T2Stimulate Documentation

Release 0.1.0

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CHAPTER 1

T2Stimulate

MRI T2 decay curve simulation with imperfect refocusing pulses (non-180 degrees)

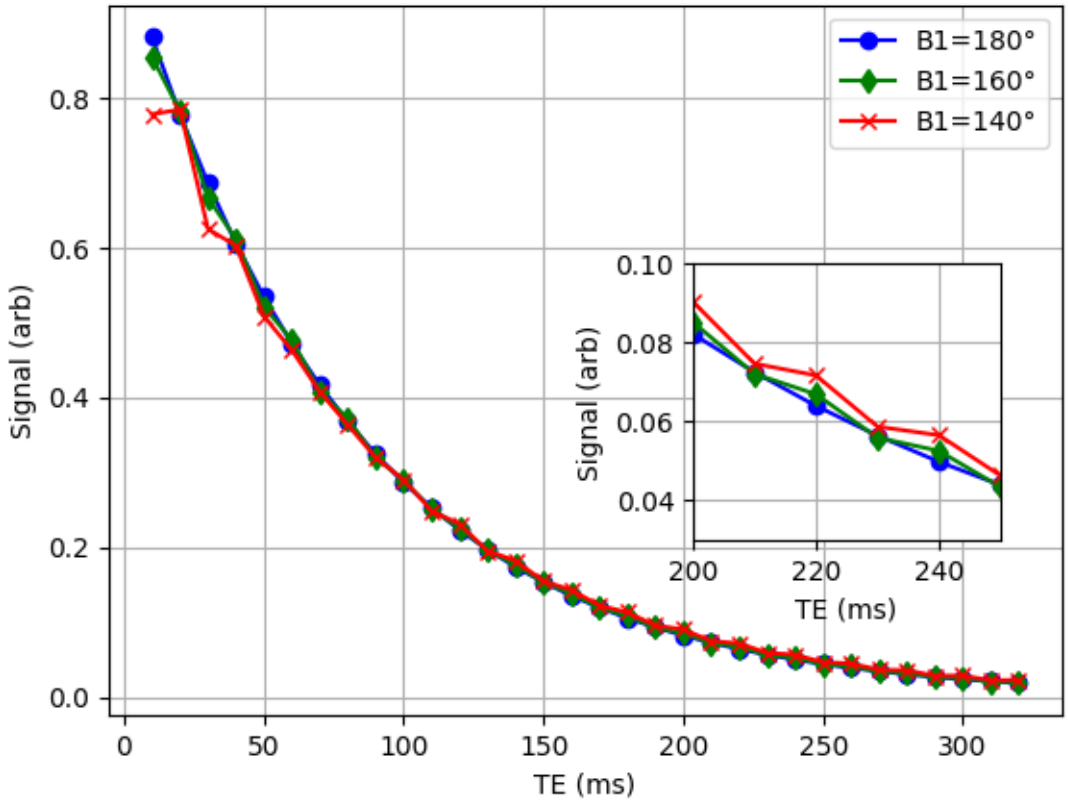
- Free software: GNU General Public License v3
- Documentation: https://t2stimulate.readthedocs.io.

A T2 multi-echo decay curve in MRI is traditionally modeled as a decaying exponential with one or more exponential components. This assumes the refocusing pulse flip angle is at or near 180 degrees, and, if not, that other gradients are added in as spoilers to remove the signal from stimulated echoes.

The stimulated echoes were modeled many years ago in a paper (ref) and were then implemented in simulation code and were found to be sufficient to use for fitting multi-echo decay curves from non-180 degree refocussing pulse sequences.

Below is an example of three curves of a 32 echo MRI Pulse sequence with TE=10ms and refocusing pulse flip angles of 180 degrees, 160 degrees and 140 degrees. The code was:

And the resulting plot:



1.1 Features

- TODO

1.2 Credits

This package was created with Cookiecutter and the audreyr/cookiecutter-pypackage project template.

