BIDScoin

Release 3.5.1

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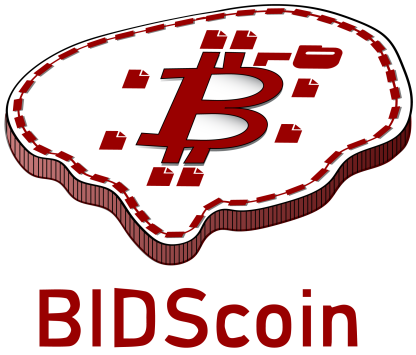
Contents



BIDScoin is a user friendly open-source python toolkit that converts ("coins") source-level (raw) neuroimaging data-sets to nifti / json / tsv data-sets that are organized following the Brain Imaging Data Structure, a.k.a. the BIDS standard. Rather then depending on complex or ambiguous programmatic logic for the identification of imaging modalities, BIDScoin uses a mapping approach to identify and convert the raw source data into BIDS data. Different runs of source data are identified by reading information from MRI header files (DICOM or PAR/REC; e.g. `ProtocolName`) and the mapping information about how these runs should be converted to BIDS can be specified a priori as well as interactively by the researcher – bringing in the missing knowledge that often exists only in his or her head!

Because all the mapping information can be easily edited with the Graphical User Interface (GUI), BIDScoin requires no programming knowledge in order to use it.

BIDScoin is developed at the Donders Institute of the Radboud University.

CHAPTER 1

BIDScoin functionality

- [x] DICOM source data
- [x] PAR / REC source data (Philips)
- [ ] P7 source data (GE)
- [ ] Nifti source data
- [x] Physiological source data*
- [x] Fieldmaps*
- [x] Multi-echo data*
- [x] Multi-coil data*
- [x] PET data*
- [ ] Stimulus / behavioural logfiles
- [x] Plug-ins
- [x] Defacing
- [x] Multi-echo combination

```
* = DICOM source data (tested for Siemens)
```

```
Are you a python programmer with an interest in BIDS who knows all about GE and / or␣
↪Philips data?
Are you experienced with parsing stimulus presentation log-files? Or do you have␣
↪ideas to improve
the this toolkit or its documentation? Have you come across bugs? Then you are highly␣
↪encouraged to
provide feedback or contribute to this project on https://github.com/Donders-
↪Institute/bidscoin.
```

CHAPTER 2

Note:

The full BIDScoin documentation is hosted at Read the Docs

Issues can be reported at Github

2.1 Installation

BIDScoin can be installed and should work on Linux, MS Windows and on OS-X computers (this latter option has not been tested) that satisfy the system requirements:

- dcm2niix
- python 3.6 or higher

2.1.1 Dcm2niix installation

BIDScoin relies on dcm2niix to convert DICOM and PAR/REC files to nifti. Please download and install dcm2niix yourself according to the instructions. When done, make sure that the path to the dcm2niix binary / executable is set correctly in the BIDScoin Options in the `[path_to_bidscoin]/heuristics/bidsmap_template.yaml` file or in the Site specific / customized template file.

2.1.2 Python 3 installation

BIDScoin is a python package and therefore a python interpreter needs to be present on the system. On Linux this is usually already the case, but MS Windows users may need to install python themselves. See e.g. this python 3 distribution for instructions. They may also need to install the MS Visual C++ build tools (sorry for this pain).

2.1.3 BIDScoin installation

To install BIDScoin on your system run the following command in a command-terminal (institute users may want to activate a virtual / conda python environment first):

```
$ pip install bidscoin
```

This will give you the latest stable release of the software. To get the very latest (development) version of the software you can install the package directly from the github source code repository:

```
$ pip install git+https://github.com/Donders-Institute/bidscoin
```

If you do not have git (or any other version control system) installed you can download and unzip the code yourself in a directory named e.g. `bidscoin` and run:

```
$ pip install bidscoin
```

Updating BIDScoin

Run the pip command as before with the additional `--upgrade` option:

```
$ pip install --upgrade bidscoin
```

Caution:

- The bidsmaps are not garanteed to be compatible between different BIDScoin versions
- After a succesful BIDScoin installation or upgrade, it may be needed to (re)do any adjustments that were done on the Site specific / customized template file(s) (so make a back-up of these before you upgrade)

2.2 Data preparation

2.2.1 Required source data structure

BIDScoin requires that the source data input folder is organized according to a `sub-identifier/[ses-identifier]/data` structure (the `ses-identifier` subfolder is optional). The `data` folder can have various formats, as shown in the following examples:

1. **A 'seriesfolder' organization**. A series folder contains a single data type and are typically acquired in a single run – a.k.a 'Series' in DICOM speak. This is how users receive their data from the (Siemens) scanners at the DCCN:

```
sourcedata
|-- sub-001
|   |-- ses-mri01
|   |   |-- 001-localizer
|   |   |   |-- 00001_1.3.12.2.1107.5.2.19.45416.2017121914582956872274162.IMA
|   |   |   |-- 00002_1.3.12.2.1107.5.2.19.45416.2017121914583757650874172.IMA
|   |   |   `-- 00003_1.3.12.2.1107.5.2.19.45416.2017121914583358068374167.IMA
|   |   |
|   |   |-- 002-t1_mprage_sag_p2_iso_1.0
|   |   |   |-- 00002_1.3.12.2.1107.5.2.19.45416.2017121915051526005675150.IMA
|   |   |   |-- 00003_1.3.12.2.1107.5.2.19.45416.2017121915051520026075138.IMA
|   |   |   |-- 00004_1.3.12.2.1107.5.2.19.45416.2017121915051515689275130.IMA
|   |   |   [..]
|   |   [..]
```

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```
|   |
|   `-- ses-mri02
|       |-- 001-localizer
|       |   |-- 00001_1.3.12.2.1107.5.2.19.45416.2017121914582956872274162.IMA
|       |   |-- 00002_1.3.12.2.1107.5.2.19.45416.2017121914583757650874172.IMA
|       |   `-- 00003_1.3.12.2.1107.5.2.19.45416.2017121914583358068374167.IMA
|       [..]
|
|-- sub-002
|   `-- ses-mri01
|       |-- 001-localizer
|       |   |-- 00001_1.3.12.2.1107.5.2.19.45416.2017121914582956872274162.IMA
|       |   |-- 00002_1.3.12.2.1107.5.2.19.45416.2017121914583757650874172.IMA
|       |   `-- 00003_1.3.12.2.1107.5.2.19.45416.2017121914583358068374167.IMA
|       [..]
[..]
```

2. **A 'DICOMDIR' organization**. A DICOMDIR is dictionary-file that indicates the various places where all the various DICOM files are stored. DICOMDIRs are often used in clinical settings and may look like:

```
sourcedata
|-- sub-001
|   |-- DICOM
|   |   `-- 00001EE9
|   |       `-- AAFC99B8
|   |           `-- AA547EAB
|   |               |-- 00000025
|   |               |   |-- EE008C45
|   |               |   |-- EE027F55
|   |               |   |-- EE03D17C
|   |               |   [..]
|   |               |
|   |               |-- 000000B4
|   |               |   |-- EE07CCDA
|   |               |   |-- EE0E0701
|   |               |   |-- EE0E200A
|   |               |   [..]
|   |               [..]
|   `-- DICOMDIR
|
|-- sub-002
|   [..]
[..]
```

3. **A flat DICOM organization**. In a flat DICOM organization all the DICOM files of all the different Series are simply put in one large directory. This organization is sometimes used when exporting data in clinical settings:

```
sourcedata
|-- sub-001
|   `-- ses-mri01
|       |-- IM_0001.dcm
|       |-- IM_0002.dcm
|       |-- IM_0003.dcm
|       [..]
|
|-- sub-002
```

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```
|   `-- ses-mri01
|       |-- IM_0001.dcm
|       |-- IM_0002.dcm
|       |-- IM_0003.dcm
|       [..]
[..]
```

4. **A PAR/REC organization**. All PAR/REC(/XML) files of all the different Series are put in one directory. This organization is how users often export their data from Philips scanners in research settings:

```
sourcedata
|-- sub-001
|   `-- ses-mri01
|       |-- TCHC_066_1_WIP_Hanneke_Block_2_SENSE_4_1.PAR
|       |-- TCHC_066_1_WIP_Hanneke_Block_2_SENSE_4_1.REC
|       |-- TCHC_066_1_WIP_IDED_SENSE_6_1.PAR
|       |-- TCHC_066_1_WIP_IDED_SENSE_6_1.REC
|       |-- TCHC_066_1_WIP_Localizer_CLEAR_1_1.PAR
|       |-- TCHC_066_1_WIP_Localizer_CLEAR_1_1.REC
|       [..]
|
|-- sub-002
|   `-- ses-mri01
|       |-- TCHC_066_1_WIP_Hanneke_Block_2_SENSE_4_1.PAR
|       |-- TCHC_066_1_WIP_Hanneke_Block_2_SENSE_4_1.REC
|       |-- TCHC_066_1_WIP_IDED_SENSE_6_1.PAR
|       |-- TCHC_066_1_WIP_IDED_SENSE_6_1.REC
|       |-- TCHC_066_1_WIP_Localizer_CLEAR_1_1.PAR
|       |-- TCHC_066_1_WIP_Localizer_CLEAR_1_1.REC
|       [..]
[..]
```

Note: You can store your session data in any of the above data organizations as zipped (`.zip`) or tarzipped (e.g. `.tar.gz`) archive files. BIDScoin workflow tools will unpack/unzip those archive files in a temporary folder and will process your session'' data'' from there. The BIDScoin tools will run *dicomsort* in a temporary folder for flat/DICOMDIR data to sort them in seriesfolders. BIDScoin tools that work from a temporary folder has the downsde of getting a speed penalty. Also note that privacy-sensitive data samples will then be stored in `[bidsfolder]/code/bidscoin/provenance`.

