

Difmap Roadmap

Renkun Kuang

September 16, 2019

Contents

| | | |
|----------|---|-----------|
| 1 | Introduction | 2 |
| 2 | Install Difmap (and PGPLOT) | 2 |
| 3 | Difmap: An Interactive Program for Synthesis Imaging, link | 7 |
| 3.1 | Interferometry in a Nutshell | 8 |
| 3.2 | What Does Difmap Do? | 9 |
| 3.2.1 | Data Inspection and Editing | 9 |
| 3.2.2 | Difference Mapping | 9 |
| 3.3 | Difmap Architecture | 10 |
| 3.3.1 | The Observation Object | 10 |
| 4 | Difmap Cookbook, link | 10 |
| 5 | A New Guide to DIFMAP, link1, link2 | 11 |
| 5.1 | Starting DIFMAP | 11 |
| 5.2 | Downloading data from NARO | 11 |
| 5.3 | Loading Data | 15 |

There are [three parts to the Caltech VLBI Analysis programs](#), and DIFMAP is one of them.

Difmap (Shepherd 1997) provides editing, imaging, self-calibration, and pipelining capabilities in an interactive package, [link](#).

This file records my Difmap learning process including the Concept, Installation processes and Using Difmap to processing various data.

1 Introduction

DIFMAP is an interactive mapping program that replaces many of the Caltech VLBI analysis programs. It is written in ANSI C, and runs on Sun, IBM, and HP workstations and possibly other UNIX workstations with X-window graphics. For a description, see [DIFMAP: an interactive program for synthesis imaging](#) by M. C. Shepherd, T. J. Pearson, and G. B. Taylor [Bull. Amer. Astron. Soc., 26, 987-989 (1994); Bull. Amer. Astron. Soc., 27, 903 (1995).]; and [DIFMAP: an interactive program for synthesis imaging*****](#) by M. C. Shepherd [ASP Conference Series, vol.125, "Astronomical Data Analysis Software and Systems VI"].

DIFMAP is obtainable by anonymous ftp from <ftp://ftp.astro.caltech.edu/pub/difmap/>. An introductory users' guide is available in the [Cookbook](#).

Other useful links: [Difmap Tutorial](#)

2 Install Difmap (and PGPLOT)

DIFMAP is obtainable by anonymous ftp from <ftp://ftp.astro.caltech.edu/pub/difmap/>. So first using [lftp](#) command to download the file.

```
lftp ftp.astro.caltech.edu:/pub> lcd .
lcd ok, local cwd=/home/anything/.DIFMAP
lftp ftp.astro.caltech.edu:/pub> mirror difmap/
New: 9 files, 0 symlinks
4868240 bytes transferred in 13 seconds (374.4 KiB/s)
lftp ftp.astro.caltech.edu:/pub> exit

# anything @ anything-China in ~/.DIFMAP [17:51:23]
$ ls
difmap

# anything @ anything-China in ~/.DIFMAP [17:51:24]
$ ls difmap
automap          cookbook.ps.gz   difmap2.5e.tar.gz  help.pdf  README
change_details.txt difmap2.5d.tar.gz difmap.html        muppet
```

里面的help.pdf - A manual of Difmap help pages - 共277页， 2018年11月出的。
cookbook.ps 共 36 页
按照difmap.html的提示安装。

To successfully install difmap you will need the following items:

1. An ANSI-C compiler (eg. gcc). You can get the gcc distribution via anonymous ftp from prep.ai.mit.edu in directory /pub/gnu/.

2. A FORTRAN-77 compiler.

`sudo apt install gfortran`

3. PGPLOT at version 5.0.2 or above. This may be obtained via anonymous ftp from ftp.astro.caltech.edu in directory /pub/pgplot/. Older versions of PGPLOT will not work with this version of Difmap.

