

`niiT1vfa` is a program that performs a fast nonlinear least squares fit to [Variable Flip Angle \(VFA\)](#) for  $T_1$  estimation using a robust and efficient version of the Levenberg-Marquardt minimization algorithm provided by a derivative solver in the [GNU Scientific Library](#) (GSL). Input VFA data and output data are in the [Nifti-1](#) format which can be inspected and analysed using [ImageJ](#) software.

## Build

The routine links against GSL which is not typically bundled with Linux. The `niiT1vfa` Makefile assumes that the library is installed in either a standard system location or at `/usr/local/lib`. The GSL source can be downloaded from <https://www.gnu.org/software/gsl/>. Extract the source, change directory to it and run `./configure` followed by `make` and (as root) `make install` to install at `/usr/local`.

Extract the `niiT1vfa` source with `tar -xvzf niiT1vfa.tar.gz`

`cd niiT1vfa` and build with `make` or, for debug mode, `make debug`

If the libraries can only be installed in a user's home directory adjust the `LIBPATH` location specified in the Makefile

## Site Installation

Site installation requires root privilege. Copy the `niiT1vfa` binary to `/usr/local/bin`

## User Installation

Install to `$HOME/bin` with `make install`

## Usage

```
niiT1vfa [-f FA1,...,FAn] [-r TR] [-m maxT1] [-t thr]
        [-a AFI.nii] [-p AFIfliplr] [-s] VFA.nii
```

VFA.nii is the file containing the VFA data

Options:

<code>[-f FA1,FA2,...,FAn]</code>	specify flip angles
<code>[-r TR]</code>	specify TR/s (default 0.0028 s)
<code>[-m maxT1]</code>	maximum T1/s (default 10.0 s)
<code>[-t thr]</code>	threshold (default automatic)
<code>[-a AFI.nii]</code>	use AFI FA file to correct prescribed FAs
<code>[-p AFIfliplr]</code>	prescribed AFI flip/deg (default 64 deg)
<code>[-s]</code>	generate T1 & iteration stats

Output:

<code>T1_VFA.nii</code>	T1 estimate
<code>M0_VFA.nii</code>	$M0^*$ estimate, $M0^* = M0 \cdot \exp(-TE/T2^*)$
<code>NIT_VFA.nii</code>	Number of iterations (-s option only)