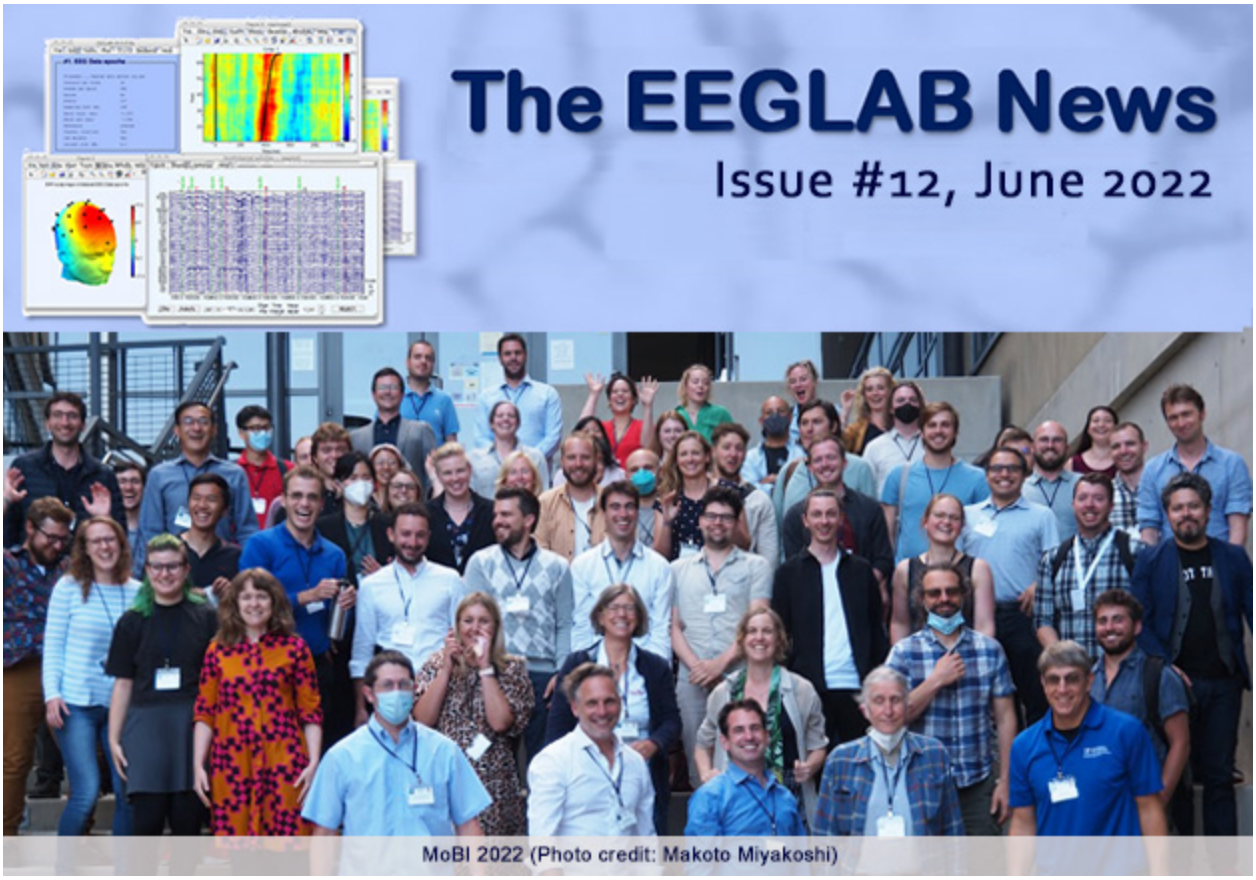

MoBI 2022 (Photo credit: Makoto Miyakoshi)

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What's New

MoBI 2022. The Fourth International Symposium on Mobile Brain/Body Imaging (MoBI 2022; see group photo above) was held in person at UC San Diego (La Jolla, California) June 7-10, 2022, preceded by a 3-day hands-on MoBI workshop (June 5-7). EEGLAB has multiple tools and plug-ins to process Mobile Brain Imaging data, which were presented at this conference. Click here to view photos of the event!