2.2.2 Data management utilities

dicomsort

The `dicomsort` command-line tool is a utility to move your flat- or DICOMDIR-organized files (see *above*) into a 'seriesfolder' organization. This can be useful to organise your source data in a more convenient and human readable way, as DICOMDIR or flat DICOM directories can often be hard to comprehend. The BIDScoin tools will run icomsort in a temporary folder if your data is not already organised in series-folders, so in principle you don't really need to run it yourself. Running dicomsort beforehand does, however, give you more flexibility in handling special cases that are not handled properly and it can also give you a speed benefit.

```
usage: dicomsort [-h] [-i SUBPREFIX] [-j SESPREFIX] [-f FIELDNAME] [-r]
                 [-e EXT] [-n] [-p PATTERN] [-d]
```

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```
                dicomsource

Sorts and / or renames DICOM files into local subdirectories with a (3-digit)
SeriesNumber-SeriesDescription directory name (i.e. following the same listing
as on the scanner console)

positional arguments:
  dicomsource           The name of the root folder containing the
                        dicomsource/[sub/][ses/]dicomfiles and / or the
                        (single session/study) DICOMDIR file

optional arguments:
  -h, --help            show this help message and exit
  -i SUBPREFIX, --subprefix SUBPREFIX
                        Provide a prefix string for recursive searching in
                        dicomsource/subject subfolders (e.g. "sub") (default:
                        None)
  -j SESPREFIX, --sesprefix SESPREFIX
                        Provide a prefix string for recursive searching in
                        dicomsource/subject/session subfolders (e.g. "ses")
                        (default: None)
  -f FIELDNAME, --fieldname FIELDNAME
                        The dicomfield that is used to construct the series
                        folder name ("SeriesDescription" and "ProtocolName"
                        are both used as fallback) (default:
                        SeriesDescription)
  -r, --rename          Flag to rename the DICOM files to a PatientName_Series
                        Number_SeriesDescription_AcquisitionNumber_InstanceNum
                        ber scheme (recommended for DICOMDIR data) (default:
                        False)
  -e EXT, --ext EXT     The file extension after sorting (empty value keeps
                        the original file extension), e.g. ".dcm" (default: )
  -n, --nosort          Flag to skip sorting of DICOM files into SeriesNumber-
                        SeriesDescription directories (useful in combination
                        with -r for renaming only) (default: False)
  -p PATTERN, --pattern PATTERN
                        The regular expression pattern used in
                        re.match(pattern, dicomfile) to select the dicom files
                        (default: .*\.(IMA|dcm)$)
  -d, --dryrun          Add this flag to just print the dicomsort commands
                        without actually doing anything (default: False)

examples:
  dicomsort /project/3022026.01/raw
  dicomsort /project/3022026.01/raw --subprefix sub
  dicomsort /project/3022026.01/raw --subprefix sub-01 --sesprefix ses
  dicomsort /project/3022026.01/raw/sub-011/ses-mri01/DICOMDIR -r -e .dcm
```

rawmapper

Another command-line utility that can be helpful in organizing your source data is `rawmapper`. This utility can show you the overview (map) of all the values of DICOM-fields of interest in your data-set and, optionally, use these fields to rename your source data sub-folders (this can be handy e.g. if you manually entered subject-identifiers as [Additional info] at the scanner console and you want to use these to rename your subject folders).

```
usage: rawmapper [-h] [-s SESSIONS [SESSIONS ...]]
                 [-d DICOMFIELD [DICOMFIELD ...]] [-w WILDCARD]
                 [-o OUTFOLDER] [-r] [-n SUBPREFIX] [-m SESPREFIX]
                 [--dryrun]
                 sourcefolder

Maps out the values of a dicom field of all subjects in the sourcefolder, saves
the result in a mapper-file and, optionally, uses the dicom values to rename
the sub-/ses-id's of the subfolders. This latter option can be used, e.g.
when an alternative subject id was entered in the [Additional info] field
during subject registration (i.e. stored in the PatientComments dicom field)

positional arguments:
  sourcefolder          The source folder with the raw data in
                        sub-#/ses-#/series organisation

optional arguments:
  -h, --help            show this help message and exit
  -s SESSIONS [SESSIONS ...], --sessions SESSIONS [SESSIONS ...]
                        Space separated list of selected sub-#/ses-# names /
                        folders to be processed. Otherwise all sessions in the
                        bidsfolder will be selected (default: None)
  -d DICOMFIELD [DICOMFIELD ...], --dicomfield DICOMFIELD [DICOMFIELD ...]
                        The name of the dicomfield that is mapped / used to
                        rename the subid/sesid foldernames (default:
                        ['PatientComments'])
  -w WILDCARD, --wildcard WILDCARD
                        The Unix style pathname pattern expansion that is used
                        to select the series from which the dicomfield is
                        being mapped (can contain wildcards) (default: *)
  -o OUTFOLDER, --outfolder OUTFOLDER
                        The mapper-file is normally saved in sourcefolder or,
                        when using this option, in outfolder (default: None)
  -r, --rename          If this flag is given sub-subid/ses-sesid directories
                        in the sourcefolder will be renamed to sub-dcmval/ses-
                        dcmval (default: False)
  -n SUBPREFIX, --subprefix SUBPREFIX
                        The prefix common for all the source subject-folders
                        (default: sub-)
  -m SESPREFIX, --sesprefix SESPREFIX
                        The prefix common for all the source session-folders
                        (default: ses-)
  --dryrun              Add this flag to dryrun (test) the mapping or renaming
                        of the sub-subid/ses-sesid directories (i.e. nothing
                        is stored on disk and directory names are not actually
                        changed)) (default: False)

examples:
  rawmapper /project/3022026.01/raw/
  rawmapper /project/3022026.01/raw -d AcquisitionDate
  rawmapper /project/3022026.01/raw -s sub-100/ses-mri01 sub-126/ses-mri01
  rawmapper /project/3022026.01/raw -r -d ManufacturerModelName AcquisitionDate --
↪dryrun
  rawmapper raw/ -r -s sub-1*/* sub-2*/ses-mri01 --dryrun
  rawmapper -d EchoTime -w *fMRI* /project/3022026.01/raw
```

Note: If these data management utilities do not satisfy your needs, then have a look at this reorganize_dicom_files

tool.

2.3 The BIDScoin workflow

With a sufficiently organized source data folder, the data conversion to BIDS can be performed by running the *(1a)* the `bidsmapper`, *(1b)* the `bidseditor` and *(2)* the `bidscoiner` command-line tools. The bidsmapper starts by making a map of the different kind of datatypes (scans) in your source dataset, which you can then edit with the bidseditor. The bidscoiner reads this so-called study bidsmap, which tells it how exactly to convert ("coin") the source data into a BIDS data repository.

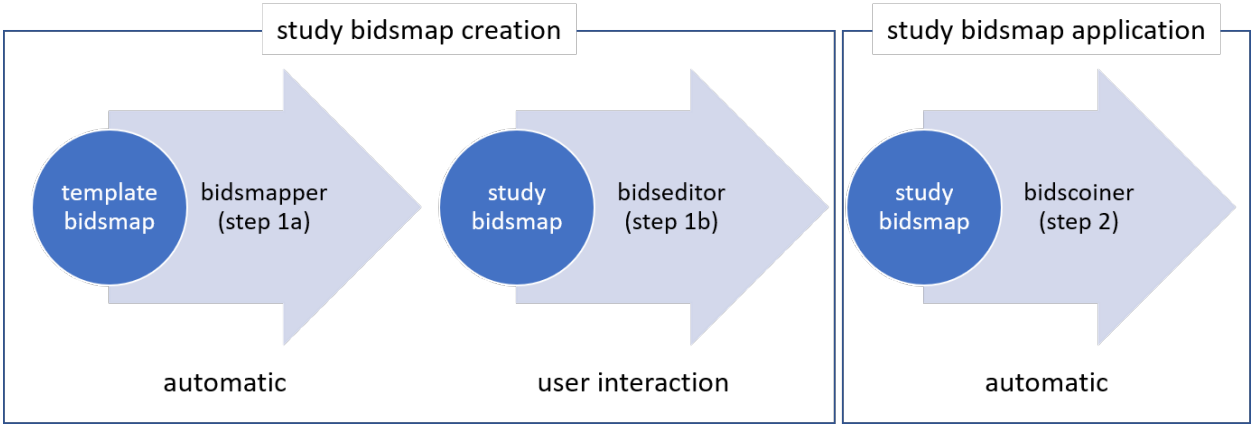

Fig. 1: Creation and application of a study bidsmap

By default (but see the `-i` option of the bidsmapper below), step 1a automatically launches step 1b, so in it's simplest form, all you need to do to convert your raw source data into BIDS is to run two simple commands, e.g.:

```
$ bidsmapper sourcefolder bidsfolder
$ bidscoiner sourcefolder bidsfolder
```

If you add new subjects all you need to do is re-run the bidscoiner – unless the scan protocol was changed, then you also need to first re-run the bidsmapper to add the new samples to the study bidsmap.

2.3.1 Step 1a: Running the bidsmapper

```
usage: bidsmapper [-h] [-b BIDSMAP] [-t TEMPLATE] [-n SUBPREFIX]
                  [-m SESPREFIX] [-i {0,1,2}] [-v]
                  sourcefolder bidsfolder

