Analysis

Analysis routines (run on LINUX):
iman – IMage ANalysis; makes maps out of raw data files saved be the acquisition program (**ContImage**), can make movies, pictures of green, compresses and decompresses raw data files.

mapans – MAP ANalysis Single; map viewer, opens and modifies a map file saved by **iman**.

mapanm2 – MAP ANalysis Multiple 2; combines two maps (adds, subtracts, divides, or other).

binan – BIN ANalysis; opens, manipulates, and animates movies or binned frames made by **iman**.

Flow of data in a typical imaging experiment:

ContImage saves raw frames in a set of files ->
iman (depending on specified command line options) produces a map, binned frames (movies) or condition maps ->
mapans opens and manipulates maps made by iman ->
mapanm2 combines 2 maps to remove hemodynamic delay (the two maps are of opposite direction of stimulus flow) or to reduce noise (the two maps are made with identical stimulus) ->
mapans opens and manipulates maps combined by **mapanm2** and generates figures for printing or further editing.
binan animates and manipulates the binned frames produced by iman.

mapanm2

mapam2 – MAP ANalysis Multiple 2. The primary purpose of **mapam2** is to combine two maps generated by **iman**. **Mapans** works only with two map at a time. **Mapanm2** performs basic operations, such as addition, subtraction or averaging, in pixel-by-pixel manner. The major purpose of this routine is to calculate an average map of two maps acquired for stimuli of opposite temporal direction, and thus to remove the hemodynamic delay.

The program is evoked from the command line of a terminal with two required file names and options.

1. How to open maps with mapanm2

The program is evoked from the command line of a terminal with two file names and options (see Figure 1).

The following command line demonstrates the simplest use of **mapans**:

```
mapanm2  t_35l.0700.mapraw1_104_62_4741dt1_a
t_35l.0800.mapraw1_104_51_4730dt1_a
```

This command opens a window with 10 (5x2) panels (Figure 1) by default. The first column is the phase (φ_1) and amplitude (ρ_1) maps from the first file respectively. The second column is the maps from the second file (φ_2 and ρ_2). The third one is the difference map calculated by the following expression: $\rho_1 \rho_2 \exp[I (\varphi_1 - \varphi_2)]$, that is $\varphi_{dif} = \varphi_1 - \varphi_2$ and $\rho_{dif} = \rho_1 \rho_2$ (I is the complex unit $I*I=-1$). The fourth one is the sum map calculated by $\rho_1 \rho_2 \exp[I (\varphi_1 + \varphi_2)]$, that is $\varphi_{sum} = \varphi_1 + \varphi_2$ and $\rho_{sum} = \rho_1 \rho_2$. And finally the fifth map is the average map calculated by the following expression: $\sqrt{\rho_1 \rho_2} \exp[I (\varphi_1 - \varphi_2)/2]$, that is $\varphi_{average} = (\varphi_1 - \varphi_2)/2$ and $\rho_{average} = \sqrt{\rho_1 \rho_2}$, where sqrt=$\sqrt{\ }$.

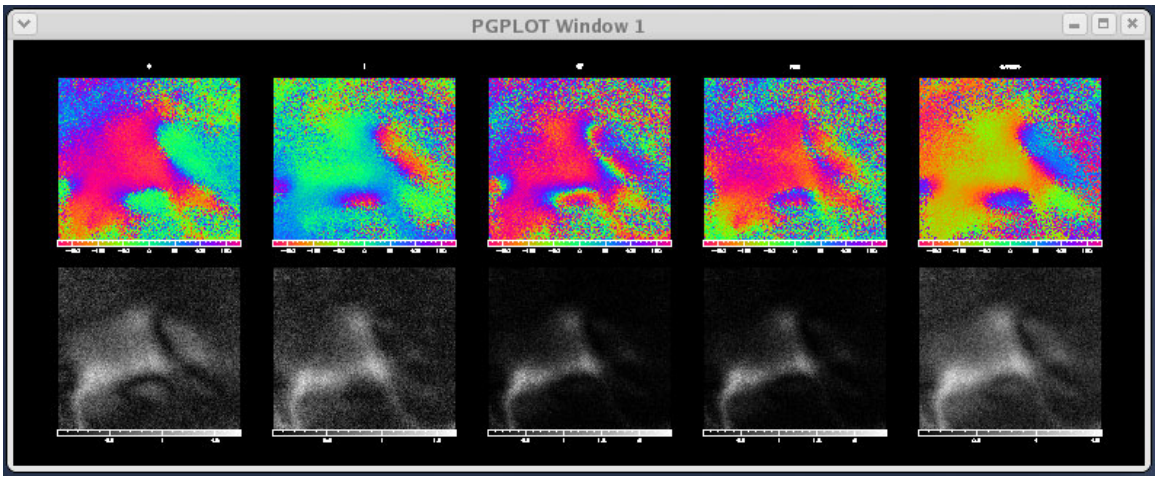


Figure 1. Display window of **mapanm2**. Simplest usage. The display window shows five maps: first file, second file, difference of, sum of, and average of the two provided maps.