`mkdir ~/.PGPLOT && cd ~/.PGPLOT`

`LFTP FTP.ASTRO.CALTECH.EDU/PUB`

`lcd .`

`mirror pgplot`

```
# anything @ anything-China in ~/.PGPLOT [18:12:26]
$ lftp ftp.astro.caltech.edu/pub
cd ok, cwd=/pub
lftp ftp.astro.caltech.edu:/pub> lcd .
lcd ok, local cwd=/home/anything/.PGPLOT
lftp ftp.astro.caltech.edu:/pub> mirror pgplot/
Total: 1 directory, 23 files, 1 symlink
New: 23 files, 1 symlink
4146226 bytes transferred in 26 seconds (153.9 KiB/s)
lftp ftp.astro.caltech.edu:/pub> exit

# anything @ anything-China in ~/.PGPLOT [18:13:33]
$ ls pgplot
copyright.notice  install-vms.txt  pgplot5.2.tar.gz  ver501.txt  ver511.txt
DOC               pgplot520.tar.gz  README            ver502.txt  ver520.txt
install.txt       pgplot521.tar.gz  sys_win.readme    ver503.txt  ver521.txt
install-unix.txt  pgplot522.tar.gz  ver500.txt        ver510.txt  ver522.txt
```

Install PGPLOT in Ubuntu, original link

After `sudo make`:

```
*** Finished compilation of PGPLOT ***
```

Note that if you plan to install PGPLOT in a different directory than the current one, the following files will be needed.

```
libpgplot.a  
grfont.dat  
rgb.txt  
pgxwin_server
```

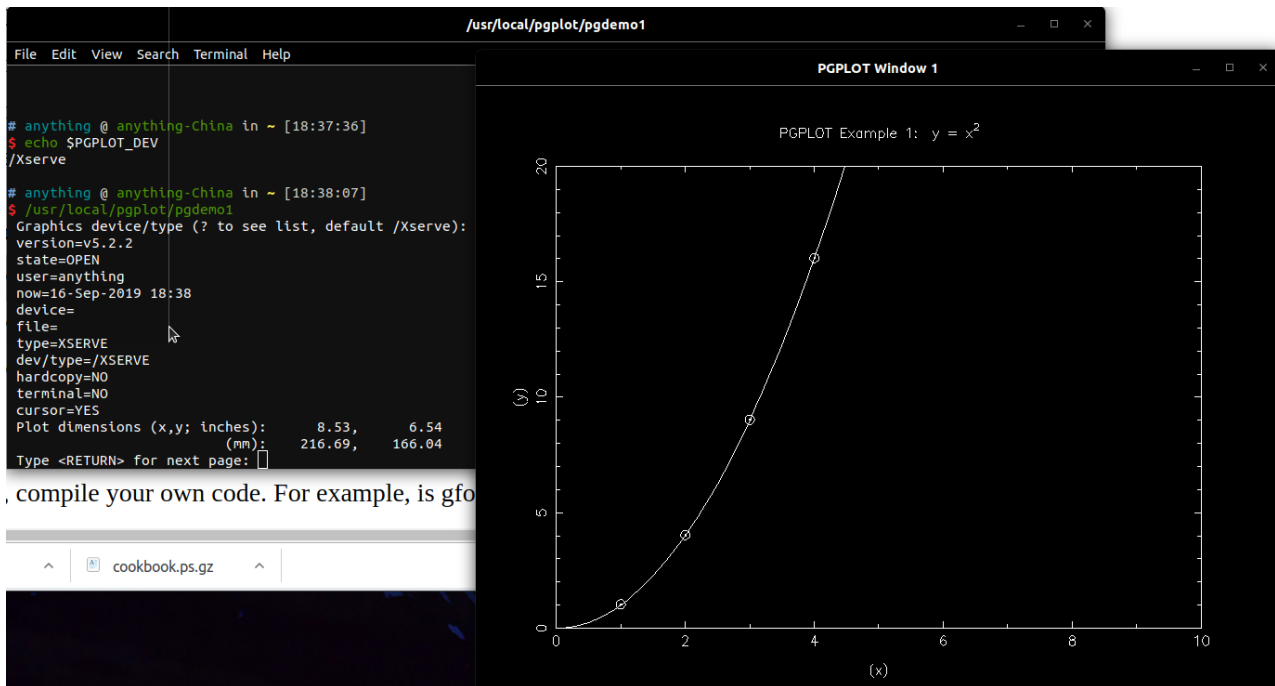
Also note that subsequent usage of PGPLOT programs requires that the full path of the chosen installation directory be named in an environment variable named PGPLOT_DIR.