Creates a bidsmap.yaml YAML file in the bidsfolder/code/bidscoin that maps the
information from all raw source data to the BIDS labels. You can check and edit
the bidsmap file with the bidseditor (but also with any text-editor) before
passing it to the bidscoiner. See the bidseditor help for more information and
useful tips for running the bidsmapper in interactive mode (the default).

positional arguments:
  sourcefolder          The study root folder containing the raw data in
                        sub-#/[ses-#/]data subfolders (or specify --subprefix
                        and --sesprefix for different prefixes)
```

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```
  bidsfolder            The destination folder with the (future) bids data and
                        the bidsfolder/code/bidscoin/bidsmap.yaml output file

optional arguments:
  -h, --help            show this help message and exit
  -b BIDSMAP, --bidsmap BIDSMAP
                        The bidsmap YAML-file with the study heuristics. If
                        the bidsmap filename is relative (i.e. no "/" in the
                        name) then it is assumed to be located in
                        bidsfolder/code/bidscoin. Default: bidsmap.yaml
  -t TEMPLATE, --template TEMPLATE
                        The bidsmap template with the default heuristics (this
                        could be provided by your institute). If the bidsmap
                        filename is relative (i.e. no "/" in the name) then it
                        is assumed to be located in bidsfolder/code/bidscoin.
                        Default: bidsmap_dccn.yaml
  -n SUBPREFIX, --subprefix SUBPREFIX
                        The prefix common for all the source subject-folders.
                        Default: 'sub-'
  -m SESPREFIX, --sesprefix SESPREFIX
                        The prefix common for all the source session-folders.
                        Default: 'ses-'
  -s, --store           Flag to store the provenance data samples in the
                        bidsfolder/'code'/'provenance' folder
  -i {0,1,2}, --interactive {0,1,2}
                        {0}: The sourcefolder is scanned for different kinds
                        of scans without any user interaction. {1}: The
                        sourcefolder is scanned for different kinds of scans
                        and, when finished, the resulting bidsmap is opened
                        using the bidseditor. {2}: As {1}, except that already
                        during scanning the user is asked for help if a new
                        and unknown run is encountered. This option is most
                        useful when re-running the bidsmapper (e.g. when the
                        scan protocol was changed since last running the
                        bidsmapper). Default: 1
  -v, --version         Show the installed version and check for updates

examples:
  bidsmapper /project/foo/raw /project/foo/bids
  bidsmapper /project/foo/raw /project/foo/bids -t bidsmap_template
```

After the source data has been scanned, the bidsmapper will automatically launch *step 1b*. For a fully automated workflow users can skip this interactive step using the `-i` option (see above).

Tip: The default template bidsmap (`-t bidsmap_dccn`) is customized for acquisitions at the DCCN. If this bidsmap is not working well for you, consider adapting it to your needs so that the bidsmapper can recognize more of your scans and map them to BIDS the way you prefer.

2.3.2 Step 1b: Running the bidseditor

```
usage: bidseditor [-h] [-b BIDSMAP] [-t TEMPLATE] [-d DATAFORMAT]
                  [-n SUBPREFIX] [-m SESPREFIX]
                  bidsfolder
```

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```
This tool launches a graphical user interface for editing the bidsmap.yaml file
that is produced by the bidsmapper. The user can fill in or change the BIDS labels
for entries that are unidentified or sub-optimal, such that meaningful and nicely
readable BIDS output names will be generated. The saved bidsmap.yaml output file
will be used by the bidscoiner to actually convert the source data to BIDS.

You can hoover with your mouse over items to get help text (pop-up tooltips).

positional arguments:
  bidsfolder        The destination folder with the (future) bids data

optional arguments:
  -h, --help        show this help message and exit
  -b BIDSMAP, --bidsmap BIDSMAP
                    The bidsmap YAML-file with the study heuristics. If
                    the bidsmap filename is relative (i.e. no "/" in the
                    name) then it is assumed to be located in
                    bidsfolder/code/bidscoin. Default: bidsmap.yaml
  -t TEMPLATE, --template TEMPLATE
                    The bidsmap template with the default heuristics (this
                    could be provided by your institute). If the bidsmap
                    filename is relative (i.e. no "/" in the name) then it
                    is assumed to be located in bidsfolder/code/bidscoin.
                    Default: bidsmap_dccn.yaml
  -d DATAFORMAT, --dataformat DATAFORMAT
                    The format of the source data, e.g. DICOM or PAR.
                    Default: DICOM
  -n SUBPREFIX, --subprefix SUBPREFIX
                    The prefix common for all the source subject-folders.
                    Default: 'sub-'
  -m SESPREFIX, --sesprefix SESPREFIX
                    The prefix common for all the source session-folders.
                    Default: 'ses-'

examples:
  bidseditor /project/foo/bids
  bidseditor /project/foo/bids -t bidsmap_template.yaml
  bidseditor /project/foo/bids -b my/custom/bidsmap.yaml
```

As shown below, the main window of the bidseditor opens with the `BIDS map` tab that contains a list of `input samples` that uniquely represents all the different files that are present in the source folder, together with the associated `BIDS output name`. The path in the `BIDS output name` is shown in red if the modality is not part of the BIDS standard, striked-out gray when the runs will be ignored in the conversion to BIDS, otherwise it is colored green. Double clicking the sample (DICOM) filename opens an inspection window with the full header information (double clicking sample filenames works throughout the GUI).

The user can click the `Edit` button for each list item to open a new edit window, as show below. In this interface, the right BIDS `Modality` (drop down menu) and the `suffix` label (drop down menu) can set correctly, after which the associated BIDS `Entities` can be edited (double click black items). As a result, the new BIDS `Output name` is then shown in the bottom text field (green text indicates that the name is BIDS valid). This is a preview of the BIDS output data, if that looks satisfactory, the user can store this mapping to the bidsmap and return to the main window by clicking the `OK` button. Editing the source attributes of a study bidsmap is usually not necessary and adviced against. See The bidsmap explained for more explanation about the special bidsmap feautures.

Finally, if all BIDS output names in the main window are fine, the user can click on the `Save` button and proceed with running the bidscoiner tool. Note that the bidsmapper and bidseditor don't do anything except reading from and

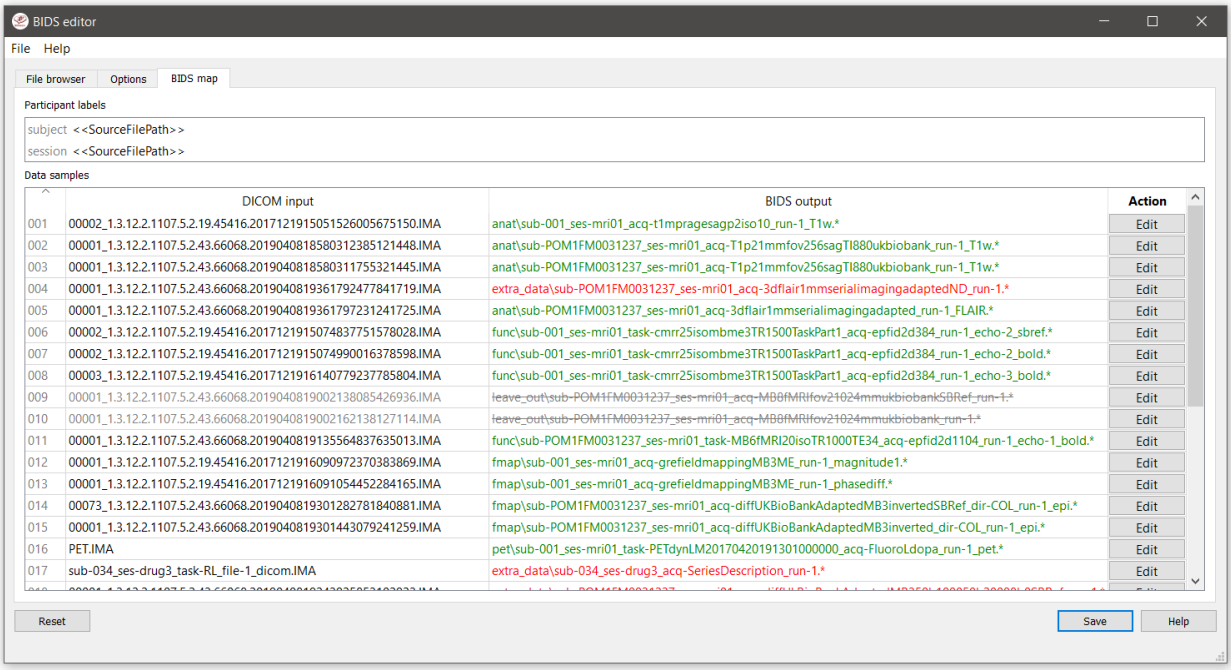

Fig. 2: The main window with an overview of all the bidsmap run items

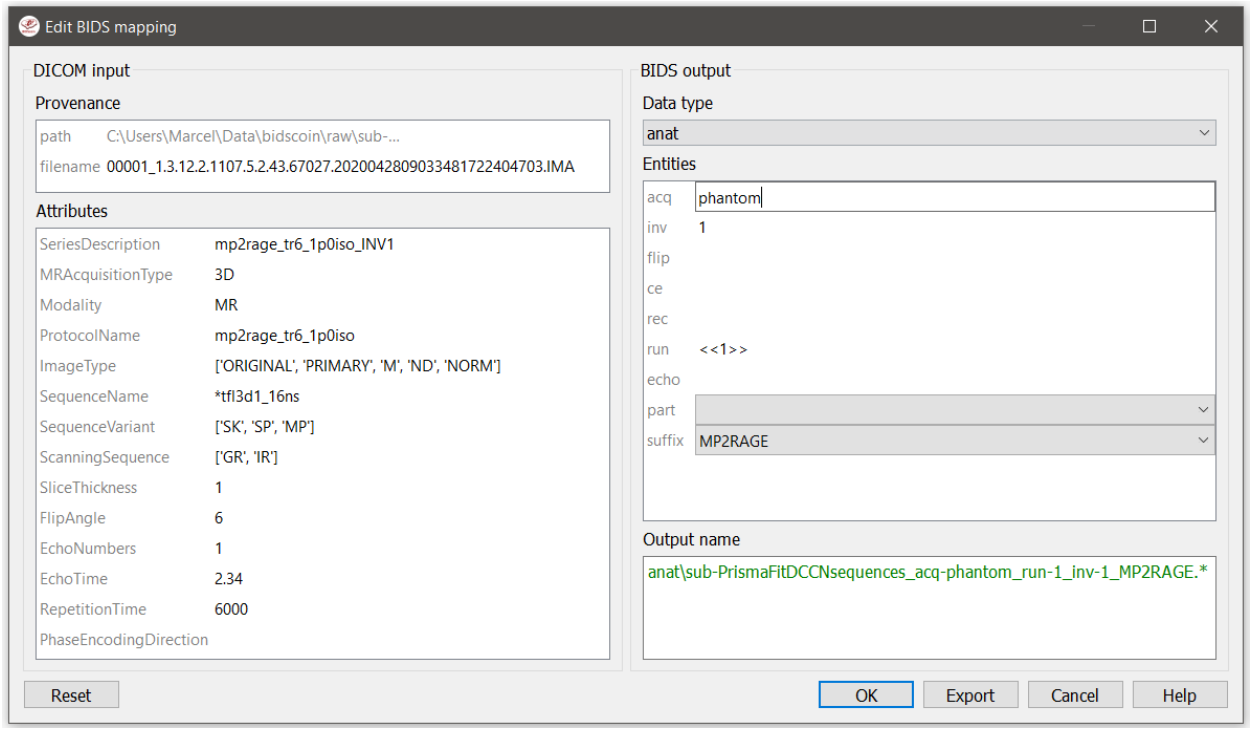

Fig. 3: The edit window for customizing a bidsmap run item, showing the `acq` value being set to `phantom`

writing to the `bidsmap.yaml` file.

Fieldmaps

The way fieldmaps are acquired and stored varies considerably between sequences and manufacturers, and may therefore require special treatment. For instance, it could be that you have `magnitude1` and `magnitude2` data in one series-folder (which is what Siemens can do). In that case you should select the `magnitude1` suffix and let bidscoiner automatically pick up the other magnitude image during runtime. The same holds for `phase1` and `phase2` data. The suffix `magnitude` can be selected for sequences that save fielmaps directly. See the BIDS specification for more details on fieldmap suffixes.

Fieldmaps are typically acquired to be applied to specific other scans from the same session. If this is the case then you should indicate this in the `IntendedFor` field, either using a single search string or multiple dynamic strings to select the runs that have that string pattern in their BIDS file name. For instance you can use `task` to select all functional runs or use `<<Stop*Go><Reward>>` to select "Stop1Go"-, "Stop2Go"- and "Reward"-runs. NB: bidsapps may not use the fieldmap at all if this field is left empty!

2.3.3 Step 2: Running the bidscoiner