In this simple example **mapanm2** displays the maps and prompts the user to press "Return" in the terminal window. To enable saving capabilities option `-iX` should be specified, where `X` codes for windows that may need to be saved in a bit OR manner. The first window is assigned bit 1 (1), the second bit 2 (4), the third one bit 3 (8), and so on. To be able to go through all five windows sum of all bits should be specified: X=31=1+2+4+8+16. If there is a need to save only the last (average) map X=16. The following command starts **mapanm2** with the display and interactive window.

```
mapanm2  -i31  t_35l.0700.mapraw1_104_62_4741dt1_a
t_35l.0800.mapraw1_104_51_4730dt1_a
```

The display window will show the first map only and the same map will be shown in the interactive window (Figure 2). Similar to **mapans q** entered over the interactive window (or middle mouse button click) quits the current map panel, display the next map in the display window and plots the same map in the interactive window. Entering **Q** (shift-q) will terminate the program completely. Entering **S** (**S**ave, shift-s) will save the current map as a raw pixel bitmap (a file that can be open with **mapans**). The filenames are generated automatically. For example, if shift-s was entered over the interactive window when it was displaying the **dif**ference map of files `t_35l.0700.mapraw1_104_62_4741dt1_a` and `t_35l.0800.mapraw1_104_51_4730dt1_a` the following file name will be used to save the **dif** map `t_35l.07-08.dif` . The file

names used to save the **sum** and **average** maps are `t_35l.07-08.sum` and `t_35l.07-08.average` respectively. The maps saved by **mapanm2** can be open for further editing by **mapans**.

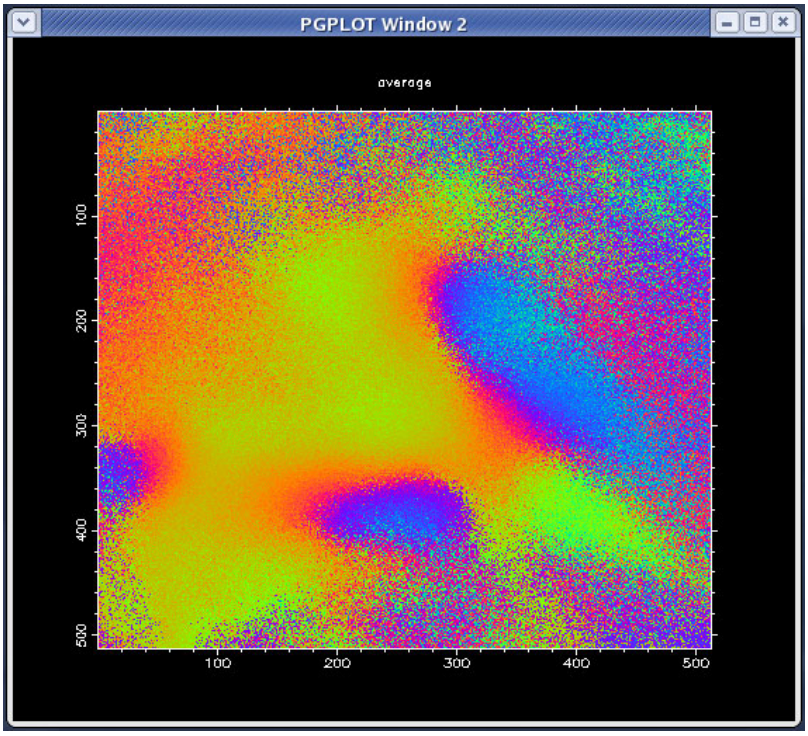
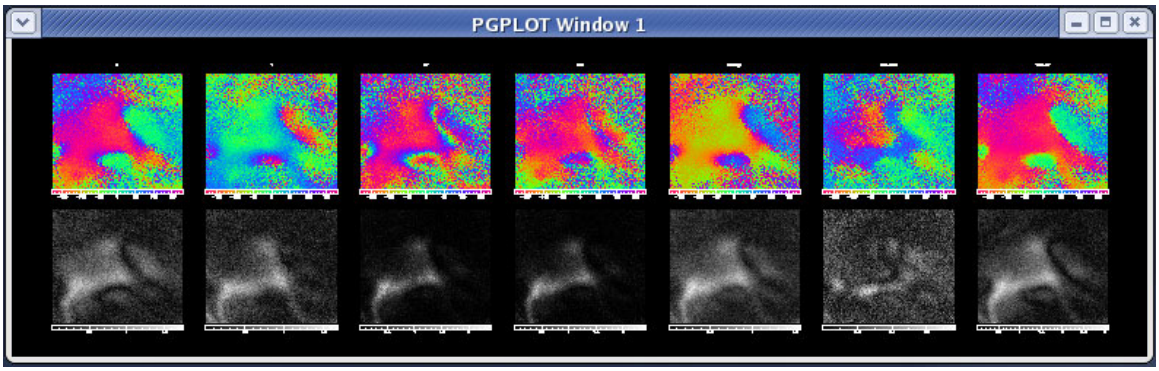


