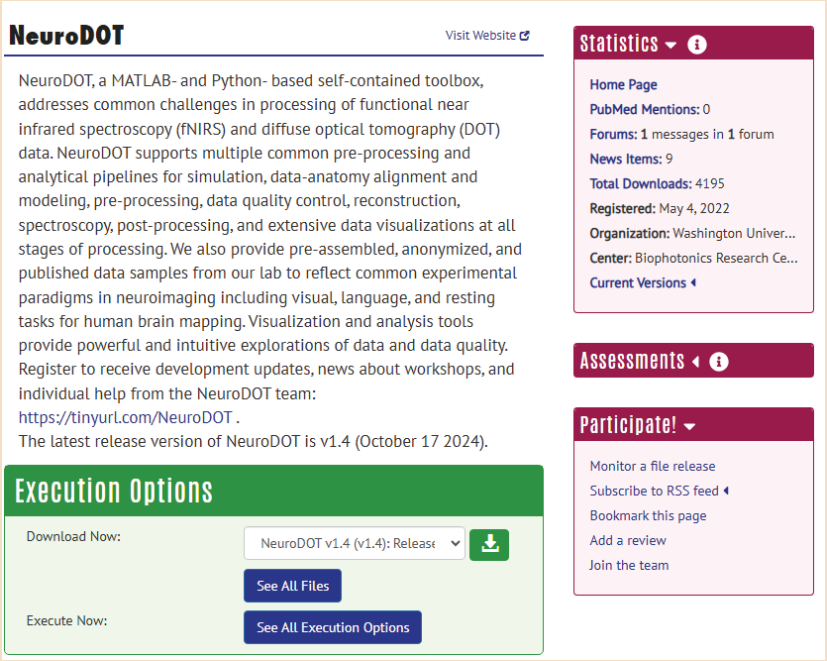
NeuroDOT

NeuroDOT Newsletter: February 7, 2025
NeuroDOT v1.4 and NeuroDOT_py v1.0.0 Releases!

- Welcome to the first NeuroDOT newsletter!
- We will be sending a newsletter along with each new release of the NeuroDOT toolbox, approximately every 6 months.
- On 10/17/2024 NeuroDOT v1.4 and NeuroDOT_py v1.0.0 were released, and are available for download on NITRC (https://www.nitrc.org/projects/neurodot) and from the Python Packaging Index (with pip).

Contents



NeuroDOT

Release Updates

Matlab

Major Updates since NeuroDOT v1.3:

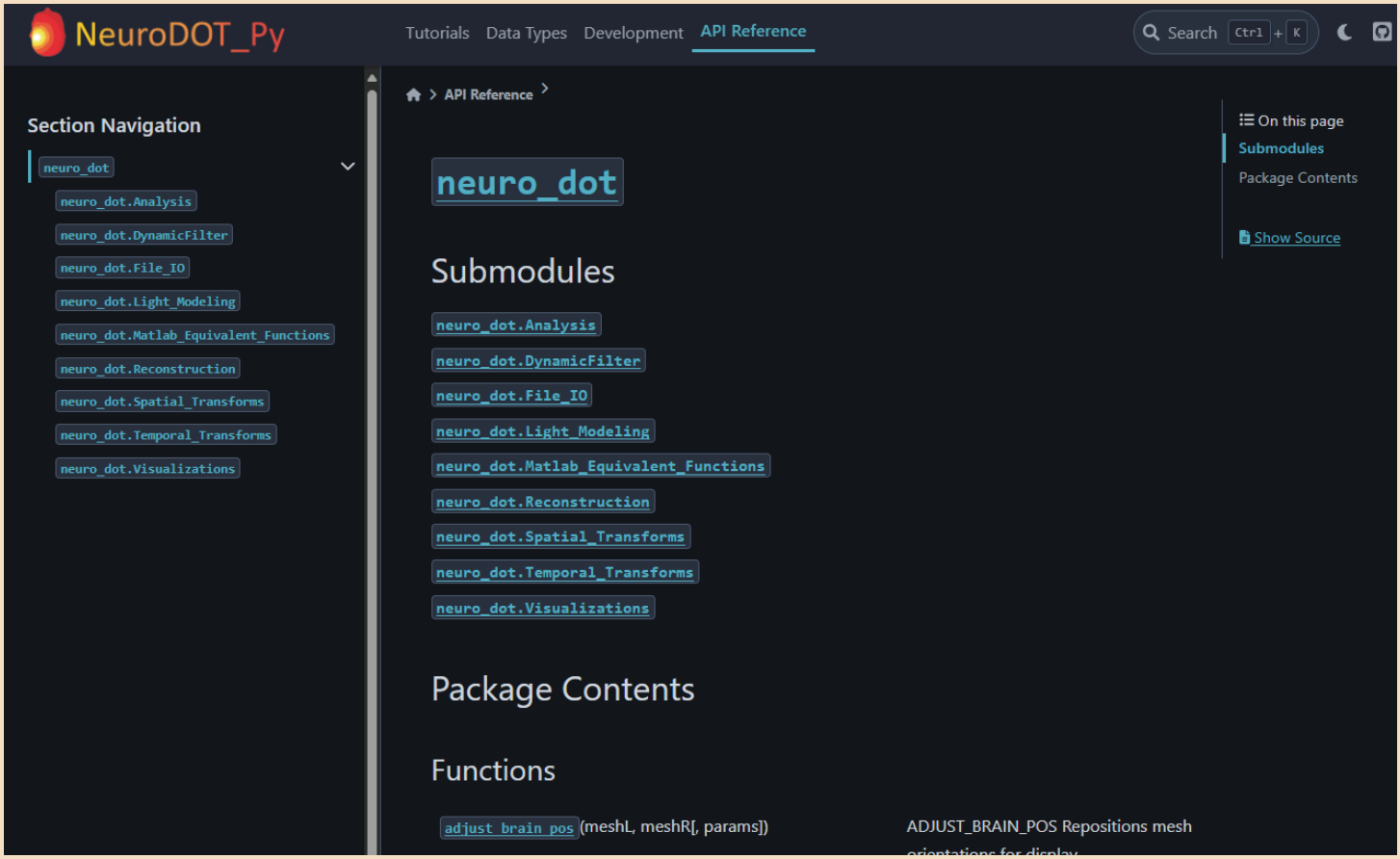
1. GUIs
   A. Render Tool: interactive GUI to select a NIfTI or 4dfp overlay and render the data on a default or custom cortical mesh. Alternatively, data may be passed to the app directly from the command line or from within a script.
2. Format Compatibility updates:
   A. SaveVolumetricData: added option for saving in nii.gz format
   B. snirf2ndot: updated to work on variables in the workspace, in addition to optionally accepting file inputs
   C. lumo2ndot: added compatibility with Gowerlabs LUMO systems
3. New Support Files:
   A. Added Glasser and Schaefer Parcellation files to Support Files:
      I. Glasser_2016_Parcels.nii
      II. Glasser_12nets_360parcels_on_MNI.mat
      III. Schaefer2018_7nets_300parcels_on_MNI.mat
      IV. Schaefer2018_7nets_400parcels_on_MNI.mat
      V. Schaefer2018_17nets_400parcels_on_MNI.mat
4. Other function updates:
   A. Resample_Vol_to_Parcel: resamples data to a single time trace for each parcel in the field of view of a specified volume
   B. Plot_RawData_Cap_DQC:
      I. Added new layouts for "tall" arrays in 2D
      II. Fixed colorbar orientation for arrays with single source-detector separation distances.
   C. Plot_RawData_Metrics_II_DQC: Added params.logfft to plot power spectrum on log-log axes by default, both axes will be logarithmic
5. Tutorial & Documentation updates:
   A. Tutorial for Participant Specific Head Modeling
      I. Utilizes FreeSurfer 7.2 recon_all segmentation routine, compatible with Linux OS (CentOS6, CentOS7, CentOS8, and Ubuntu18)
      II. Mac OS compatibility coming soon!
         a. Excluding FreeSurfer, the script is compatible with Windows and Mac operating systems.
6. Updated contact information and created feedback and user registration forms
   A. Contact the development team: neurodot-support@wustl.edu
   B. Provide feedback: https://forms.gle/iEYfEZhfj99FVEs29
   C. Become a registered user: https://tinyurl.com/NeuroDOT

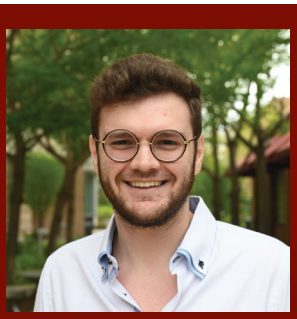
NeuroDOT

Python

The first official release of NeuroDOT_py is now available via the Python Packaging Index (PyPi). NeuroDOT_py v1.0.0 can be installed using the following code: pip install neurodot_py

1. Functions needed for fNIRS data pre-processing and image reconstruction
2. Jupyter Notebooks for preprocessing, image reconstruction, and full data processing
3. Support files and helper functions for loading fNIRS data in Python
4. Sphinx documentation site, here: https://wustl-orl.github.io/NeuroDOT_py/index.html