```
usage: bidscoiner [-h] [-p PARTICIPANT_LABEL [PARTICIPANT_LABEL ...]] [-f]
                  [-s] [-b BIDSMAP] [-n SUBPREFIX] [-m SESPREFIX] [-v]
                  sourcefolder bidsfolder

Converts ("coins") datasets in the sourcefolder to nifti / json / tsv datasets in the
bidsfolder according to the BIDS standard. Check and edit the bidsmap.yaml file to
your needs using the bidseditor tool before running this function. You can run
bidscoiner after all data is collected, or run / re-run it whenever new data has
been added to the source folder (presuming the scan protocol hasn't changed). If you
delete a (subject/) session folder from the bidsfolder, it will be re-created from the
sourcefolder the next time you run the bidscoiner. Image tags indicating properties
such as echo-number or complex data can be appended to the "acq" value if the BIDS
datatype does not provide for this (e.g. "sub-01_acq-MEMPRAGE_T1w.nii" becomes
"sub-01_acq-MEMPRAGEe1_T1w.nii")

Provenance information, warnings and error messages are stored in the
bidsfolder/code/bidscoin/bidscoiner.log file.

positional arguments:
  sourcefolder          The source folder containing the raw data in
                        sub-#/[ses-#]/data format (or specify --subprefix and
                        --sesprefix for different prefixes)
  bidsfolder            The destination / output folder with the bids data

optional arguments:
  -h, --help            show this help message and exit
  -p PARTICIPANT_LABEL [PARTICIPANT_LABEL ...], --participant_label PARTICIPANT_LABEL␣
↪[PARTICIPANT_LABEL ...]
                        Space seperated list of selected sub-# names / folders
                        to be processed (the sub- prefix can be removed).
                        Otherwise all subjects in the sourcefolder will be
                        selected
  -f, --force           If this flag is given subjects will be processed,
                        regardless of existing folders in the bidsfolder.
                        Otherwise existing folders will be skipped
  -s, --skip_participants
```

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```
                        If this flag is given those subjects that are in
                        particpants.tsv will not be processed (also when the
                        --force flag is given). Otherwise the participants.tsv
                        table is ignored
  -b BIDSMAP, --bidsmap BIDSMAP
                        The bidsmap YAML-file with the study heuristics. If
                        the bidsmap filename is relative (i.e. no "/" in the
                        name) then it is assumed to be located in
                        bidsfolder/code/bidscoin. Default: bidsmap.yaml
  -n SUBPREFIX, --subprefix SUBPREFIX
                        The prefix common for all the source subject-folders.
                        Default: 'sub-'
  -m SESPREFIX, --sesprefix SESPREFIX
                        The prefix common for all the source session-folders.
                        Default: 'ses-'
  -v, --version         Show the installed version and check for updates

examples:
  bidscoiner /project/foo/raw /project/foo/bids
  bidscoiner -f /project/foo/raw /project/foo/bids -p sub-009 sub-030
```

Tip: Check your json sidecar files of your fieldmaps, in particular see if they have the expected `IntendedFor` values.

Note: The provenance of the produced BIDS data-sets is stored in the `[bidsfolder]/code/bidscoin/bidscoiner.log` file. This file is also very useful for debugging / tracking down bidscoin issues.

2.4 The bidsmap explained

2.4.1 Structure and content

Generally speaking, a bidsmap contains a collection of key-value dictionaries that define how different source data runs (e.g. a T1w- or a T2w-scan) should map onto BIDS filenames. As illustrated in the figure below (but see also the screenshot of the edit window), a run-item consists of `provenance`, `attributes` and `bids` key-value dictionaries:

- The provenance item contains the pathname of a source data sample that is representative for this run.
- The attributes dictionary contains keys and values that are properties of the source data and that are (pre-) selected to uniquely identify a run item. A source data sample is positively identified only if all specified (non-empty) values match.
- The bids dictionary contains key-value pairs that are used to construct the associated BIDS output filename.

A bidsmap has a BIDScoin `Options` and a `PlugIns` section, followed by source modality sections (e.g. `DICOM`, `PAR`, `P7`, `Nifti`, `FileSystem`). Within a source modality section there sub-sections for the `participant_label` and `session_label`, and for the BIDS datatypes (`anat`, `func`, `dwi`, `fmap`, `pet`, `beh`) plus the additional `extra_data` datatype. BIDScoin tools will go through the list of run items of a datatype from top to bottom until they come across an item that matches with the data sample at hand. At that point a bidsmapping is established.