Figure 2. Interactive window of **mapanm2**. The window shows the phase component of the average map. Use **p** to toggle between the phase and amplitude components in the interactive window.

Some other, less frequently used map combinations, can be calculated with **mapanm2**, for example **true_sum** and **true_dif** which are pixel-by-pixel sum $(\rho_1 \exp[I\,\varphi_1] + \rho_2 \exp[I\,\varphi_2])/2$ or difference $(\rho_1 \exp[I\,\varphi_1] - \rho_2 \exp[I\,\varphi_2])$ of the initial two maps. To request these and other operations the number of display window panels should be increased via `-PX` option. Note that `X=5` by default. The following command will open the display window with 7 maps (see Figure 3) each of which will be interactive (option `-i127`)

```
mapanm2  -i127 -P7
t_35l.0700.mapraw1_104_62_4741dt1_a
t_35l.0800.mapraw1_104_51_4730dt1_a
```

The **true_sum** and **true_dif** maps can be saved in the same manner as other maps, i.e. by entering **S** over respective interactive window.



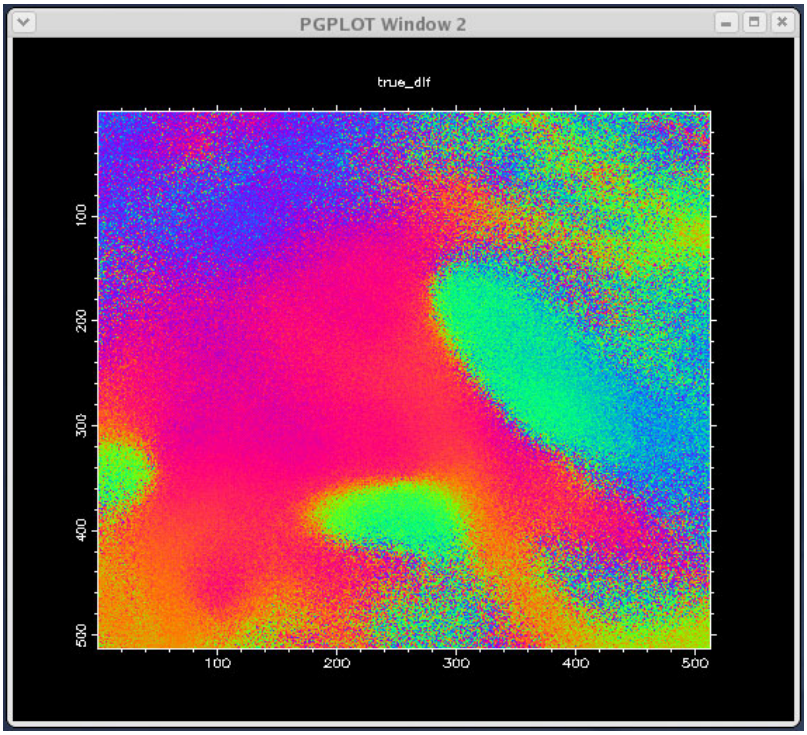


Figure 3. Seven panel display and ineractive windows of **mapanm2**. The display window shows the **true_sum** and **true_dif** maps besides the five maps shown in Figure 1. The interactive window displays the **true_dif** map.

In some cases the **average** map may have artifacts (phase discontinuities) caused by division by 2. Using option `-S` may reduce the artifacts. This option tells **mapanm2** not to add **π** to negative phase values. Note: the saved **average** map should be shifted in **mapans** by 180degrees if option `-S` was used.

Appendix

List of other options.

```
-H <float> - high-pass filter domain (default
0.000000)
 -I <int> - inversion of  second image (default 1)
 -L <float> - low-pass filter domain (default
0.000000)
 -P <int> - number of panels
 -R <int,int,int,int> or <int,int,intxint> - ROI
(XL,YT,XR,YB or XL,YT,XDxYD)
 -f <filename> - needs 2 (4, old version) files (X
and Y components)
 -h - print this help
 -i <int> - interactive mode
 -s - cancel adding Pi to negative phi'sn
 -w <float> - main window width
```