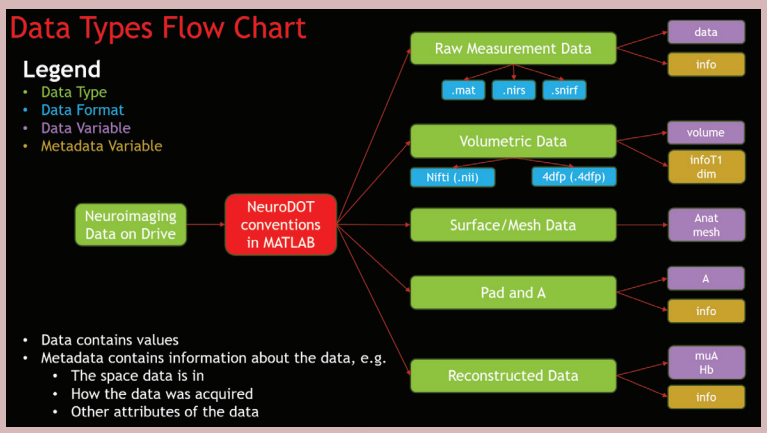
Developer's Corner - Ari

Data Organization Tutorial

I'd like to take some time to highlight the Data Organization Tutorial. I developed this tutorial to make it easier to learn about different types of data.

If you're curious where information about your stimulus paradigm is located, or perhaps the anatomical space your data is in, you can find the answers to those questions in this tutorial.

The Data Organization Tutorial is a great resource for people who wish to gain more familiarity with how data and metadata objects are represented.

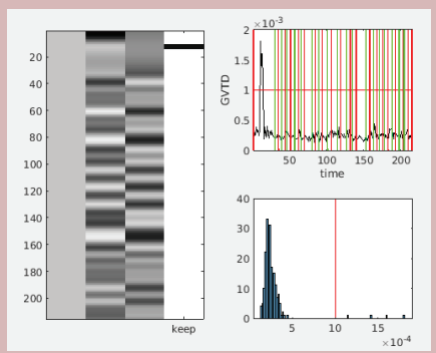


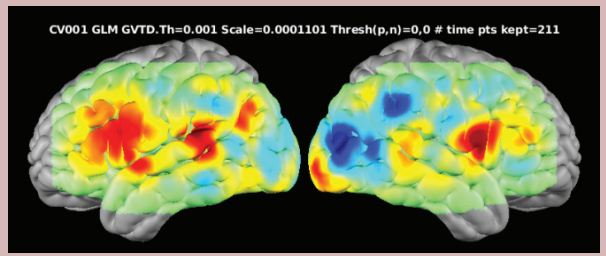
General Linear Modeling

Another useful tool is the function GLM_181206. This function can be found in the Functions/Analysis folder and creates a general linear model (GLM) based on a model of the hemodynamic response function (hrf) and a set of stimulus times found in info.paradigm.synchpoints. This function can also be utilized for motion censoring using the global variance of the temporal derivative (GVTD) signal (Sherafati et al.,*HBM,* 2020).

The function outputs a set of beta values for each stimulus type along with a design matrix. It also creates a figure, showing the design matrix with columns for the constant term, then columns for each type of stimulus, here rest and covert verb production. The final column corresponds to time points censored using a GVTD-based threshold. On the right, the GVTD threshold is shown as a horizontal red line on the time trace plot and vertical red line on the histogram. The GVTD threshold used is 0.1%, based on current standards, as also used in Yang et al., *Molecular Autism,* 2024.

The beta values generated can then be plotted on the cortical surface with PlotInterpSurfMesh, shown here on an MNI atlas-based mesh. Data shown here is from a covert verb production task, detailed in Schroeder et al., *NeuroImage,* 2023. This dataset is available on NITRC at: https://www.nitrc.org/frs/?group_id=1563.



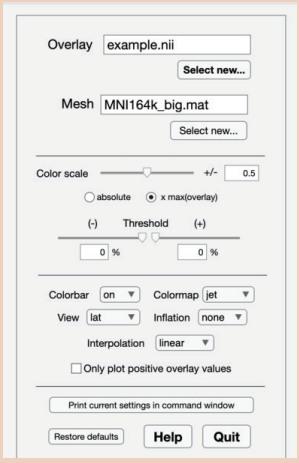


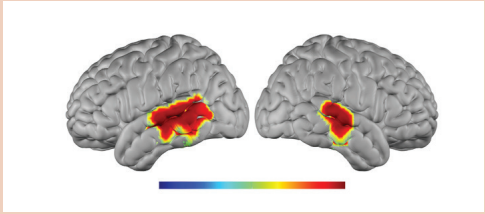
GLM output figure and beta map. A GVTD threshold of 0.001 was used to censor noisy time points.

Developer's Corner - Mike

Rendertool: Interactive Surface Rendering

The latest release of NeuroDOT includes RenderTool -- a standalone Matlab application for interactive surface rendering. The GUI offers convenient exploration of rendering options such as color scaling, colormap selection, view orientation, and cortical inflation. A rendered image can be saved in a variety of file formats, allowing results to be included in a presentation or loaded into editing software for manuscript preparation. Alternatively, render settings can be saved for later use in scripted processing.