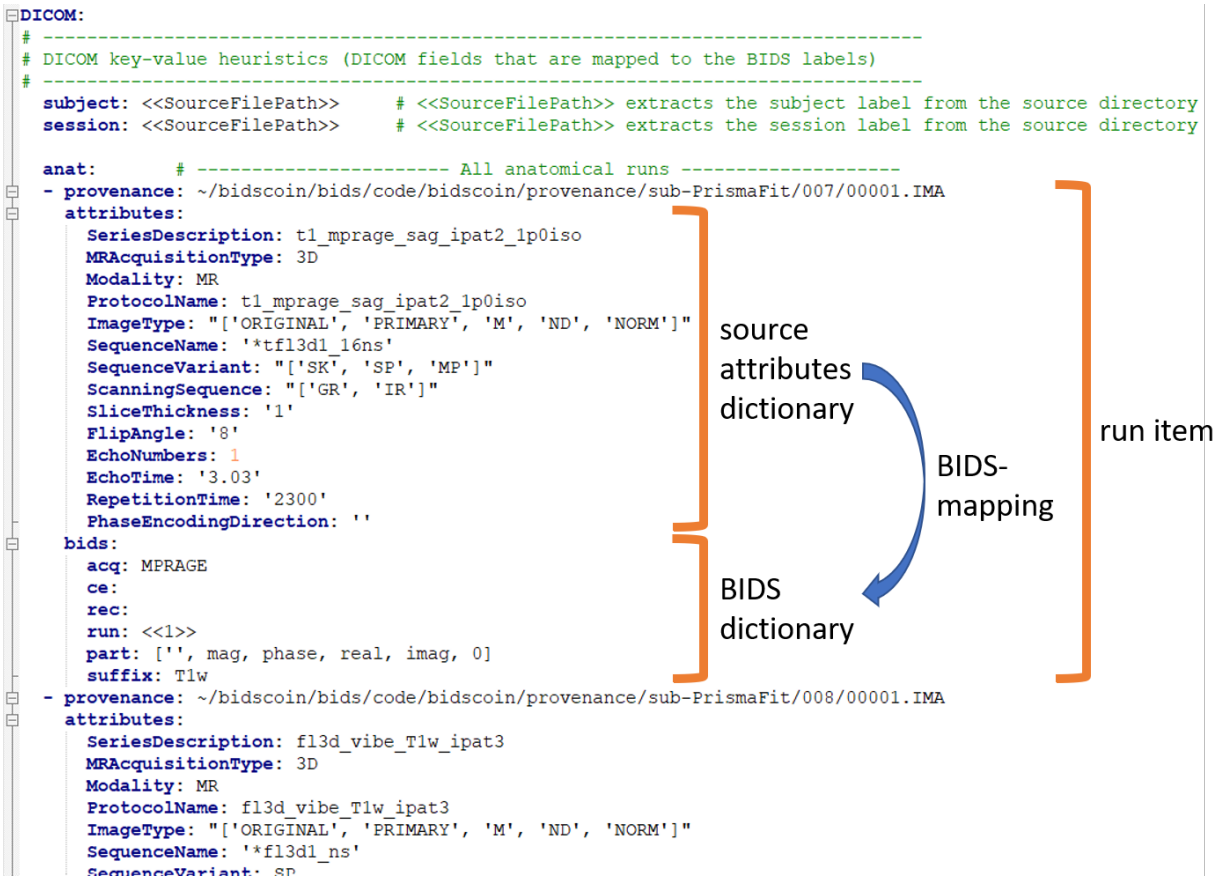

Fig. 4: A snippet of a study `bidsmap.yaml` file, showing a `DICOM` section with a few run items in the `anat` subsection

2.4.2 From template to study

A bidsmap can either be a template bidsmap or a study bidsmap. The difference between them is that a template bidsmap is a comprehensive set of pre-defined run items and serves as an input for the bidsmapper to automatically make a first version of a study bidsmap. The study bidsmap is thus derived from the template bidsmap and contains only those run items that are present in the data. The study bidsmap can be interactively edited with knowledge that is specific to a study and that cannot be extracted from the data (e.g. set a `task` value to "rest"). A user normally doesn't have to interact with the template bidsmap, but it is sure possible to create your own.

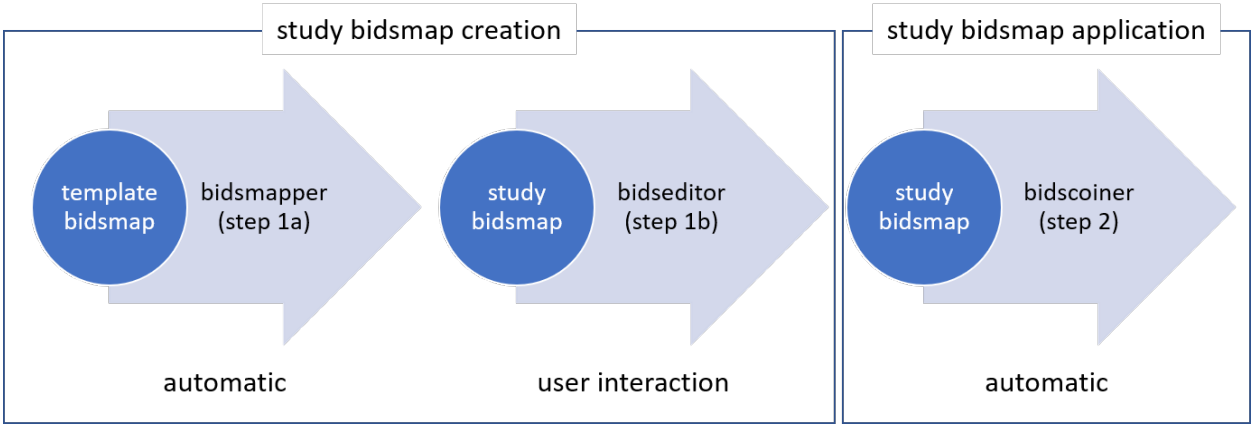

Fig. 5: Creation and application of a study bidsmap

2.4.3 Special bidsmap features

- **Source attribute wildcards**. Source attribute values can contain Unix shell-style `*` wildcards to facilitate more liberal run matching. For instance you can use `SeriesDescription: '*MPRAGE*'` to match all MPRAGE DICOM series as they come from your MRI scanner.
- **Source attribute list**. Instead of a normal string, a source attribute value can also be a list of strings, in which case a match is positive if any of the list items matches with the source attribute of the run. For instance `SequenceName: ['\*epfid\*', 'fm2d2r']` will liberally match all DICOM sequences with that have `epfid` in their `SequenceName` and it will strictly match on `fm2d2r`.
- **Dynamic bids value**. Bids values can be static, in which case the value is just a normal string, or dynamic, when the string is enclosed with pointy brackets. In case of single pointy brackets the bids value will be replaced during bidsmapper, bidseditor and bidscoiner runtime by the value of the source attribute. For instance `acq: <MRAcquisitionType><SeriesDescription>` will be replaced by `acq: 3DMPRAGE`. In case of double enclosed pointy brackets, the value will be updated only during bidscoiner runtime – this is useful for bids values that are subject/session dependent. For instance `run: <<1>>` will be replaced with `run: 1` or e.g. increased to `run: 2` if a file with that bidsname already exists.
- **Bids value list**. Instead of a normal string, a bids value can also be a list of strings, with the last list item being the (zero-based) list index that selects the final bids value. For instance the list `['mag', 'phase', 'real', 'imag', 1]` would select `phase` as a value. A bids value list is made visible in the bidseditor as a drop-down menu.

The special bidsmap features are most useful when added to template bidsmaps.

2.5 Finishing up

After a successful run of bidscoiner, the work to convert your data in a fully compliant BIDS dataset is unfortunately not yet fully over and, depending on the complexity of your data-set, additional tools may need to be run and meta-data may need to be entered manually (not everything can be automated).

2.5.1 Adding meta-data

For instance, you should update the content of the `dataset_description.json` and `README` files in your bids folder and you may need to provide e.g. additional `*_scans.tsv`,`*_sessions.tsv` or `participants.json` files (see the BIDS specification for more information). Moreover, if you have behavioural log-files you will find that BIDScoin does not (yet) support converting these into BIDS compliant `*_events.tsv/json` files (advanced users are encouraged to use the bidscoiner plug-in possibility and write their own log-file parser).

2.5.2 Data sharing utilities

Multi-echo combination

Before sharing or pre-processing their images, users may want to combine the separate the individual echos of multi-echo MRI acquisitions. The `echcombine`-tool is a wrapper around `mecombine` that writes BIDS valid output.

```
usage: echocombine [-h] [-p PARTICIPANT_LABEL [PARTICIPANT_LABEL ...]]
                   [-o {fmap,anat,func,dwi,beh,pet,extra_data,derivatives}]
                   [-a {PAID,TE,average}] [-w [WEIGHTS [WEIGHTS ...]]]
                   bidsfolder pattern

A wrapper around the 'mecombine' multi-echo combination tool (https://github.com/
↪Donders-Institute/multiecho).

This wrapper is fully BIDS-aware (a 'bidsapp') and writes BIDS compliant output

positional arguments:
  bidsfolder            The bids-directory with the (multi-echo) subject data
  pattern               Globlike recursive search pattern (relative to the
                        subject/session folder) to select the first echo of
                        the images that need to be combined, e.g.
                        '*task-*echo-1*'

optional arguments:
  -h, --help            show this help message and exit
  -p PARTICIPANT_LABEL [PARTICIPANT_LABEL ...], --participant_label PARTICIPANT_LABEL␣
↪[PARTICIPANT_LABEL ...]
                        Space separated list of sub-# identifiers to be
                        processed (the sub- prefix can be left out). If not
                        specified then all sub-folders in the bidsfolder will
                        be processed (default: None)
  -o {fmap,anat,func,dwi,beh,pet,extra_data,derivatives}, --output {fmap,anat,func,
↪dwi,beh,pet,extra_data,derivatives}
                        A string that determines where the output is saved. It
                        can be the name of a BIDS modality folder, such as
                        'func', or of the derivatives folder, i.e.
                        'derivatives'. If output = [the name of the input
                        modality folder] then the original echo images are
                        replaced by one combined image. If output is left
```

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```
                        empty then the combined image is saved in the input
                        modality folder and the original echo images are moved
                        to the extra_data folder (default: None)
  -a {PAID,TE,average}, --algorithm {PAID,TE,average}
                        Combination algorithm (default: TE)
  -w [WEIGHTS [WEIGHTS ...]], --weights [WEIGHTS [WEIGHTS ...]]
                        Weights for each echo (default: None)

examples:
  echocombine /project/3017065.01/bids func/*task-stroop*echo-1*
  echocombine /project/3017065.01/bids *task-stroop*echo-1* -p 001 003
  echocombine /project/3017065.01/bids func/*task-*echo-1* -o func
  echocombine /project/3017065.01/bids func/*task-*echo-1* -o derivatives -w 13 26 39␣
↪52
  echocombine /project/3017065.01/bids func/*task-*echo-1* -a PAID
```

Defacing

Before sharing or pre-processing their images, users may want to deface their anatomical MRI acquisitions as to protect the privacy of their subjects. The `deface`-tool is a wrapper around `pydeface` that writes BIDS valid output.