In-person EEGLAB Workshop in Lublin Catholic University, Poland. The EEGLAB workshop in Lubin is coming up in September. Please register here. Most of the EEGLAB developers will be present, and it will be the first in-person meeting in more than two years. In-person meetings are rich in interaction and a unique opportunity for you to come with your data and get advice from experts on how to process it. Additional news over the past few months has to do with the EEGLAB data platform.

Progress on NEMAR.org – a data, tools, and compute resource for human electromagnetic brain imaging research. NEMAR.org, a data, tools, and compute resource for human electromagnetic brain imaging research. The new website is ready at NEMAR.org and now serves the human 'neuroelectromagnetic' (NEM: EEG, MEG, iEEG) datasets shared publicly via OpenNeuro.org data archive. OpenNeuro is the leading BIDS-formatted archive for Neuroimaging data, and has partnered with us to tailor its extensive backend EEG database for EEG, MEG, and iEEG users. You can search and find MEEG datasets on OpenNeuro, but NEMAR has tailored options for searching and visualizing datasets. NEMAR allows search on keywords ('EEG', 'attention', etc.) and returns a mapping to the individual BIDS-format data and metadata files. Soon, we expect visitors will be able to review data and data quality measures for each available dataset, and will be given additional download options. The time is thus arrived in which any researcher or research student can

use EEGLAB (and/or other computing environments) to freely and efficiently explore and process any of the increasingly large storehouse of NEM data shared via OpenNeuro, including using NSG resources to perform computationally intensive statistical data processing using tools such as AMICA decomposition and neural network training. See the OpenScience section for more information.

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.

Overview of plug-ins on EEGLAB. We do not have new plug-ins to feature this month. Over the past year there have been 103,711 plug-in downloads. In the plug-in manager, you may see which plug-ins are the most popular. These are data import plug-ins: *BIOSIG*, a toolbox and EEGLAB plug-in designed by Alois Schlogl (58,271 all time downloads); *File-IO*, another plug-in developed by the Donders Center for Neuroimaging; *BVA-IO* fto import Brain Vision data. Plug-ins to import *Neuroscan* and *MFF* (EGI/Magstim) data are also popular. The most popular data processing extension is *Fieldtrip*, with 15,489 downloads through the plug-in manager. Fieldtrip is integrated into EEGLAB functions for source localization, likely explaining its popularity. The *clean_rawdata* plug-in for cleaning data has 10,155 downloads, and the *Cleanline* plug-in for removing line noise, 8,929 downloads. Then comes *ERPLAB*, which despite being on the plug-in manager for only 2 years, has 7,887 downloads. *ICLabel,* for automatically flagging artifactual components, is also popular, with 6,170 downloads. Altogether the plug-in manager serves 143 plug-ins; we invite you to browse the listing and search for keywords. There are, for example, 28 plug-ins with descriptions mentioning 'artifact rejection', 45 plug-ins mentioning 'ICA', 2 plug-ins for 'microstate analysis', etc...

EEGLAB has a centralized system for uploading new plug-ins and new plug-in versions is to prevent automated acceptance of malicious code. Every time someone downloads a plug-in, its counter is updated. Repeated downloads by the same computer are not taken into account. New plug-ins can be submitted on this page. Please send us your new plug-in description so we can advertise it in this section.

EEGLAB automated testing. In collaboration with The Mathworks and VersionBay, an EEGLAB team has developed a set of automated unit tests for EEGLAB functions hosted on GitHub. GitHub has capabilities for automated testing and is compatible with MATLAB 2020b and later versions. Now, any time there is a change to the EEGLAB codebase, the automated tests run automatically on GitHub servers to test the modified code on multiple EEGLAB versions. The integration with GitHub ensures code stability, testing that new code merged into EEGLAB does not break existing functions. It also performs the heavy lifting of managing errors, if any, and tracking potential problems. We are moving toward making code integrity testing for all of EEGLAB based on GitHub and Codecov. The new GitHub repository uses 'GIT-lfs' to manage the large dataset used for testing. If you have code and/or data to contribute to help ensure the stability of the whole EEGLAB codebase (including plug-ins), we welcome pull requests to https://github.com/sccn/eeglab-testcases.