RenderTool works for any volumetric data that is aligned to the surface underlay. It also works for data in the workspace, as well as from NIfTI file formats, allowing visualization of data generated using NeuroDOT as well as other neuroimaging software such as SPM or FSL.

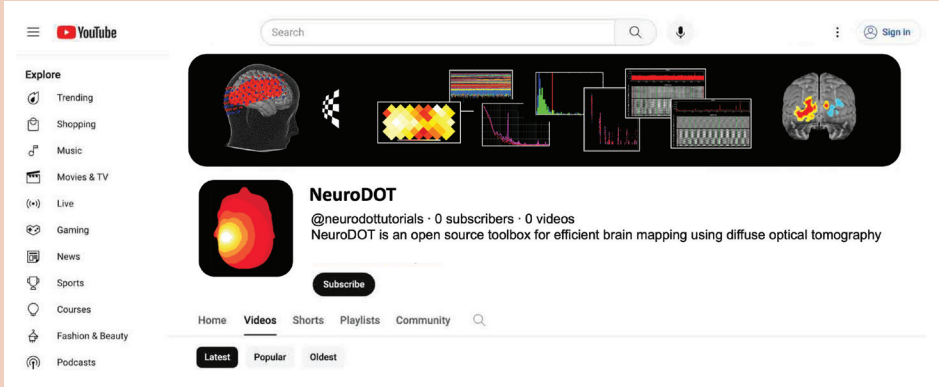
NeuroDOT on YouTube

We are currently in the process of expanding our documentation to include an instructional video series that will be available on Youtube.

Each video will focus on a specific topic such as software installation, data input, data processing, light modeling, or visualization of results. Each begins with a review of preliminaries and pertinent background information, then turns to practical application. Importantly, the videos connect to the Powerpoint tutorials currently included with the NeuroDOT distribution. These resources complement one another, with the videos providing overview and context, and the Powerpoints providing step-by-step self-guided exercises. As the series expands, specialized topics and deeper explorations of theory and computational issues will be included.

Whether you are new to optical imaging or have previously worked with NeuroDOT, these instructional videos will help develop your proficiency analyzing fNIRS and HD-DOT data.

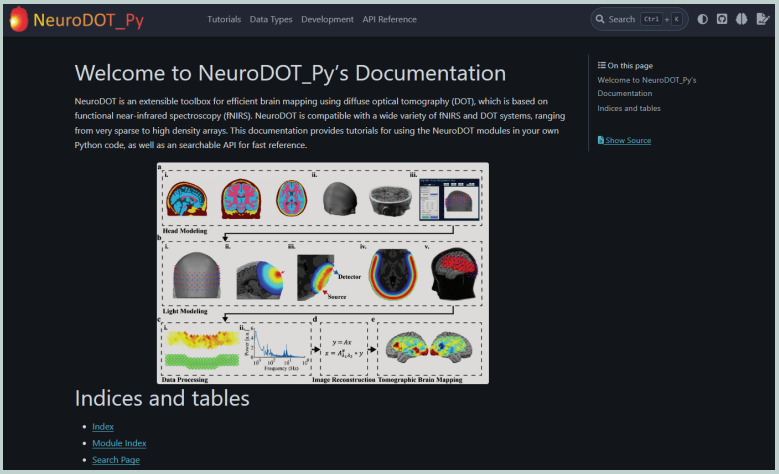
The NeuroDOT YouTube channel is now live! We have many videos planned , and are happy to develop specific new videos to address user questions. Please reach out to the development team with any video ideas or suggestions.

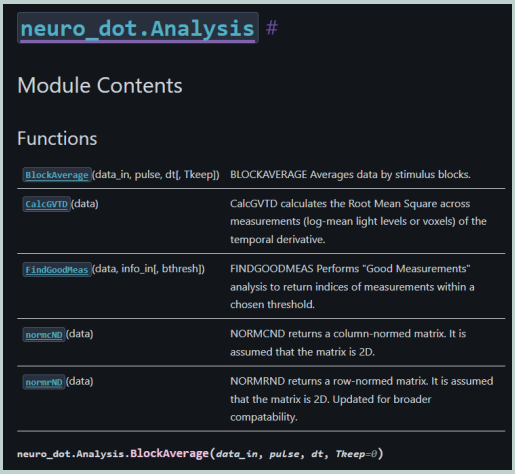


Developer's Corner - Emma

NeuroDOT_Py Documentation

Along with our latest NeuroDOT_py GitHub release, we launched a web-based version of our documentation on GitHub: https://wustl-orl.github.io/NeuroDOT_py/index.html. On this site, you can find descriptions and usage instructions for each function and Jupyter notebook in NeuroDOT_py.