```
usage: deface [-h] [-p PARTICIPANT_LABEL [PARTICIPANT_LABEL ...]]
              [-o {fmap,anat,func,dwi,beh,pet,extra_data,derivatives}] [-c]
              [-n NATIVESPEC] [-a ARGS]
              bidsfolder pattern

A wrapper around the 'pydeface' defacing tool (https://github.com/poldracklab/
↪pydeface).

This wrapper is fully BIDS-aware (a 'bidsapp') and writes BIDS compliant output

positional arguments:
  bidsfolder            The bids-directory with the (multi-echo) subject data
  pattern               Globlike search pattern (relative to the
                        subject/session folder) to select the images that need
                        to be defaced, e.g. 'anat/*_T1w*'

optional arguments:
  -h, --help            show this help message and exit
  -p PARTICIPANT_LABEL [PARTICIPANT_LABEL ...], --participant_label PARTICIPANT_LABEL␣
↪[PARTICIPANT_LABEL ...]
                        Space separated list of sub-# identifiers to be
                        processed (the sub- prefix can be left out). If not
                        specified then all sub-folders in the bidsfolder will
                        be processed (default: None)
  -o {fmap,anat,func,dwi,beh,pet,extra_data,derivatives}, --output {fmap,anat,func,
↪dwi,beh,pet,extra_data,derivatives}
                        A string that determines where the defaced images are
                        saved. It can be the name of a BIDS modality folder,
                        such as 'anat', or of the derivatives folder, i.e.
                        'derivatives'. If output is left empty then the
                        original images are replaced by the defaced images
                        (default: None)
  -c, --cluster         Flag to submit the deface jobs to the high-performance
                        compute (HPC) cluster (default: False)
```

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```
  -n NATIVESPEC, --nativespec NATIVESPEC
                        DRMAA native specifications for submitting deface jobs
                        to the HPC cluster (default: -l
                        walltime=00:30:00,mem=1gb)
  -a ARGS, --args ARGS  Additional arguments (in dict/json-style) that are
                        passed to pydeface. See examples for usage (default:
                        {})

examples:
  deface /project/3017065.01/bids anat/*_T1w*
  deface /project/3017065.01/bids anat/*_T1w* -p 001 003 -o derivatives
  deface /project/3017065.01/bids anat/*_T1w* -n "-l walltime=00:60:00,mem=2gb"
  deface /project/3017065.01/bids anat/*_T1w* -a '{"cost": "corratio", "verbose": ""}'
```

2.5.3 BIDS validation

If all of the above work is done, you can (and should) run the web-based bidsvalidator to check for inconsistencies or missing files in your bids data-set (NB: the bidsvalidator also exists as a command-line tool).

2.6 Options

BIDScoin has different options and settings (see below) that can be adjusted per study bidsmap. You can use a text editor to edit the bidsmap template `[path_to_bidscoin]/heuristics/bidsmap_template.yaml` if you want to adjust the default)

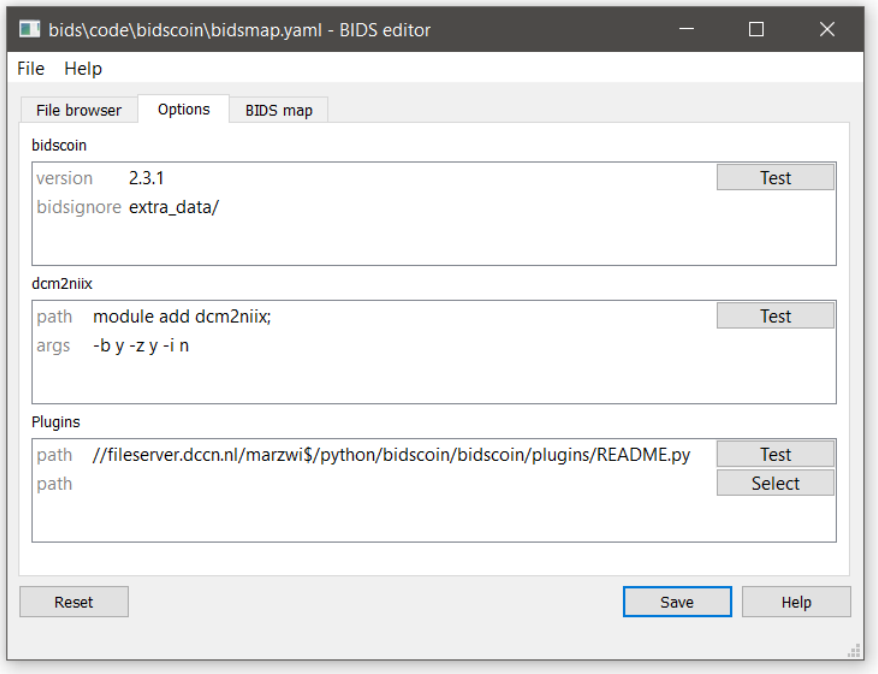

Fig. 6: The bidseditor options window with the different BIDScoin settings

2.6.1 BIDScoin

- `version`: should correspond with the version in ../bidscoin/version.txt
- `bidsignore`: Semicolon-separated list of entries that are added to the .bidsignore file (for more info, see BIDS specifications), e.g.:
  - `extra_data/;pet/;myfile.txt;yourfile.csv`

2.6.2 dcm2niix

The nifti- and json-files are generated with dcm2niix. Here you can adjust how dcm2niix is used:

- `path`: Command to set the path to dcm2niix, e.g.:
  - `module add dcm2niix/1.0.20180622;` (note the semi-colon at the end)
  - `PATH=/opt/dcm2niix/bin:$PATH;` (note the semi-colon at the end)
  - `/opt/dcm2niix/bin/` (note the slash at the end)
  - `'\"C:\\Program Files\\dcm2niix\"'` (note the quotes to deal with the whitespace)
- `args`: Argument string that is passed to dcm2niix. Click [Test] and see the terminal output for usage

---

Tip: SPM users may want to use '-z n', which produces unzipped nifti's

---

2.6.3 Plugins

BIDScoin provides the possibility for researchers to write custom python functions that will be executed at bidsmapper and bidscoiner runtime. To use this functionality, enter the name of the module (default location is the plugins-folder; otherwise the full path must be provided) in the bidsmap dictionary file to import the plugin functions. See advanced usage for more details.

2.7 Advanced usage

2.7.1 Site specific / customized template

> The run-items in the default template bidsmap (named `bidsmap_template.yaml`) have empty / non-matching source attributes, and therefore the bidsmapper will not make any guesses about BIDS datatypes and run-items. As a result, it will classify all runs as `extra_data`, leaving all the subsequent bidseditor decision making to the user. One alternative is to use the much more intelligent `bidsmap_dccn.yaml` template bidsmap. This bidsmap may work much better but it may also make wrong suggestions, since it is tailored to the MR acquisitions at the Donders Institute. To improve that and to have BIDScoin convert your studies in a better way, you **may** consider creating and using your own customized template bidsmap.

Tip: To create your own template bidsmap you can probably best make a copy of the DCCN template (`[path_to_bidscoin]/heuristics/bidsmap_dccn.yaml`) as a starting point and adapt it to your needs. If you want to use different source attributes to improve run identifications, then beware that the attribute values should not vary between different repeats of the data acquision. Otherwise the number of run-items in the bidsmap will not

be a shortlist of the different acquisition protocols in your study, but will become a lengthy list that is proportional to the number of subjects and sessions.

Editing the template

1. **Using the bidseditor**. This is the easiest way to create a bidsmap template since it uses only a GUI and doesn't require in-depth knowledge of bidsmaps and YAML files. If you have a run item in your study that you would like to be automatically mapped in other / future studies you can simply append that run to the standard or to a custom template bidsmap by editing it to your needs and click the `Export` button (see below). Note that you should first empty the source attribute values (e.g. `EchoTime`) that vary across repeats of the same run. With the GUI you can still use advanced features, such as Unix shell-style wildcards in the values of the source attributes (see left panel), or such as using lists of attribute values (of which either one can match), or simply empty fields to ignore the item. The main limitation of using the GUI is that the run items are always appended to a bidsmap template, meaning that they are last in line and will be used only if no other item in the template matches. It also means that like this you cannot edit the already existing run items in the bidsmap. Another (smaller) limitation is that with the GUI you cannot make usage of YAML anchors and references, yielding a less clearly formatted bidsmap that is harder to maintain. Both limitations are overcome when directly editing the template bidsmap yourself using a text editor (see next point).