After [sudo make cpg](#):

```
*** Finished compilation of the C PGPLOT wrapper library ***
```

Note that if you plan to install the library in a different directory than the current one, both libcpplot.a and cpgplot.h will be needed.

After [Successfully installed](#):



In uvf_difmap folder install difmap:

```
sudo ./configure linux-i486-gcc
```

```
sudo ./makeall
```

Error:

```
/usr/bin/ld: cannot find -lpgplot
```

```
/usr/bin/ld: cannot find -lncurses
```

```
collect2: error: ld returned 1 exit status
```

Using [this link](#) to solve

```
sudo ln -s /home/anything/.CASA/lib/libpgplot.so.5 libpgplot.so
```

```
sudo ln -s /home/anything/.CASA/lib/libncurses.so.5 libncurses.so
```

```
sudo cp /home/anything/.CASA/lib/libpng15.so.15 /usr/lib/x86_64-linux-gnu
```

```
sudo cp /home/anything/.CASA/lib/libgfortran.so.3 /usr/lib/x86_64-linux-gnu
```

```
sudo ln -s /home/anything/.CASA/lib/libgfortran.so.3 /usr/lib/x86_64-linux-gnu/libgfortran.so
```

Finally: `sudo ./makeall` finished:

```

Compiling the command parser library libsphere.a
make: Nothing to be done for 'default'.
Compiling difmap itself
gfortran -o difmap startup.o f77main.o difmap.o slfcal.o wmapbeam.o maplot.o moddif.o vlbhead.o uvaver.o mapmem.o mapclean.o
mapres.o costran.o uvinvert.o clphs.o clplot.o vlbhist.o enumpar.o symtab.o plbeam.o uvrotate.o stnstr.o uvtrans.o corplt.o
modplot.o uvradplt.o vedit.o vplot.o color.o uvplot.o timplt.o specplot.o markerlist.o uvf_read.o uvf_write.o obs.o subarray.
o obutil.o binan.o dpage.o if.o ifpage.o intrec.o obedit.o obhead.o uvpage.o chlist.o obpol.o telcor.o visaver.o utbin.o intl
ist.o obshift.o resoff.o winmod.o subamphs.o addamphs.o nextif.o wtscal.o units.o scans.o mapwin.o stokes.o visstat.o pb.o ma
pcor.o hms.o termstr.o visflags.o telspec.o ellips.o uvrange.o baselist.o spectra.o pollist.o freelist.o planet.o cksum.o fni
nt.o dntint.o frange.o imran.o minmax.o lmfit.o matinv.o newfft.o model.o modvis.o besj.o addmod.o modfit.o modeltab.o -L/hom
e/anything/.DIFMAP/difmap/uvf_difmap/lib -lsphere -L/home/anything/.DIFMAP/difmap/uvf_difmap/lib -llogio -L/home/anything/.DI
FMAP/difmap/uvf_difmap/lib -lpager -L/home/anything/.DIFMAP/difmap/uvf_difmap/lib -lcpplot -lpgplot -lX11 -L/home/anything/.
DIFMAP/difmap/uvf_difmap/lib -lfits -L/home/anything/.DIFMAP/difmap/uvf_difmap/lib -lrecio -L/home/anything/.DIFMAP/difmap/uv
f_difmap/lib -lscrfl -L/home/anything/.DIFMAP/difmap/uvf_difmap/lib -lslalib -ltecla -lncurses /usr/lib/gcc/x86_64-linux-gnu
/8/libgcc.a -lm
/usr/bin/ld: /home/anything/.DIFMAP/difmap/uvf_difmap/lib/libpager.a(pager.o): in function 'new_Pager':
pager.c:(.text+0x2af): warning: the use of `tmpnam' is dangerous, better use `mkstemp'
/usr/bin/ld: warning: libgfortran.so.3, needed by /usr/lib/gcc/x86_64-linux-gnu/8/../../../../x86_64-linux-gnu/libpgplot.so, may
conflict with libgfortran.so.5
mv difmap /home/anything/.DIFMAP/difmap/uvf_difmap/difmap
chmod ugo+rx /home/anything/.DIFMAP/difmap/uvf_difmap/difmap

```

Then, run difmap and an error comes out:

```
./difmap
```

```
./difmap: error while loading shared libraries: libpgplot.so.5: cannot open shared object file:
No such file or directory
```

