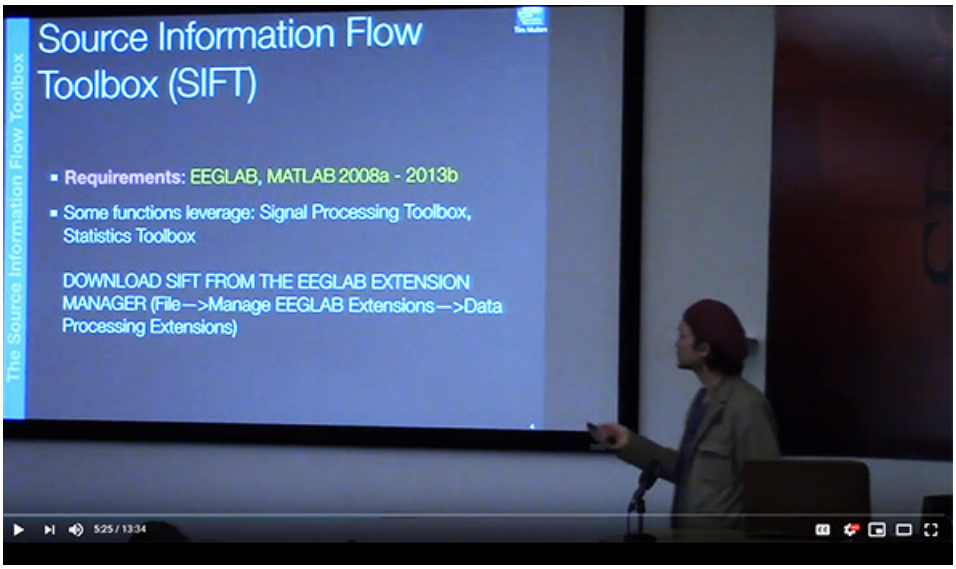
Bigdely-Shamlo, N., Touryan, J., Ojeda, A., Kothe, C., Mullen, T., and Robbins, K. (2020). Automated EEG mega-analysis II: Cognitive aspects of event related features. *NeuroImage* 207,116054. DOI://10.1016/j.neuroimage.2019.116054.

Dimigen, O. (2020). Optimizing the ICA-based removal of ocular EEG artifacts from free viewing experiments. *NeuroImage* 207,116117. DOI://10.1016/j.neuroimage.2019.116117.

Ehinger, B., & Dimigen, O. (2019). Unfold: an integrated toolbox for overlap correction, non-linear modeling, and regression-based EEG analysis. *PeerJ* 7(1):e7838, 2019. DOI: //10.7717/peerj.7838.

Dimigen, O. & Ehinger, B.V. (submitted). Analyzing combined eye-tracking/EEG experiments with (non)linear deconvolution models. *bioRxiv*. DOI://10.1101/735530.

Online



SIFT Intro: Building and Visualizing Source Connectivity
Presented by Tim Mullen at the EEGLAB Workshop in San Diego in 2016

Note: Scott Makeig is now working with Wes Thompson and Tim Mullen to build and publish on SIFT toolbox software for clustering event-related network activities across subjects.