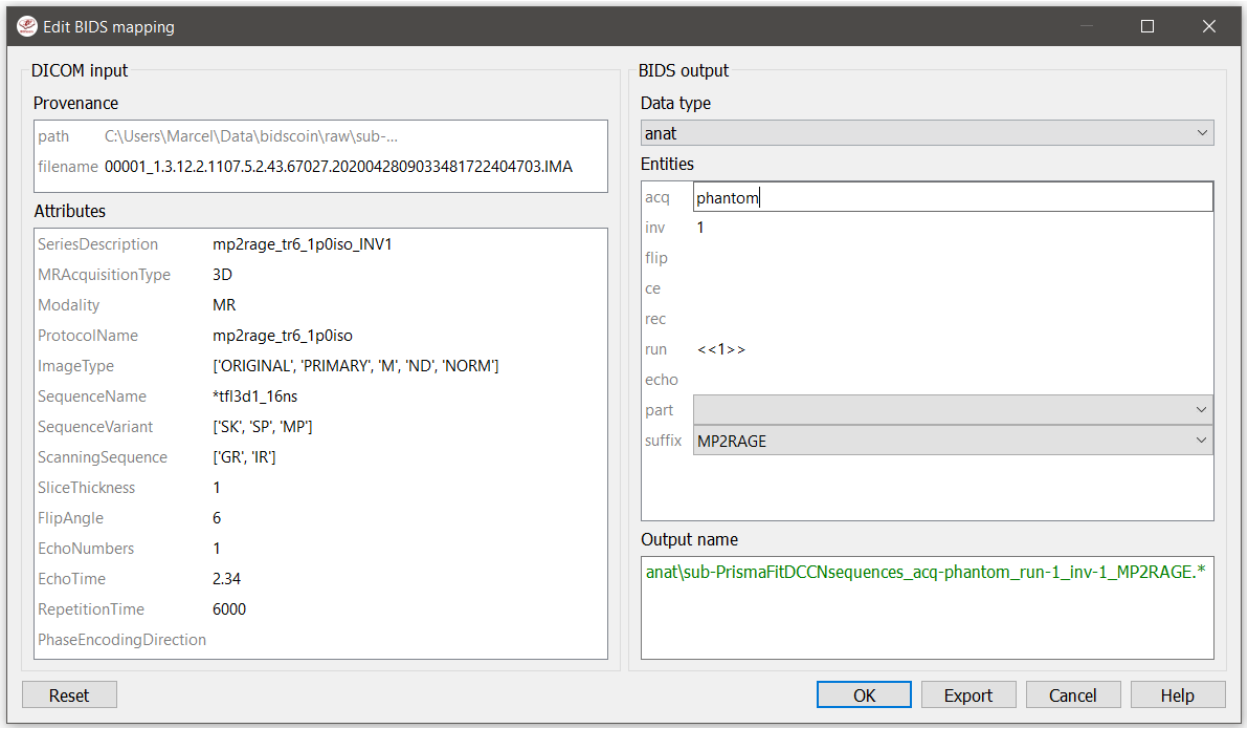

Fig. 7: The edit window with the option to export the customized mapping of run a item

2. **Using a text editor**. This is the most powerful way to create or modify a bidsmap template but requires more indepth knowledge of YAML and of how BIDScoin identifies different acquisitions in a protocol given a bidsmap. How you can customize your template is well illustrated by the DCCN template bidsmap (`[path_to_bidscoin]/heuristics/bidsmap_dccn.yaml`). If you open that template, there are a few things to take notice of (as shown in the template snippet below). First, you can see that the DCCN template makes use of YAML anchors and aliases (to make maintanance more sustainable). The second thing to notice is that, of the first run, all values of the attribute dictionary are empty, meaning that it won't match any run / will be ignored. In that way, however, the subsequent runs that alias (`<<: *anatattributes_dicom`) this

anchor (`&anatattributes_dicom`) will inherit only the keys and can inject their own values, as shown in the second run. The first run of each modality sub-section (like `anat`) also serves as the default bidsmapping when users manually overrule / change the bids modality using the bidseditor GUI.

```
anat:       # ---------------------- All anatomical runs --------------------
- provenance: ~                      # The fullpath name of the DICOM file from␣
↪which the attributes are read. Serves also as a look-up key to find a run in the␣
↪bidsmap
  attributes: &anat_dicomattr
    Modality: ~
    ProtocolName: ~
    SeriesDescription: ~
    ImageType: ~
    SequenceName: ~
    SequenceVariant: ~
    ScanningSequence: ~
    MRAcquisitionType: ~
    SliceThickness: ~
    FlipAngle: ~
    EchoNumbers: ~
    EchoTime: ~
    RepetitionTime: ~
    PhaseEncodingDirection: ~
  bids: &anat_dicoment_nonparametric  # See: schema/datatypes/anat.yaml
    acq: <SeriesDescription>
    ce: ~
    rec: ~
    run: <<1>>
    part: ['', 'mag', 'phase', 'real', 'imag', 0]
    suffix: T1w
- provenance: ~
  attributes:
    <<: *anat_dicomattr
    SeriesDescription: ['*mprage*', '*MPRAGE*', '*MPRage*', '*t1w*', '*T1W*', '*T1w*',
↪ '*T1*']
    MRAcquisitionType: 3D
  bids: *anat_dicoment_nonparametric
- provenance: ~
  attributes:
    <<: *anat_dicomattr
    SeriesDescription: ['*t2w*', '*T2w*', '*T2W*', '*T2*']
    SequenceVariant: "['SK', 'SP']"
  bids:
    <<: *anat_dicoment_nonparametric
    suffix: T2w
```

Snippet from the ''bidsmap_dccn.yaml'' template, showing a `DICOM` section with the first two run items in the `anat` subsection

2.7.2 Plugins

BIDScoin has the option to import plugins to further automate / complete the conversion from source data to BIDS. The plugin takes is called each time the BIDScoin tool has finished processing a run or session, with arguments containing information about the run or session, as shown in the plugin example code below. The functions in the plugin module should be named `bidsmapper_plugin` to be called by bidsmapper and `bidscoiner_plugin` to be called by bidscoiner.

```
import logging
from pathlib import Path

LOGGER = logging.getLogger(f'bidscoin.{Path(__file__).stem}')


def bidsmapper_plugin(seriesfolder: Path, bidsmap: dict, bidsmap_template: dict) ->␣
↪dict:
    """
    The plugin to map info onto bids labels

    :param seriesfolder:        The full-path name of the raw-data series folder
    :param bidsmap:             The study bidsmap
    :param bidsmap_template:    Full BIDS heuristics data structure, with all options,
↪ BIDS labels and attributes, etc
    :return:                    The study bidsmap with new entries in it
    """

    LOGGER.debug(f'This is a bidsmapper demo-plugin working on: {seriesfolder}')
    return bidsmap


def bidscoiner_plugin(session: Path, bidsmap: dict, bidsfolder: Path, personals:␣
↪dict) -> None:
    """
    The plugin to cast the series into the bids folder

    :param session:     The full-path name of the subject/session raw data source␣
↪folder
    :param bidsmap:     The full mapping heuristics from the bidsmap YAML-file
    :param bidsfolder:  The full-path name of the BIDS root-folder
    :param personals:   The dictionary with the personal information
    :return:            Nothing
    """

    LOGGER.debug(f'This is a bidscoiner demo-plugin working on: {session} ->
↪{bidsfolder}')
```

Plugin example code

2.8 Screenshots

2.8.1 The bidseditor

2.9 Demo and tutorial

2.9.1 BIDS introduction and BIDScoin demo

A good starting point to learn more about BIDS and BIDScoin is to watch this presentation from the OpenMR Benelux 2020 meeting (slides). The first 14 minutes Robert Oostenveld provides a general overview of the BIDS standard, after which Marcel Zwiers presents the design of BIDScoin and demonstrates hands-on how you can use it to convert a dataset to BIDS.