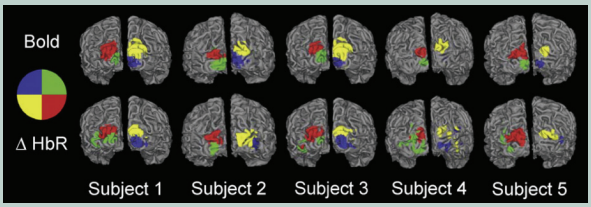
Data Sharing

In addition to our software and documentation, we host multiple datasets on NITRC (https://www.nitrc.org/projects/neurodot)

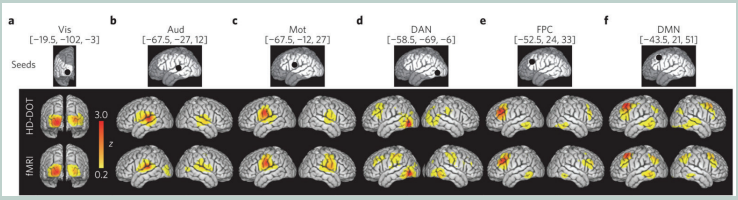
1. Retinotopy (Eggebrecht et al., *NeuroImage,* 2012)
2. Resting state (Eggebrecht et al., *Nature Photonics,* 2014)
3. Hierarchical language (Schroeder et al., *NeuroImage,* 2023)
4. Adult and pediatric wide-field HD-DOT (Tripathy et al., *HBM,* 2024)
5. More data to come…

Each dataset also contains a "README" text file, so you can find out about what the dataset contains.

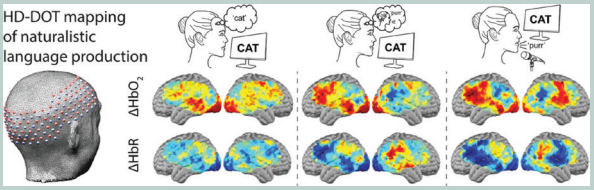
Anyone is welcome to email NeuroDOT support if there are any questions about the data or the particular stimulus used for any of the shared datasets: neurodot-support@wustl.edu



Eggebrecht et al., *NeuroImage*, 2012



Eggebrecht et al., *Nature Photonics,* 2014



Schroeder et al., *NeuroImage,* 2023

Developer's Corner - Abby

User Interfaces AlignMe

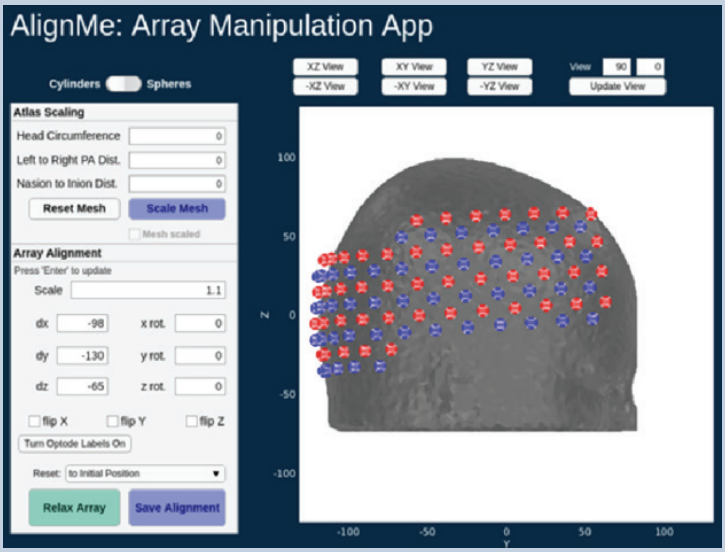
AlignMe is an interactive app which allows for precise optode registration.

In AlignMe, atlas scaling can be performed using participant measures of head circumference, left to right pre-auricular distance, and nasion to inion distance.

AlignMe also allows for manual grid placement and relaxation to atlas or participant anatomy-based head meshes using cap fit photos.

