tedana Multi-echo fMRI and related open tools

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tedana.readthedocs.io

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WHY CARE ABOUT MULTI-ECHO FMRI?

Do you care about reproducibility and reliability of fMRI studies?
Want to conduct fMRI studies without a sample size of a small nation?
Better data requires reducing noise, particularly structured noise.
Collecting multi-echo fMRI[1,2] opens ways to empirically identify and remove non-BOLD-weighted noise[3-5].

tedana is

1. Open software in a best practice based development framework to test and improve multi-echo methods with an emphasis on an ICA-based denoising method[3,4]

2. Makes multi-echo fMRI denoising methods more accessible and understandable

3. A *community* and resources for people interested in multi-echo fMRI whether or not they use tedana software

TEDANA PUBLICATION TO CITE!

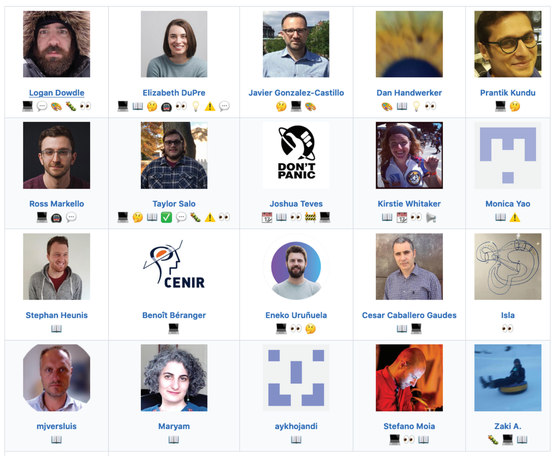
DuPre, Salo et al., (2021). "TE-dependent analysis of multi-echo fMRI with tedana." Journal of Open Source Software, 6(66), 3669, https://doi.org/10.21105/joss.03669

WAYS TO CONNECT

Multi-echo questions: https://neurostars.org with 'multi-echo' or 'tedana' tags
Subscribe to the tedana (low volume) newsletter: http://tinyletter.com/tedana-devs
Join the conversation: mattermost.brainhack.org/brainhack/channels/tedana
Code and resources are open source. Contribute at: https://github.com/ME-ICA/tedana

Interactive report demo and a list of multi-echo content at OHBM: https://github.com/ME-ICA/ohbm-2022-multiecho

CONTRIBUTORS



You!

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9. https://trendscenter.org/software/gift/

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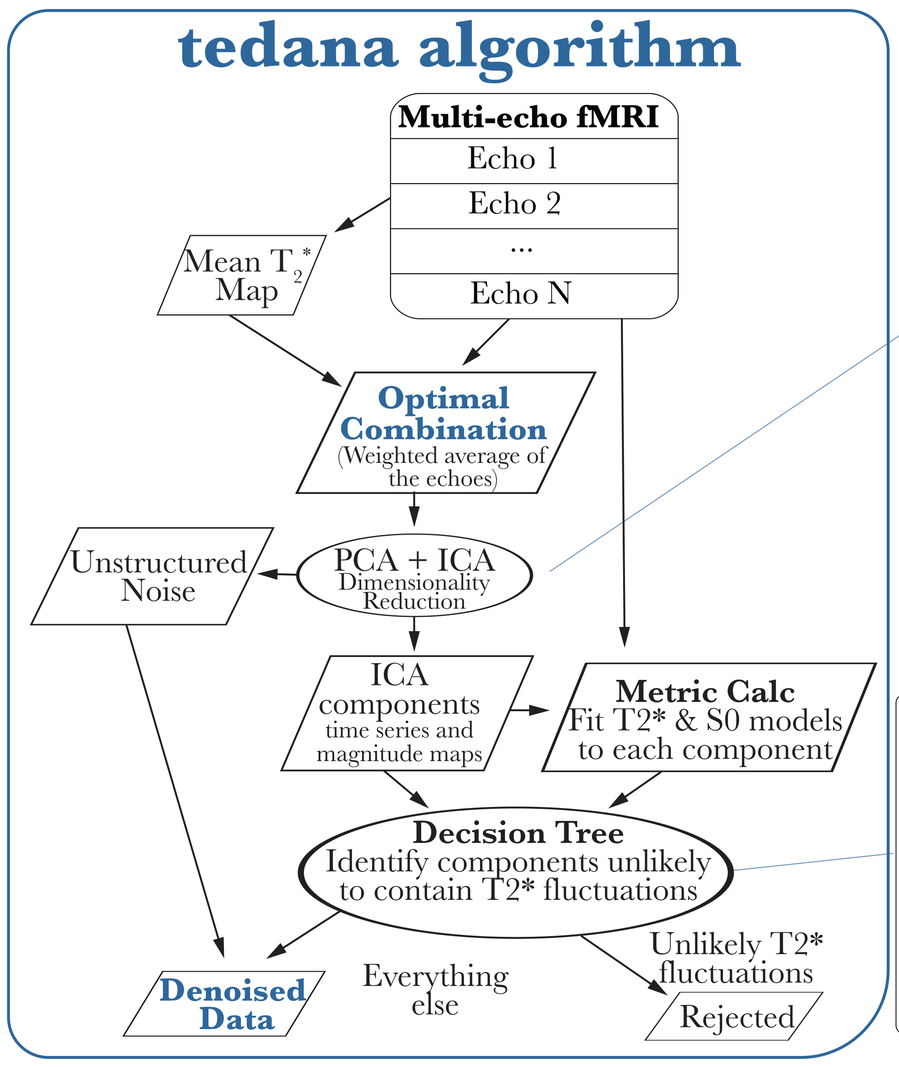
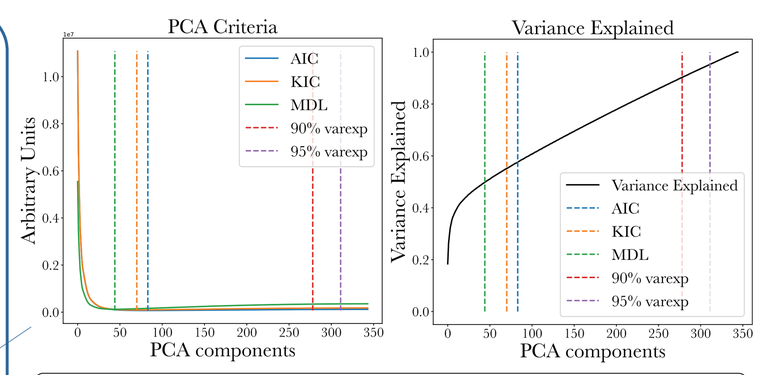
IMPROVEMENTS