Open Science

Here we highlight news of open EEG and related data, tools, and other resources.

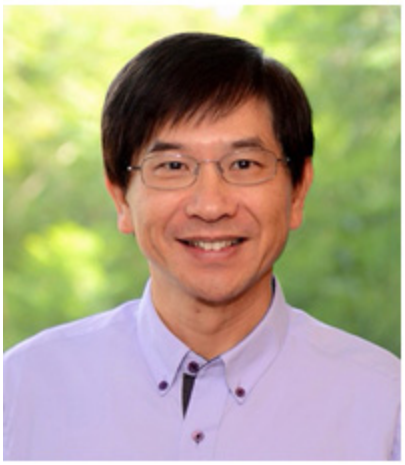
Frontier special topic issue. Free and open-source academic toolboxes have gained increasing

prominence in the field of MEG/EEG research to disseminate cutting-edge methods, share best practices between different research groups, and pool resources for developing essential tools for the MEG/EEG community. However, most training material and tutorials only show analysis of a single "typical best" subject, whereas most real MEG/EEG studies involve group data analysis. It is then left to the researchers to figure out how to make the transition and obtain group results. A special Research Topic of Frontiers addresses this gap by publishing detailed descriptions of complete group analyses for which code and data are also shared. The EEGLAB team has been instrumental in this effort.

BIDS and HED. Brain Imaging Data Structure (BIDS) standards are being adopted by neuroimaging data repositories around the world. See this link for a how-to tutorial on the BIDs data structure. EEGLAB includes a BIDS EEG I/O plug-in. Hierarchical Event Descriptors (HED) is the only BIDS-compatible system for specifying the nature of events and other temporal structure in neuroimaging time series data. A paper on latest-generation HED annotation is available here. Currently a edozen or more NEMAR/OpenNeuro datasets include descriptions of data events and temporal structure in the HED format. The HED Working group is working to make HED a widely used (and still the only) annotation standard for event annotation. A Quickstart guide to HED annotation is available, as are online tools for its use. The online app CTAGGER (tutorial here) simplifies finding appropriate HED tags for events in your data.

Profiles

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



Tzyy-Ping Jung, Ph.D.
Co-Director, Center for Advanced Neurological Engineering, Institute for Neural Computation (INC) and Institute of Engineering in Medicine (IEM), and Associate Director, Swartz Center for Computational Neuroscience (SCCN), INC, both at UC San Diego

Tzyy-Ping Jung (Associate Director of the SCCN and Co-Director of the Center for Advanced Neurological Engineering of the INC and IEM, UC San Diego) has been an important part of SCCN and EEGLAB from their beginnings.

In 1993, as a newly minted Ph.D. in electrical engineering from Ohio State University, Dr. Jung was recruited by Dr. Scott Makeig (Director of SCCN) to help him analyze electroencephalographic (EEG) data. Soon after, he began working with Scott at the laboratory of collaborator Dr. Terrence Sejnowski (Co-Director of the INC and Director of the Computational Neurobiology Laboratory (CNL) at the Salk Institute). But Dr. Jung's move to San Diego didn't start as smoothly as he would have hoped. "That is a very interesting story," he relates. "In October 1993, I just started my position with Scott as a postdoc at the Naval Health Research Center (NHRC) in Point Loma, San Diego. After working there for one week, the Center bureaucracy realized that I was not a U.S. citizen and had no permission to work on a Navy base! Scott approached Terry Sejnowski, and he allowed me to work temporarily at the Salk Institute in his CNL Lab. Read more »

Upcoming Events

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

- **An in person EEGLAB Workshop is scheduled for Sept. 12-16** at the Catholic University Lublin

in Lublin, Poland. This site has detailed information.