After this command:

```
sudo cp /home/anything/.CASA/lib/libpgplot.so.5 /usr/lib/x86_64-linux-gnu/
```

it is fine:

```

# anything @ anything-China in ~/.DIFMAP/difmap/uvf_difmap [19:32:16]
$ ./difmap
Caltech difference mapping program - version 2.5e (30 May 2019)
Copyright (c) 1993-2019 California Institute of Technology. All Rights Reserved.
Type 'help difmap' to list difference mapping commands and help topics.
Started logfile: difmap.log on Mon Sep 16 19:32:19 2019
0>help difmap
The following is a list of difference mapping topics and commands on
which help documentation is available. Other information can be found
in the difmap cookbook. To see help for a given entry in the following
list, type

    help name

where name is the entry that you want to learn about.

General help topics:
-----
antenna_names
    A description of the format of telescope specifications.
editing
    General discussion of editing in difmap.
models
    An overview of how models are used in difmap.
multi_if
    An overview of multi-IF mapping.
polarization
    Overview of Difmap polarization mapping.
spectral_line
Press return to continue, Q [or command] to quit, or P to page.
#exit
Listing completed.
Exiting program
Log file difmap.log closed on Mon Sep 16 19:32:45 2019

```

Finally, add this line:

```
export PATH=/home/anything/.DIFMAP/difmap/uvf_difmap:$PATH
```

to ~/.zshrc file and source ~/.zshrc

3 Difmap: An Interactive Program for Synthesis Imaging, [link](#)

Difmap is a stand-alone program used by the radio-astronomy community to produce images from radio interferometers. It reads and writes the standard UV FITS file format produced by packages such as AIPS, and provides convenient ways to inspect, edit, and self-calibrate visibility data while incrementally building up a model of the sky. Some time will also be spent describing the general structure of Difmap, particularly how being contained within a single-process is exploited to achieve speed, portability, and a degree of interactivity that is hard to match in larger systems.

An integrated difference mapping environment in which all of the functionality of the Caltech VLBI package would be incorporated within a single program.

Three month the minimum quorum of commands needed to implement difference mapping, packaged under a scripting interface. The resulting program was called Difmap.

Difmap quickly spread throughout the VLBI community, and later, after Difmap had been upgraded to support multi-dimensional AIPS UV-FITS files, it became a popular alternative to more general packages, such as AIPS.

No significant development has taken place since the release of the FITS version of Difmap in April 1995, **owing to a reduction in NSF funding**. However, Difmap has retained a strong following and has required very little maintenance.

3.1 Interferometry in a Nutshell

The essential steps needed to construct an image from signals received by a radio interferometer are:

1. Point an array of telescopes at a radio source.
2. Measure the complex wavefronts that arrive at each telescope with radio receivers.
3. Insert artificial delays in the signal paths of each telescope so that the telescopes all appear to be at the same effective distance from the source.
4. Interfere signals from pairs of telescopes and record the resulting complex fringe visibilities as a function of time.
5. Note that the visibilities from a given pair of telescopes sample spatial frequencies on the sky in proportion to the projected separation of the telescopes. Also note that this separation changes as the Earth turns, so each pair of telescopes samples a locus of spatial frequencies as a function of time. This is called Earth rotation synthesis.
6. Use the observations of a bright source to calibrate the visibilities.
7. Interpolate the visibilities onto a 2-D spatial-frequency plane called the UV plane.
8. Calculate the FFT of the UV plane. The resulting image is called a dirty map, and constitutes an image of the source corrupted by the point-spread function of the interferometer.
9. Form a model of the source through CLEAN deconvolution of the dirty map, or by fitting a model to the visibilities.

10. Convolve the model by an elliptical Gaussian approximation of the point spread function of the interferometer, and add the result to the un-modeled residual noise in the dirty map. This is called a clean map.
11. Publish the map.

3.2 What Does Difmap Do?

3.2.1 Data Inspection and Editing

A significant fraction of Difmap is devoted to providing users with convenient tools for interactive data inspection and editing. A family of graphical commands displays observed and model visibilities from a variety of perspectives, and allows the user to flag or unflag visibilities directly with the mouse. Simple key-bindings are combined with mouse positioning to quickly navigate through telescopes, baselines, bands, and sub-arrays, to edit visibilities collectively or individually, to zoom in on parts of the data, and to perform many other command-specific operations. These facilities are important because:

- They allow users quickly to identify and excise corrupt data.
- They provide a direct comparison between the model and the data.
- They help to familiarize users with the peculiarities of their datasets.
- They provide beginners with visualization tools to learn how given visibility profiles produce given maps.
- They can be used to inspect dynamically changes made to the visibilities and the model during processing.

