LMFIT2

Release 2.0

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Installation Guide

lmfit2 is a GPLv3 licensed implementation of the First-Principles Fitting Methodology (FPFM) algorithm described in Statistically Self-Consistent and Accurate Errors for SuperDARN Data. This algorithm was specifically developed for fitting SuperDARN "rawacf" data, but the principles used to develop the algorithm are broadly applicable to parameter extraction via fitting models to data. lmfit2 was written in two different languages, C and Python. We recommend that you use the C version. These pages will show you how to use lmfit2.

This documentation will not teach you much about how to fit data, but there are many good resources on this topic already available (try numerical recipes, specifically the chapter on modeling data). We also published a paper explaining the FPFM algorithm and implementation in detail.

lmfit2 fitted data was used in a study identifying ULF waves in SuperDARN data and it is being developed on GitHub.

Basic Usage

For the C version, if you want to fit a rawacf file (in dmap format), you would do something like this:

```
make_lmfit2 -new yyyymmdd.hhmm.rawacf > yyyymmdd.hhmm.lmfit2
```

For the python version, with *lmfit2.py* in the working directory, you would do something like this:

```
from lmfit2 import main
main(yyyymmdd.hhmm.rawacf,yyyymmdd.hhmm.lmfit2)
```

How to Use This Guide

First, you need to install lmfit2. Luckily for you there's a handy *Installation* guide to help you.

Next, you can try using lmfit2 as explained above in the Basic Usage section.

Perhaps some tutorials will be added to this guide in the future! If you would like this to happen, or you have bug reports, patches, feature requests, and/or other comments, please submit them to the GitHub issue tracker.

If you have a question about the use of lmfit2, please post it to the issue tracker.

2.1 Installation

lmfit2 is availble in both C and Python, with each having a different installation procedure. The C version needs to be compiled against the RST package. The Python version is not a package, but instead a script.

We recommended that you use the C version. The Python version is only provided for testing purposes.

2.1.1 C Version Installation

First, install RST using this guide.

Next, obtain a copy of lmfit2 source code. Here we'll assume you are using *git*, then compile the C source code:

```
BASEPATH=`pwd`
git clone https://github.com/asreimer/lmfit2.git@v1.0
cd ${BASEPATH}/lmfit2/C
LIBPATH=$RSTPATH/lib IPATH=$RSTPATH/include make
```

After the build completes, a *make_lmfit2* binary will be available in *${BASEPATH}/lmfit2/C/bin*. You can add this location to your user path or you can copy the binary to an existing location on your path.

2.1.2 Test the C binary

To make sure that the installation was successful, you can execute a unit test located in *${BASEPATH}/lmfit2/C/tests*:

```
cd ${BASEPATH}/lmfit2/C/tests
bash test.bash
```

This might take a minute and should result in no errors if everything is working as it should.

2.1.3 Python Version Installation

The python version depends on the *lmfit* python library. You can install it using *pip*, like so:

```
pip install lmfit
```

The python version is not set up to be a python package, instead it is intened to be used as a script. To "install" it, simply copy both the *lmfit2.py* and *dmap.py* python files to wherever you want to them to be.

2.1.4 Test the Python Code

Assuming that you have grabbed the source code for lmfit2 using *git* (see the above section: C Version Installation), navigate to the *lmfit2/python* directory and run:

```
python tests/test.py
```

This will take a minute or two and should result in no errors if everything is working as it should.

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If you make use of lmfit2 in your work, please cite our paper (Radio Science, ADS, BibTeX)

Changelog

4.1 1.0 (2018-05-12)

- Initial full release of code since Radio Science publication
- Included unit testing for C and python versions
- Some bug fixes to the python version to bring it up to date with C version