From the eeglablist

(… the EEGLABLIST email list) *This section contains brief questions and answers from the eeglablist archives or elsewhere.*

Q: What are the pros and cons of using ERPLAB vs. the EEGLAB Study Functions for analyzing ERPs? I have some large data sets and am wondering what the pros and cons of using ERPLAB vs. the EEGLAB Study Function are for analyzing ERPs. Thanks in advance, David

A: Scott Makeig: EEGLAB still has no built-in functions for defining and identifying peaks in ERPs. Matlab functions to serve your particular purpose might not be difficult for you to construct, however. EEGLAB does have several ERP plotting modes, as well as integrated STUDY-level robust statistics (using LIMOfunctions) which ERPLAB might not have. And, of course, EEG has source-level decomposition of the unaveraged EEG and thereby its trial-average ERPs into dominant effective source processes, which to my knowledge ERPLAB lacks. Further, these source processes can be localized by several methods, and as they are statistically independent, they very likely exhibit functional independence as well – which the STUDY statistical functions can test.

Arnaud Delorme: Note that the *bioelectromag* plug-in of EEGLAB will let you do ERP peak finding (not that I would recommend this method because there is no biological interpretation - I'd suggest examining the set of single trials using ERPimage).

Cyril Pernet: To add to Arnaud's comment on interpretability – you can watch the beginning of this LIMO tutorial (see also this paper). More on using STUDY/LIMO to test all components at all electrodes at once.

In Print

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

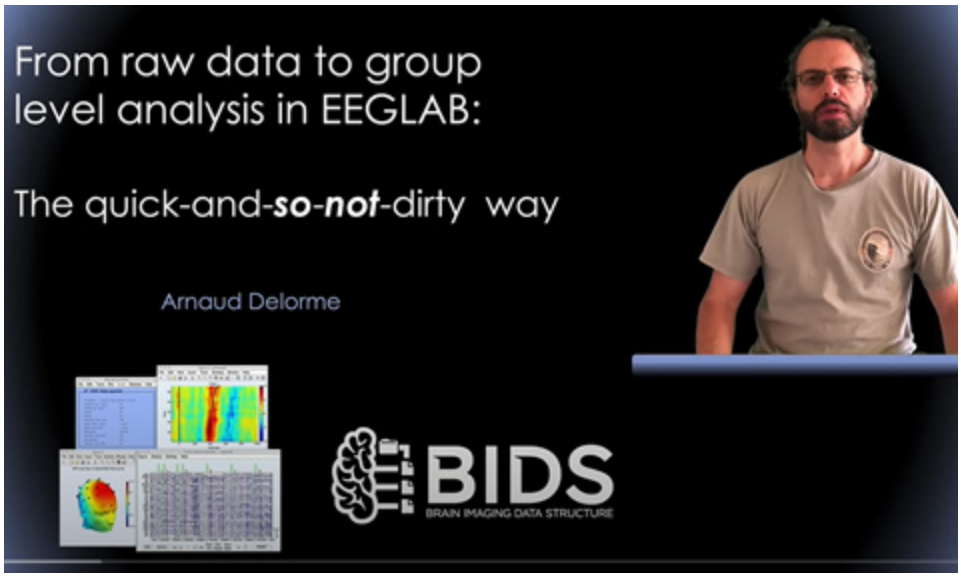
C-Y Chang, S-H Hsu, L Pion-Tonachini and T-P Jung. Evaluation of Artifact Subspace Reconstruction for Automatic Artifact Components Removal in Multi-Channel EEG Recordings. *IEEE Transactions on Biomedical Engineering*, vol. 67, no. 4, pp. 1114-1121, April 2020, doi: 10.1109/TBME.2019.2930186.

Hsu, S-H, Lin Y, Onton J, Jung T-P, Makeig S. Unsupervised learning of brain state dynamics during emotion imagination using high-density EEG. *NeuroImage*
Volume 249, 1 April 2022, 118873, https://doi.org/10.1016/j.neuroimage.2022.118873.

Jung TP, Makeig S, Humphries C, Lee TW, McKeown MJ, Iragui V, Sejnowski TJ. Removing Electroencephalographic Artifacts by Blind Source Separation. *Psychophysiology*, 2020 March; 37(163–178). Cambridge University Press.

Online

From raw data to group level analysis in EEGLAB
Arnaud Delorme, Ph.D. (August 24, 2020)



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