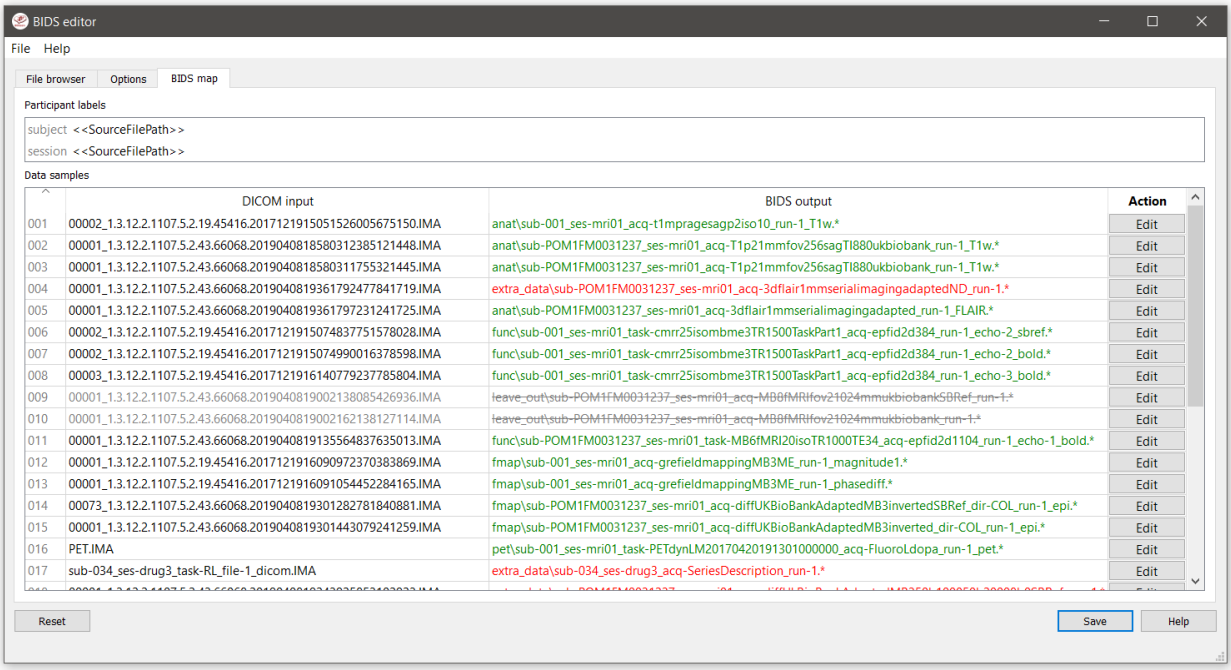

Fig. 8: The main window with an overview of all the bidsmap run items

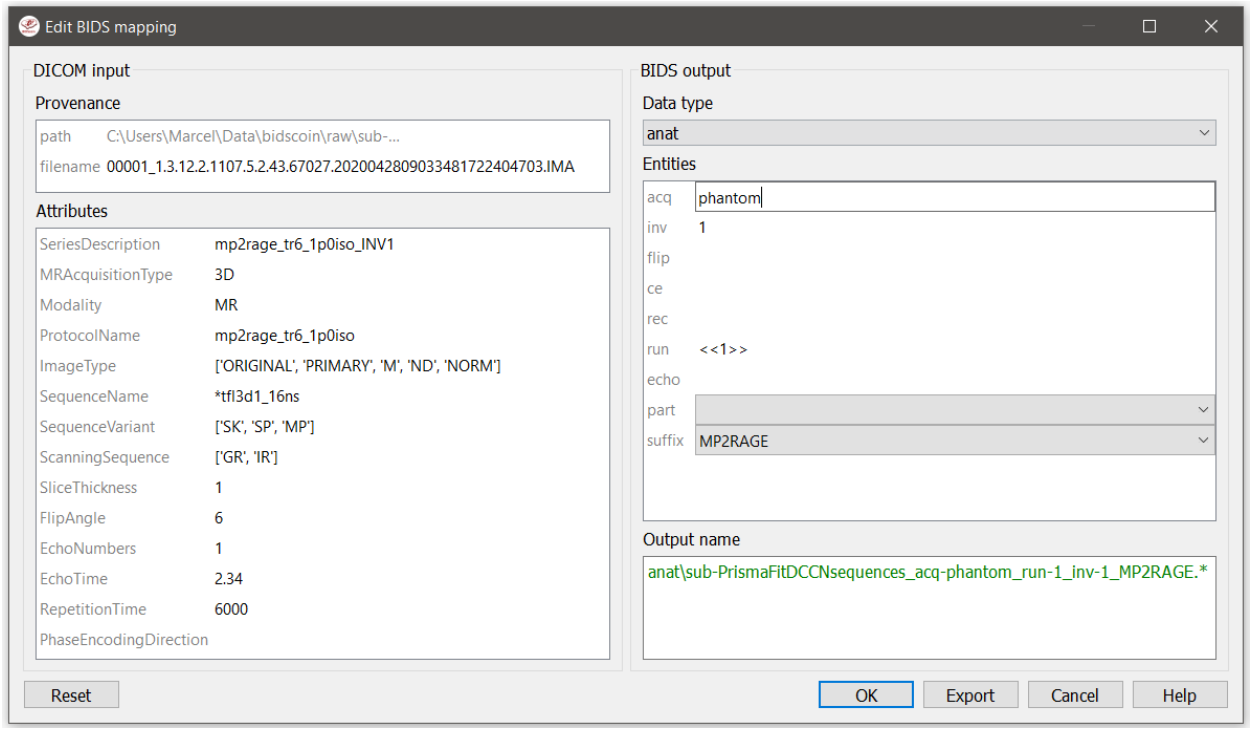

Fig. 9: The edit window for customizing a bidsmap run item, showing the `acq` value being set to `phantom`

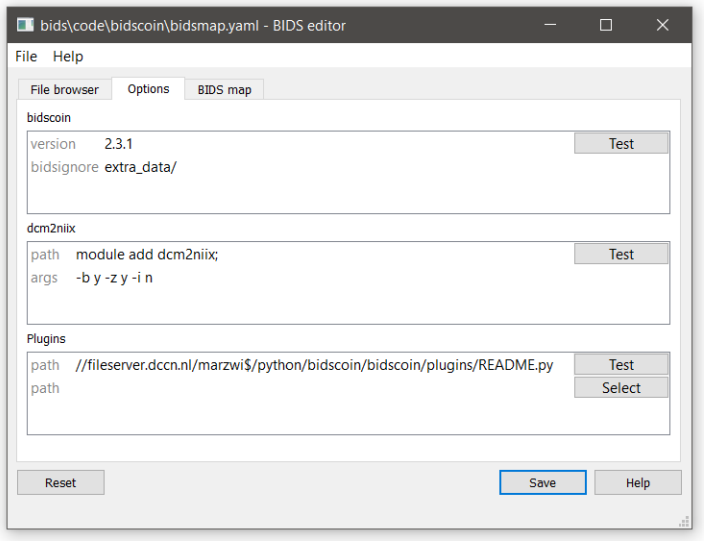

Fig. 10: The options window with BIDScoin settings

2.9.2 BIDScoin tutorial

1. **Preparation.** Activate the bidscoin environment and create a tutorial playground folder in your home directory by executing these bash commands (users from outside the DCCN may have to adapt the first two commands to their environment):

```
$ module add bidscoin
$ source activate /opt/bidscoin
$ pulltutorialdata
$ cd bidscointutorial
```

The new `bidscointutorial` folder contains a `raw` source-data folder and a `bids_ref` reference BIDS folder, i.e. the intended end product of this tutorial. In the raw folder you will find these DICOM series (aka "runs"):

```
001-localizer_32ch-head                  A localizer scan that is not scientifically␣
↪relevant and can be left out of the BIDS dataset
002-AAHead_Scout_32ch-head               A localizer scan that is not scientifically␣
↪relevant and can be left out of the BIDS dataset
007-t1_mprage_sag_ipat2_1p0iso           An anatomical T1-weighted scan
047-cmrr_2p4iso_mb8_TR0700_SBRef         A single-band reference scan of the␣
↪subsequent multi-band functional MRI scan
048-cmrr_2p4iso_mb8_TR0700               A multi-band functional MRI scan
049-field_map_2p4iso                     The fieldmap magnitude images of the first␣
↪and second echo. Set as "magnitude1", bidscoiner will recognize the format. This␣
↪fieldmap is intended for the previous functional MRI scan
050-field_map_2p4iso                     The fieldmap phase difference image of the␣
↪first and second echo
059-cmrr_2p5iso_mb3me3_TR1500_SBRef      A single-band reference scan of the␣
↪subsequent multi-echo functional MRI scan
060-cmrr_2p5iso_mb3me3_TR1500            A multi-band multi-echo functional MRI scan
061-field_map_2p5iso                     Idem, the fieldmap magnitude images of the␣
↪first and second echo, intended for the previous functional MRI scan
062-field_map_2p5iso                     Idem, the fieldmap phase difference image of␣
↪the first and second echo
```

Let's begin with inspecting this new raw data collection:

- Are the DICOM files for all the `bids/sub-*` folders organised in series-subfolders (e.g. `sub-001/ses-01/003-T1MPRAGE/0001.dcm` etc)? Use dicomsort if this is not the case (hint: it's not the case). A help text for all BIDScoin tools is available by running the tool with the `-h` flag (e.g. `rawmapper -h`)
- Use the rawmapper command to print out the DICOM values of the "EchoTime", "Sex" and "AcquisitionDate" of the fMRI series in the `raw` folder

2. **BIDS mapping.** Now we can make a bidsmap, i.e. the mapping from DICOM source-files to BIDS target-files. To that end, scan all folders in the raw data collection by running the bidsmapper command:

```
$ bidsmapper raw bids
```

- In the GUI that appears, edit the task and acquisition labels of the functional scans into something more readable, e.g. `task-Reward` for the `acq-mb8` scans and "task-Stop" for the `acq-mb3me3 scans`. Also make the name of the T1 scan more user friendly, e.g. by naming the aquisition label simply `acq-mprage`.
- Add a search pattern to the `IntendedFor` field such that the first fieldmap will select your `Reward` runs and the second fieldmap your `Stop` runs (see the bidseditor `fieldmap` section for more details)
- Since for this dataset we only have one session per subject, remove the session label (and note how the output names simplify, omitting the session subfolders and labels)
- When all done, go to the `Options` tab and change the `dcm2niix` settings to get non-zipped nifti output data (i.e. `*.nii` instead of `*.nii.gz`). Test the tool to see if it can run and, as a final step, save your bidsmap. You can always go back later to change any of your edits by running the bidseditor command line tool directly. Try that.

3. **BIDS coining.** The next step, converting the source data into a BIDS collection, is very simple to do (and can be repeated whenever new data has come in). To do this run the bidscoiner commandline tool (note that the input is the same as for the bidsmapper):

```
$ bidscoiner raw bids
```

- Check your `bids/code/bidscoin/bidscoiner.log` (the complete terminal output) and `bids/code/bidscoin/bidscoiner.errors` (the summary that is also printed at the end) files for any errors or warnings. You shouldn't have any :-)
- Compare the results in your `bids/sub-*` subject folders with the in `bids_ref` reference result. Are the file and foldernames the same (don't worry about the multi-echo images and the `extra_data` images, they are combined/generated as described below)? Also check the json sidecar files of the fieldmaps. Do they have the right `EchoTime` and `IntendedFor` fields?
- What happens if you re-run the `bidscoiner` command? Are the same subjects processed again? Re-run `sub-001`.

4. **Finishing up.** Now that you have converted the data to BIDS, you still need to do some manual work to make it fully ready for data analysis and sharing

- Combine the echos using the echocombine tool, such that the individual echo images are replaced by the echo-combined image
- Deface the anatomical scans using the echocombine tool. This will take a while, but will obviously not work well for our phantom dataset. Therefore store the 'defaced' output in the `derivatives` folder (instead of e.g. overwriting the existing images)
- Inspect the `bids/participants.tsv` file and decide if it is ok.
- Update the `dataset_description.json` and `README` files in your `bids` folder
- As a final step, run the bids-validator on your `~/bids_tutorial` folder. Are you completely ready now to share this dataset?