CHAPTER 2

Installation

2.1 Stable release

To install T2Stimulate, run this command in your terminal:

```
$ pip install t2stimulate
```

This is the preferred method to install T2Stimulate, as it will always install the most recent stable release.

If you don't have pip installed, this Python installation guide can guide you through the process.

2.2 From sources

The sources for T2Stimulate can be downloaded from the Github repo.

You can either clone the public repository:

```
$ git clone git://github.com/brechmos/t2stimulate
```

Or download the tarball:

```
$ curl  -OL https://github.com/brechmos/t2stimulate/tarball/master
```

Once you have a copy of the source, you can install it with:

```
$ python setup.py install
```

CHAPTER 3

Usage

A T2 multi-echo decay curve in MRI is traditionally modeled as a decaying exponential with one or more exponential components. This assumes the refocusing pulse flip angle is at or near 180 degrees, and, if not, that other gradients are added in as spoilers to remove the signal from stimulated echoes.

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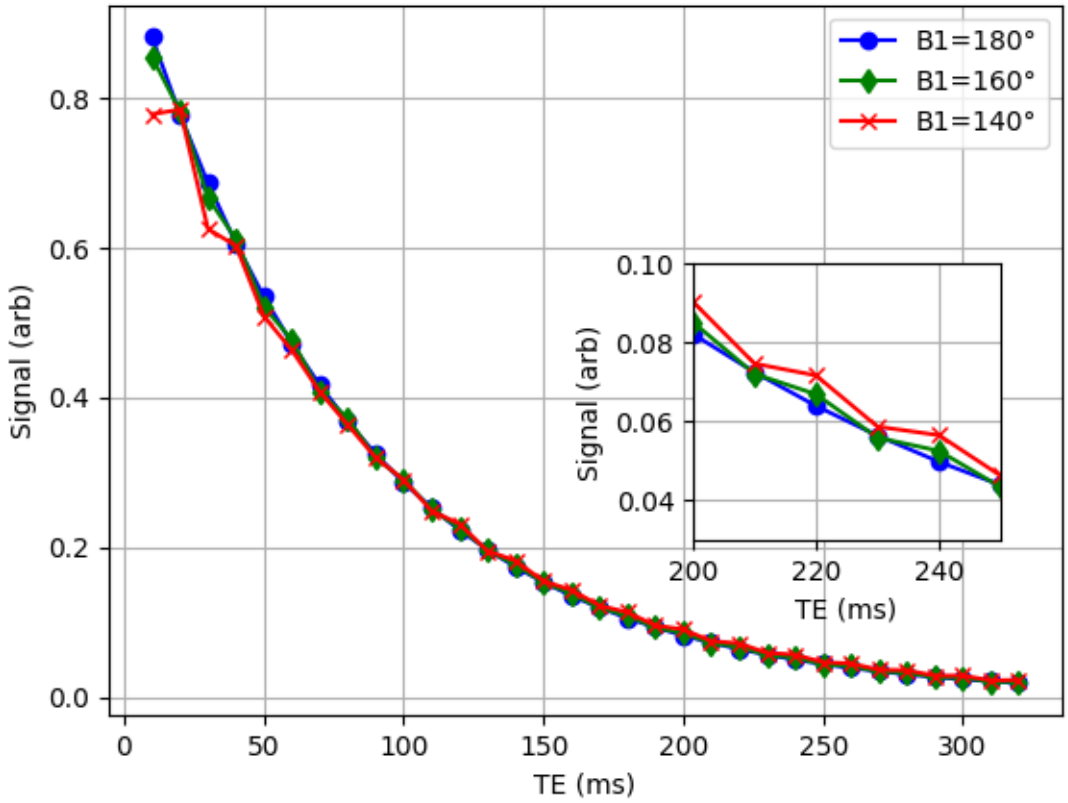
B1=180°
B1=160°
B1=140°
Signal (arb)
TE (ms)
0.0
0.2
0.4
0.6
0.8
0
50
100
150
200
250
300
0.10
0.08
0.06
0.04
200
220
240

CHAPTER 4

Contributing

Contributions are welcome, and they are greatly appreciated! Every little bit helps, and credit will always be given.