MAPCA component estimation, RICA interactive component exploration, and other projects have uses beyond multi-echo fMRI processing. We've made them stand-alone packages with their own landing page.
https://me-ica.github.io

tedana algorithm





Component estimation method with Moving Average PCA (MAPCA)[8,9] is a stand-alone python library with newly added visualizations of component selection criteria.
(Default changed to most liberal option "AIC")
https://github.com/ME-ICA/mapca

Modularization of decision tree nearly complete
New conservative tree finished & tested
Close to finished replication of current tree
Allows customization of component selection rules without altering code
Can be used to make a joint decision process for any set of metrics (multi-echo and not)

Since OHBM 2021: 3737 new and 1812 removed lines of code
Decision Tree Modularization has over 5000 new lines of code

More flexibility in masking to allow for voxels ot be retained

Better integration with:
fMRIPrep[6] (Poster #1789) and
AFNI[7] (Poster #1663)
In AFNI, run @Install_APMULTI_Demo1_rest to download a full demo that uses tedana

Expanded documentation and resourcing for how to collect and analyze multi-echo fMRI at: tedana.readthedocs.io

Improved logging of processing steps

RICA: Reports for ICA

tedana automatically generates a report that allows users to interactively examine components. RICA additional lets users investigate and change classifications of components and can work with any compatibly formatted ICA program outputs. It is a stand-alone package at https://github.com/ME-ICA/rica (Poster #2087)

Report from 5-echo data.

Can change the classification for a component and re-save the denoised data

Each component appears on a kappa (T2* weighting) vs rho (S0 weighting) scatter plot and as a share of variance

Clicking on a component in the scatter plot or pie chart opens up the time series and map for the component

FUTURE PLANS

Several years ago, the tedana developers created a list of goals for the software project. We're close to achieving the main goals! We're not there yet, but we're discussing new goals so that tedana meets user needs and can support continued methodological advances.

We want to hear from you at: https://github.com/ME-ICA/tedana/discussions/879

Software and Education

Continue to modularly integrate new methods and programs to make it easier for people use benefit from collecting multi-echo data

Revise the main workflow to be more extendable & flexible

More ways to visualize and summarize results so that users can understand and quality check their data

Expand multi-echo analysis educational tools including a work-in-progress Jupyter book
https://me-ica.github.io/multi-echo-data-analysis

Methodology Advances

Use multi-echo information to enhance and stabilize PCA component estimation

Modified ICA which maximizes T2* vs S0 fluctuations within each component

Integrate with non-multi-echo denoising methods (e.g. physiological fluctuations and motion in Poster #1546)

Add semi-automated tests of result stability or improvements so that advances in methodology can be rapidly compared across a range of data sets.
(Share your data to help us help you!)