Python

Offline Utilities

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# Introduction

Blackrock Microsystems provides a set of Python utilities to extract and plot data saved in NEV and NSx datafiles. These utilities were built using the [Anaconda](https://www.continuum.io/downloads) distribution of Python 2.7 and 3.5 and have some dependencies as noted throughout this manual.

Blackrock Microsystems data are saved in two types of files:

* NEV: Short for Neural EVents, it contains events recorded during an experimental session. These events may include information on threshold crossed spike waveforms, information received through the digital input and the serial input, tracking information recorded in NeuroMotive Video Tracking System, text comments, or other custom comments sent to the NSP during an experiment.
* NSx: Short for Neural Stream X, where X indicates the sampling frequency of the continuous file. This data type contains continuous streamed data to the NSP. Depending on the sampling frequency, a second of data may contain up to 30,000 samples in this file.
  + NS1: Data sampled at 500 Hz
  + NS2: Data sampled at 1 kHz
  + NS3: Data sampled at 2 kHz
  + NS4: Data sampled at 10 kHz
  + NS5: Data sampled at 30 kHz

File Specifications (Format)

The data files can be recorded in various file specifications. Refer to LB-0023 NEV File Format available on the website for details on what each file format contains. Blackrock Microsystems recommends using the latest file format to record your data.

# Modules

## brMiscFxns.py

This library contains miscellaneous functions that are useful in many classes and scripts, and may be required by other modules (e.g., brpylib). Current version: 1.2.0

**Dependencies**

* os
* qtpy

*function* openfilecheck**()**

Used to open a file in a specified manner.

**Usage**: openedFile = openfilecheck(open\_mode, file\_name='',

file\_ext='', file\_type='')

**Inputs**: *open\_mode*: {str} how to open the file. (*open\_mode*=’rb’ for read binary)

*file\_name*: [optional] {str} complete path and name of file to open

*file\_ext*: [optional] {str} extension for file type to open. (*file\_ext*=’.pdf’) *file\_type*: [optional] {str} type of file to open. *file\_type* = ‘PDF Files’ )

**Return**: opened File object

*function* checkequal**()**

Used to check if all values within an iterator (often a list) are equal.

**Usage**: checkequal(iterator)

**Inputs**: an iterator object, often a list

**Return**: Boolean

## brpylib.py

This library contains classes and functions for extracting information contained in NEV and NSx files saved using Blackrock Microsystems data acquisition systems. For more detailed information on all of the basic and extended header fields contained in the NsxFile and NevFile objects, refer to LB-0023 NEV File Format available on the website. Current version: 1.3.1

**Dependencies**

* \_\_future\_\_
* brMiscFxns
* collections
* datetime
* math
* numpy
* os
* struct

*class* NevFile()

Object representing all experimental setup information (headers) and data stored in the NEV file. If no file is passed using the *datafile* parameter, a prompt will ask for a file name or request to browse to an NEV file. Basic and extended headers will be extracted during initialization.

**Usage**: NevFileObj = NevFile(datafile)

**Inputs**: *datafile* – [optional] {str} complete path to NEV file

**Return**: *NevFileObj*containing opened datafile, extracted basic header and extended

headers

##### basic\_header

The basic timing, creation, and comment information of the file.

##### datafile

The currently opened NEV file. It is recommended to run NevFileObj.datafile.close() after all data extracted.

##### extended\_headers

Extended headers provide specific experimental information for the different data types stored in NEV files. Some data, such as for neural events, will have multiple extended headers for each channel (waveform and label information for neural data).

##### 

##### *function* getdata()

Returns event data for all the different possible data contained in NEV files.

**Usage**: output = NevFileObj.getdata(elec\_ids='all')

**Inputs**: *elec\_ids* – [optional] [list] of neural channel ids to extract. (elec\_ids=[1, 2])

**Return**: *output* – Dictionary with one or more of the following dictionaries. All dictionaries will include a list of Timestamps.