You can contribute in many ways:

4.1 Types of Contributions

4.1.1 Report Bugs

Report bugs at https://github.com/brechmos/t2stimulate/issues.

If you are reporting a bug, please include:

- Your operating system name and version.
- Any details about your local setup that might be helpful in troubleshooting.
- Detailed steps to reproduce the bug.

4.1.2 Fix Bugs

Look through the GitHub issues for bugs. Anything tagged with "bug" and "help wanted" is open to whoever wants to implement it.

4.1.3 Implement Features

Look through the GitHub issues for features. Anything tagged with "enhancement" and "help wanted" is open to whoever wants to implement it.

4.1.4 Write Documentation

T2Stimulate could always use more documentation, whether as part of the official T2Stimulate docs, in docstrings, or even on the web in blog posts, articles, and such.

4.1.5 Submit Feedback

The best way to send feedback is to file an issue at https://github.com/brechmos/t2stimulate/issues.

If you are proposing a feature:

- Explain in detail how it would work.
- Keep the scope as narrow as possible, to make it easier to implement.
- Remember that this is a volunteer-driven project, and that contributions are welcome :)

4.2 Get Started!

Ready to contribute? Here's how to set up *t2stimulate* for local development.

1. Fork the *t2stimulate* repo on GitHub.
2. Clone your fork locally:

```
$ git clone git@github.com:your_name_here/t2stimulate.git
```

3. Install your local copy into a virtualenv. Assuming you have virtualenvwrapper installed, this is how you set up your fork for local development:

```
$ mkvirtualenv t2stimulate
$ cd t2stimulate/
$ python setup.py develop
```

4. Create a branch for local development:

```
$ git checkout -b name-of-your-bugfix-or-feature
```

   Now you can make your changes locally.

5. When you're done making changes, check that your changes pass flake8 and the tests, including testing other Python versions with tox:

```
$ flake8 t2stimulate tests
$ python setup.py test or py.test
$ tox
```

   To get flake8 and tox, just pip install them into your virtualenv.

6. Commit your changes and push your branch to GitHub:

```
$ git add .
$ git commit -m "Your detailed description of your changes."
$ git push origin name-of-your-bugfix-or-feature
```

7. Submit a pull request through the GitHub website.

4.3 Pull Request Guidelines

Before you submit a pull request, check that it meets these guidelines:

1. The pull request should include tests.
2. If the pull request adds functionality, the docs should be updated. Put your new functionality into a function with a docstring, and add the feature to the list in README.rst.
3. The pull request should work for Python 2.7, 3.4, 3.5 and 3.6, and for PyPy. Check https://travis-ci.org/brechmos/t2stimulate/pull_requests and make sure that the tests pass for all supported Python versions.

4.4 Tips

To run a subset of tests:

```
$ py.test tests.test_t2stimulate
```

4.5 Deploying

A reminder for the maintainers on how to deploy. Make sure all your changes are committed (including an entry in HISTORY.rst). Then run:

```
$ bumpversion patch # possible: major / minor / patch
$ git push
$ git push --tags
```

Travis will then deploy to PyPI if tests pass.

CHAPTER 5

Credits

5.1 Development Lead

- Craig Jones <craig@brechmos.org>

5.2 Contributors

None yet. Why not be the first?

The software was written by myself based on Matlab code I had written in the 2000's. The paper that inspired this work was written by Hennig (Hennig J. Multiecho imaging sequences with low refocusing flip angles. J Magn Reson 1988; 78: 397–407) that described how the spin-echoes and stimulated echoes propagated through an echo train.

The original software (simulation and fitting) were completed during my PhD and then written up in the publication Magnetic Resonance in Medicine 67:1803–1814 (2012) (https://doi.org/10.1002/mrm.23157).

CHAPTER 6

History

6.1 0.1.0 (2019-06-25)

- First release on PyPI.
- Basic stimulated echo simulation written with tests.

CHAPTER 7

Indices and tables

- genindex
- modindex
- search