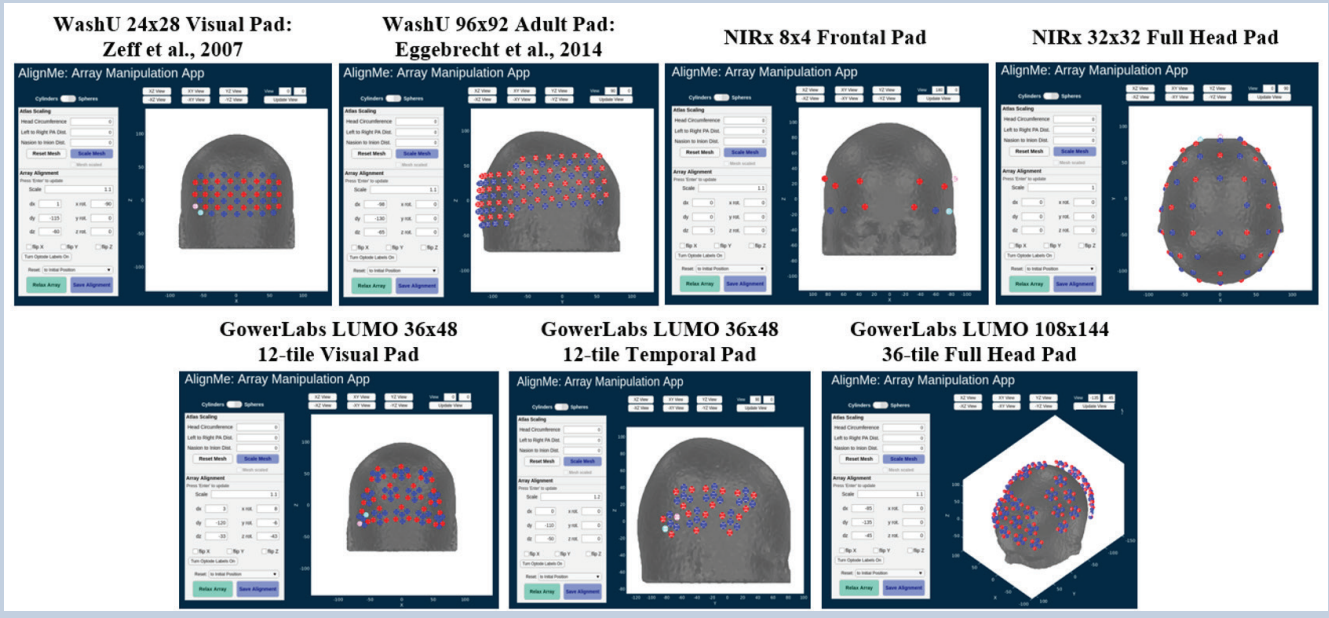
AlignMe is used in the light modeling pipelines and has its own tutorial, NeuroDOT_Tutorial_AlignMe.

We are currently developing the AlignMe UI for NeuroDOT_Py.



AlignMe: Example

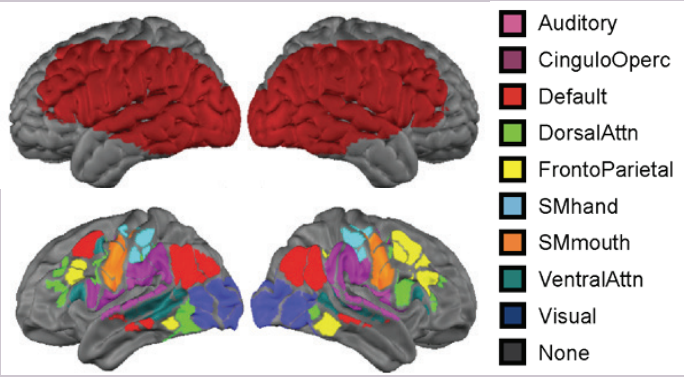
AlignMe is used in the light modeling pipelines for placing an imaging array on a head mesh, allowing for compatibility with a wide variety of imaging arrays including custom and commercially available arrays from companies like GowerLabs and NIRx. We are happy to help new users implement AlignMe for their own systems.



Developer's Corner - Dalin

Incorporation of Publicly Available Cortical Parcellations

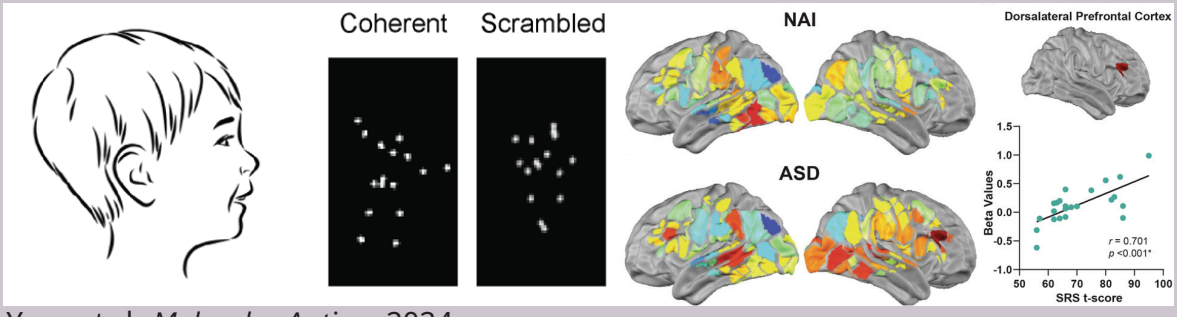
Publicly available cortical parcellations provide opportunities to couch neuroimaging results within a general anatomically and functionally defined framework for interpretation and comparison across studies. NeuroDOT includes multiple common cortical parcellations and atlases to provide options for the general user to enhance brain-focused analyses that connect optical brain mapping strategies to the broader functional neuroimaging data resources ecosystem.



