BIDS Extension Proposal 4 (BEP004): Susceptibility Weighted Imaging (SWI)

version 0.0.1 (working copy)

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Extension moderator/lead: needs SWI specialist

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This document contains a draft of the Brain Imaging Data Structure standard extension. It is a community effort to define standards in data / metadata. This is a working document in draft stage and any comments are welcome.

To contribute to this BEP, the main discussions are in this Google Doc and in the GitHub issues and PRs referenced below. Contributors are also welcome to open an issue under the bids-specification repository referencing SWI images.

For submitting new PRs related to this BEP, please submit your PR to the bep004-swi branch.

This specification is an extension of BIDS, and general principles are shared. The specification should work for many different settings and facilitate the integration with other imaging methods.

To see the original BIDS specification, see this link. This document inherits all components of the original specification (e.g. how to store imaging data, events, stimuli and behavioral data), and should be seen as an extension of it, not a replacement.

Existing github issues and PRs related to BEP004:

On bids-specification:

Issue #2489: Susceptibility weighted images (main issue - main discussion)
https://github.com/bids-standard/bids-specification/issues/2489

PR #2343: Add swi and minIP suffixes for susceptibility weighted imaging

https://github.com/bids-standard/bids-specification/pull/2343

PR #2538: [ENH] Add SWI suffix for susceptibility weighted imaging under anat/ datatype
https://github.com/bids-standard/bids-specification/pull/2538

Issue #2539: Allow mask suffix in raw data for SWI imaging

https://github.com/bids-standard/bids-specification/issues/2539

bids-examples

PR #541: Add SWI example dataset
https://github.com/bids-standard/bids-examples/pull/541

PR #565: [EXAMPLE] Add raw and derivative SWI example datasets
https://github.com/bids-standard/bids-examples/pull/565

Template:

```
sub-<participant_label>/[ses-<session_label>/]
       swi/
              sub-<participant_label>[_ses-<session_label>][_acq-<label>][_rec-<label>
       ][_run-<index>][_coil-<index>][_echo-<index>]_part-<phase|mag>_GRE.nii[.gz]
```

Background reading:

- https://radiopaedia.org/articles/susceptibility-weighted-imaging-1
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3259351/

BIDS allows for QSM imaging data to be represented in “anat”
https://bids-specification.readthedocs.io/en/stable/modality-specific-files/magnetic-resonance-imaging-data.html#anatomy-imaging-data
SWI appears to be less quantitative, so perhaps it does not fit within the existing specification.

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Breakdown of filename keys:

- `part-<phase|mag>` - denoting if this is the phase or magnitude image (MANDATORY, part of BIDS already)
- `coil-<index>` - denoting which coil is the image from (OPTIONAL) if skipped total is assumed
- `echo-<index>` - denoting which echo does this correspond to (OPTIONAL, part of BIDS already)
- `acq-<label>` - denoting which set of acquisition parameters was used (if multiple GRE acquisitions were performed - OPTIONAL, part of BIDS already)
- `rec-<label>` - denoting which reconstruction was used; “norm” corresponds to normalized images (OPTIONAL, part of BIDS already)
- `run-<index>` - denoting a repetition of acquisition with identical scanning parameters (OPTIONAL, part of BIDS already)

Examples:

Existing shared datasets that seem to include SWI data:

- https://openneuro.org/datasets/ds004265/versions/1.1.6
- https://openneuro.org/datasets/ds007195/versions/1.0.0

Total magnitude:

`sub-01_part-mag_GRE.nii.gz`

Total magnitude (multi echo):

`sub-01_part-mag_echo-1_GRE.nii.gz`

`sub-01_part-mag_echo-2_GRE.nii.gz`

Total magnitude - normalized:

`sub-01_part-mag_echo-1_rec-norm_GRE.nii.gz`

`sub-01_part-mag_echo-2_rec-norm_GRE.nii.gz`

Total phase:

sub-01_part-phase_GRE.nii.gz

Total phase (multi echo):

`sub-01_part-phase_echo-1_GRE.nii.gz`

`sub-01_part-phase_echo-2_GRE.nii.gz`

Single-coil magnitudes:

`sub-01_part-mag_coil-01_echo-1_GRE.nii.gz`

`sub-01_part-mag_coil-01_echo-2_GRE.nii.gz`

`sub-01_part-mag_coil-02_echo-1_GRE.nii.gz`

`sub-01_part-mag_coil-02_echo-2_GRE.nii.gz`

Single-coil phases:

`sub-01_part-phase_coil-01_echo-1_GRE.nii.gz`

`sub-01_part-phase_coil-01_echo-2_GRE.nii.gz`

`sub-01_part-phase_coil-02_echo-1_GRE.nii.gz`

`sub-01_part-phase_coil-02_echo-2_GRE.nii.gz`

Combined Magnitude and Phase

sub-01_swi.nii.gz

Minimum Intensity Projection

sub-01_minIP.nii.gz