**digital\_data**: Dictionary of digital events containing Reason = ‘parallel’ or ‘serial’, lists of timestamps, and lists of data values, where indexing to the lists is based on the Reason.

Note: Serial data will already be in a single byte format with the upper byte of the 16-bit stored digital value having been stripped off.

Note: For file spec 2.2 and below, AnalogData and AnalogDataUnits will be also be included.

**spike\_data**: Dictionary of neural spike events containing Units=’nV’ and lists of ChannelID, TimeStamps, ExtendedHeaderIndices, Classification, and Waveforms. TimeStamps, Classifications, and Waveforms will be 2D array where indexing into the array will give the data for ChannelID[index].

**comments**: Dictionary of comment event data containing lists of TimeStamps, CharSet, Flag, and comment strings.

**video\_sync\_events**: Dictionary of video sync event data containing lists of TimeStamps, VideoFileNum, VideoFrameNum, VideoElapsedTime\_ms, and VideoSource.

**tracking\_events**: Dictionary of tracking event data containing Parent and Node ID, TimeStamps, Node and Point Count, and tracking points.

**button\_trigger\_events**: Dictionary of event data containing TimeStamps and TriggerType.

**configuration\_events**: Dictionary of configuration event data containing TimeStamps, ConfigChangeType, and the string of what configuration change occurred.

**Dependencies**: none

**Note**: when passing *elec\_ids*, all digital events and other data contained in NEV (e.g., tracking data) will still be extracted. Only neural waveforms for channels not in *elec\_ids* will be excluded.

#### *function* processroicomments()

Returns region of interest (ROI) data processed into a Dictionary of Regions, Enter event timestamps, and Exit event timestamps.

**Usage**:

roi\_events = NevFileObj. processroicomments(comments)

**Inputs**: *comments* – Dictionary returned from getdata().

**Dependencies**:getdata()

*class* NsxFile()

Object representing all experimental setup information (headers) and data stored in the various NSx files. If no filename is passed using the file parameter, *datafile*, a prompt will ask for a file name or request to browse to an NSx file.

**Usage**: NsxFileObj = NsxFile(datafile)

**Inputs**: *datafile* – [optional] {str} complete path to NSx file

**Return**: *NsxFileObj*containing opened datafile, extracted basic header and extended

headers

##### basic\_header

The basic timing, creation, and comment information of the file.

##### datafile

The currently opened NSx file. It is recommended to run NsxFile.datafile.close() after all data extracted.

##### extended\_headers

Each channel will have its own extended header with additional information such as electrode labeling, digitization factor, and filtering specs.

##### *function* getdata()

Returns a dictionary containing data parameters and a 2D array of data.

**Usage**:output = NsxFileObj.getdata(elec\_ids='all',

start\_time\_s=0, data\_time\_s='all',

downsample=1)

**Inputs**: *elec\_ids* – [optional] [list] of neural channel ids to extract. (elec\_ids=[1, 2]).

If specific elec\_ids do not exist in the data, only those that do will be returned, along with a warning.

*start\_time\_s* – [optional] {float} Starting time for data extraction in

seconds. (start\_time\_s = 1.0)

*data\_time\_s* – [optional] {float} Length of time of data to return.

(data\_time\_s = 30.0)

*downsample* – [optional] {int} Downsampling factor (downsample = 2)

**Return**: *output* – Dictionary containing the following:

**data\_headers**: The timestamp and number of data points for each

data packet saved in the file. There will only be more than one data header when pausing is used, which will result in 0-padded data during pauses.

**elec\_ids**: List of extracted electrode ids (sorted).

**start\_time\_s**: {float} Starting time for data extraction into file.

**data\_time\_s**: {float} Length of time of all data extracted.

**downsample**: {int} The downsampling factor of the data, used to reduce data extraction size for large data files.

**samp\_per\_s**: {float} The samples per second of the returned data

**data**: 2D numpy array of continuous data. Indexing into the data will

return the data for elec\_ids[index].