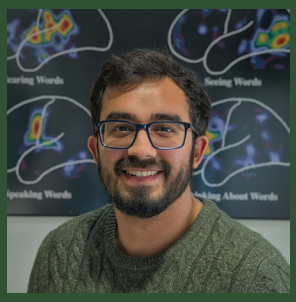
Example Use of Gordon Parcellation in a Study on Autism

Below is an example where we used an estimation of our field of view (red coloring on cortical surface) to constrain our data to the spatially overlapping set of parcels from the Gordon parcellation (Gordon et al., Cerebral Cortex, 2015), colored by putative functional network, to provide a general framework for our analyses.

In this study, we investigated how brain function in children with or without autism varies while watching movies of either coherent or scrambled biological motion (Yang et al., *Molecular Autism*, 2024). The color in each parcel on the right represents the correlation of a measure of brain function with a separately measured assessment of social reciprocity, broken down by group (NAI: non-autistic individual; ASD: autism spectrum disorder). An example scatter plot of that correlation for one parcel is also shown.



Yang et al., *Molecular Autism*, 2024



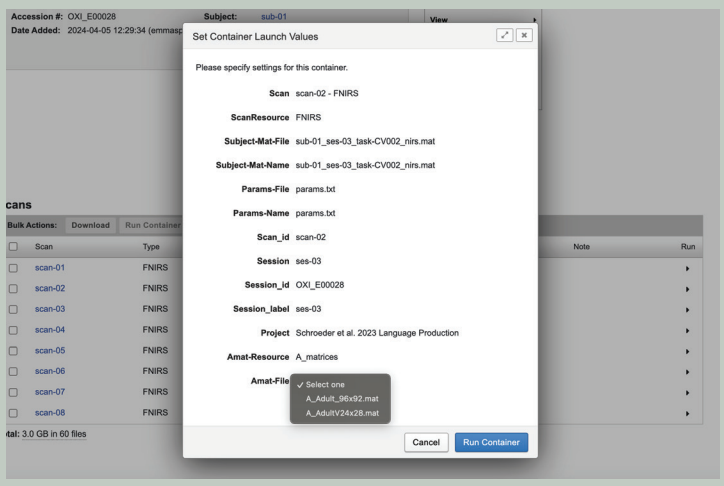
Developer's Corner - Yash

Batch data processing using OXI

The goal of OXI is to increase the accessibility of data processing by providing users with the ability to batch process their data without the need for their own high performance computing resources.

On OXI, users can create projects and upload their scans. This data can then be shared with other collaborators.

OXI uses Docker containers to process data, allowing for repeatable data processing, agnostic of user OS/system.

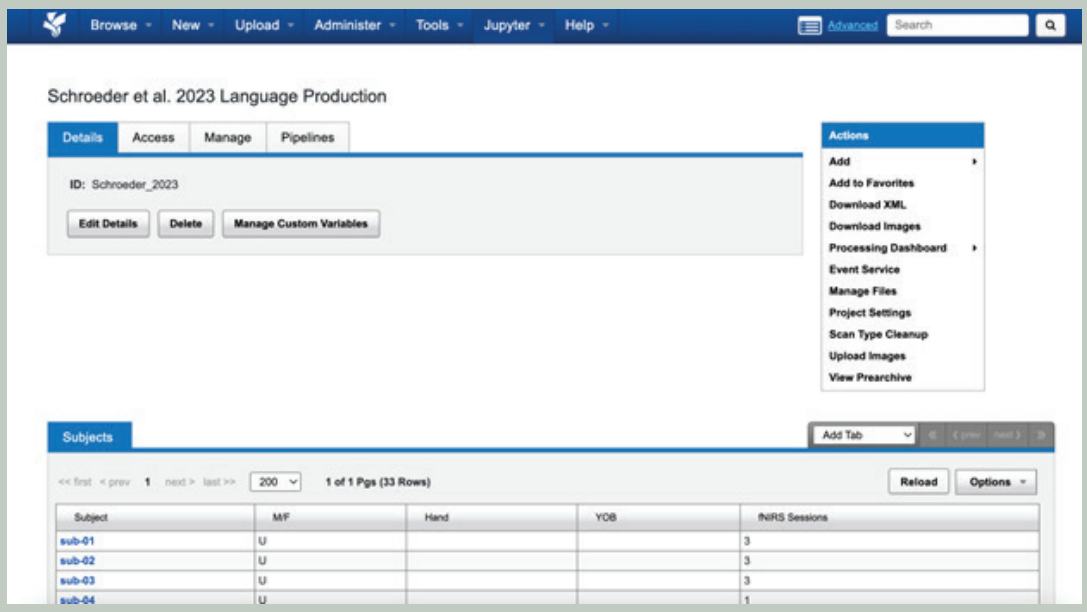


OXI Layout

On OXI, you can organize your data into projects according to the BIDS standard.

Projects are structured as subjects containing imaging sessions, which can contain multiple scans.

The data can then be batch-analyzed using the processing dashboard.



NeuroDOT

Contribute your ideas!

Submit your feedback: https://forms.gle/iEYfEZhfj99FVEs29
- Request new features
- Resolve bugs
- Share your opinions
  - Let us know what you think about this newsletter
  - Any and all comments are welcome!

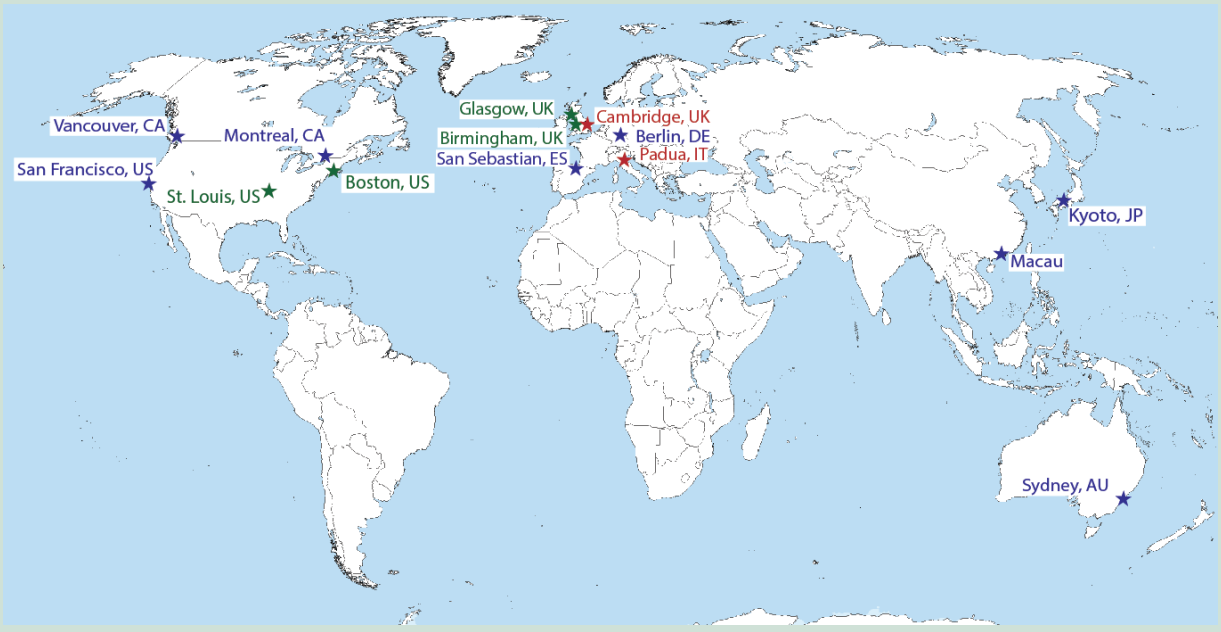
Need help integrating NeuroDOT into your workflow?

Contact the NeuroDOT development team directly for one-on-one assistance.
- E-mail: neurodot-support@wustl.edu
- Become a registered user: https://forms.gle/vrE2Y3cNkUGnbFF6A

Attend a NeuroDOT Workshop!

The map below shows locations of previous, planned, and prospective workshops. Green indicates cities where we have previously held a workshop, red indicates upcoming workshops, and blue indicates cities we have identified as prospective workshop locations.

We are very interested in expanding the planned workshop locations to other key centers in Africa, South America, Asia, and other locations. We welcome feedback and interest from the community to guide our target instutes and cities for workshops.



Key: ★ Past Workshops ★ Upcoming Workshops ★ Prospective Workshops

Attend the fNIRS Summer School in St. Louis!

Washington University in St. Louis is excited to host this year's fNIRS summer school in collaboration with the Society of fNIRS. This event presents a unique opportunity for fNIRS researchers of all career stages to engage with the community. Participants will gain comprehensive insights ranging from foundations of fNIRS/DOT lectures to hands-on sessions on data processing using NeuroDOT, alongside applications in the field. The summer school will also feature an industry session and a poster session, offering invaluable networking opportunities and a platform for early career researchers to highlight their contributions.