**Dependencies**: none

**Example**: NSxFile.getdata([5, 6, 7, 8, 9, 10], 1, 30, 2) –

returns 30 seconds of data starting from one second into the data file for channels 5-10 with a downsample factor of two.

**Note**: If bad parameters are passed, such as an invalid start\_time\_s or non-

existant elec\_ids, a warning will be displayed and parameters may be altered accordingly.

##### *function* savesubsetnsx()

Used to save a subset of data based on electrode IDs, file sizing, or file data time. If both *file\_time\_s* and *file\_size* are passed, it will default to *file\_time\_s* and determine sizing accordingly.

**Usage**:NsxFileObj.savesubsetsx(elec\_ids='all',

file\_size=None, file\_time\_s=None, file\_suffix='')

**Inputs**: *elec\_ids* – [optional] [list] of neural channel ids to extract. (elec\_ids=[1, 2]).

If specific elec\_ids do not exist in the data, only those that do will be returned, along with a warning.

*file\_size* – [optional] {in t} Byte size of each new file to save. If nothing

is passed, file\_size will be all data points. (e.g., 1024\*\*3 = 1 Gb).

*file\_time\_s* – [optional] {float} Time length of data for each new file, in

seconds. If nothing is passed, file\_size will be used as default.

*file\_suffix* – [optional] {str} Suffix to append to NSx datafile name for new

files. If nothing is passed, default will be "\_subset".

**Return**: None - None of the electrodes requested exist in the data

“SUCCESS” - All file subsets extracted and saved

**Dependencies**: none

**Example**: NsxFileObj.savesubsetnsx(elec\_ids=[1, 2, 20, 200],

file\_time\_s=30, file\_suffix='elecAndTime\_subset')

saves a set of data files that each have 30 seconds of data extracted sequentially for electrode IDs 1, 2, 20, and 200, if they exist in the data.

**Note**: If bad parameters are passed, a warning will be displayed and parameters may be altered accordingly.

**Note**: If the file name of the subset file already exists, an overwrite warning and request is presented.

# Example Scripts

## example\_extract\_continous\_data.py

This example shows how to extract and plot continuous data saved in NSx files. Current version: 1.1.1

**Dependencies**

* brpylib
* matplotlib
* numpy
* sys
* time

## example\_extract\_spike\_data.py

This example shows how to extract and plot spike waveforms saved in the NEV files. Current version: 1.1.2

**Dependencies**

* brpylib
* matplotlib
* numpy

## example\_save\_subset\_nsx.py

This example shows how to extract and save a subset of data in a new set of NSx files from data saved in an NSx file. This can be useful when very large data files are created. Current version: 1.1.1

**Dependencies**

* brpylib

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# Warranty

Blackrock Microsystems (“Blackrock”) warrants its products are free from defects in materials and manufacturing for a period of one year from the date of shipment. At its option, Blackrock will repair or replace any product that does not comply with this warranty. This warranty is voided by: (1) any modification or attempted modification to the product done by anyone other than an authorized Blackrock employee; (2) any abuse, negligent handling or misapplication of the product; or (3) any sale or other transfer of the product by the original purchaser.

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# Support

Blackrock prides itself in its customer support. For additional information on this product or any of our products, you can contact our Support team through the contact information below:

Manuals, Software Downloads, and Application Notes

[www.blackrockmicro.com/technical-support](http://www.blackrockmicro.com/technical-support)

Issues or Questions

[www.blackrockmicro.com/technical-support](http://www.blackrockmicro.com/technical-support)

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# Version History

Version 1.00 Initial Release

Version 1.10 Inclusion of example example\_save\_subset\_nsx to brpy directory

Inclusion of function NsxFile.savesubsetnsx to file brpylib.py

Version 1.11 Updates to function NsxFile.savesubsetnsx wrt overwriting files

Version 1.20 Version numbering updates to libraries and examples

Ordered dictionaries changed to basic dictionaries for class NevFile

Version 1.30 Support for Python 2.7 included along with updated file versions