3.2.2 Difference Mapping

Difmap was named after a mapping technique called Difference Mapping.

Difmap was named after a mapping technique called **Difference Mapping**.

When a model of a source is subtracted from a dirty map, what remains is known as a difference or residual map. This is a key component in Difference Mapping.

The source model that is subtracted from the dirty map is built up in an iterative fashion, usually through **CLEAN** deconvolution of successive versions of the residual map. Alternatively a model can be fitted to the observed visibilities.

When CLEAN is used to build up the source model, each iteration of CLEAN not only adds a delta-function to the model, but also subtracts that delta-function and its PSF from the residual map. Thus CLEAN automatically keeps the residual map up to date with the

changes that it makes to the model.

Conversely, when model fitting is used to build up the model, or when a user edits either the visibilities or the model between successive iterations of CLEAN, then the residual map becomes out of date. When this happens, Difmap automatically re-calculates the residual map by taking the 2-D FFT of the difference between the observed and the model visibilities.

At this point, if visibilities were edited by the user, then the current model may retain minor features that were deconvolved from those visibilities. With the offending visibilities removed from the data, these artifacts only remain in the model, so when the model is subtracted from the data, the revised residual map contains an inverted version of the artifacts. Subsequent iterations of CLEAN thus erase them from the model. This typically involves both positive and negative CLEAN components.

The ability to transparently continue deconvolution after modifying the model or the observed visibilities highlights a fundamental difference between difference mapping and traditional techniques. The traditional approach would require the user to restart deconvolution from scratch, whereas the difference mapping approach encourages the user to edit or re-calibrate the data on-the-fly as ever weaker artifacts appear in successive versions of the residual map. It also enables users to incrementally add clean windows. This is especially useful when features that were initially obscured by the point spread functions of brighter features, are revealed in the residual map.

3.3 Difmap Architecture

3.3.1 The Observation Object

4 Difmap Cookbook, [link](#)

Using `ps2pdf cookbook.ps cookbook.pdf` command to convert ps file to pdf file.

If comes this error:

```
./base/gsicc_manage.c:1244: gsicc_open_search(): Could not find default_gray.icc
— ./base/gsicc_manage.c:2261: gsicc_init_iccmanager(): cannot find default icc profile
**** Unable to open the initial device, quitting. then follow this instruction,
```

Using following commands:

```
sudo rmdir /usr/share/ghostscript/9.26/iccprofiles
```

```
sudo apt-get install -reinstall libgs9-common
```

 Then ps file can be converted to pdf file using ps2pdf command.

cook_book.pdf 共36页。

5 A New Guide to DIFMAP, [link1](#), [link2](#)

DIFMAP is a powerful and expedient program for imaging multi-element arrays. Originally intended for use with continuum VLBI data, it serves just as well when being used on VLA data sets. DIFMAP uses the increasing amounts of RAM in modern computers to minimize time spent reloading data and regenerating models. This tutorial will walk you through the basic steps of using DIFMAP to clean and self-calibrate your data.

5.1 Starting DIFMAP

With DIFMAP installed, open a terminal and navigate to the directory in which your data resides. Because most of us use AIPS to perform the first round of data flagging/calibration, many people prefer to keep files in the `/home/aips/FITS/` directory for convenience as this is where AIPS reads in and produces files.

Once you have navigated to the proper directory type “difmap” at the command prompt. This will initiate DIFMAP and we can begin loading data.

It should be noted that for this tutorial we will be using C Band C Array data for source J1036+1326. This is from Project AT0205, Seg A, source TEX1033+137, taken on 7/20/97 with 370 seconds TOS.

5.2 Downloading data from NARO

So first I need to download the data used in this tutorial. TEX1033+ at 4.860GHz in — 1997 Jul 20, VLA data

So, first I find the [VLA data archive](#), and then this website: [NRAO Science Data Archive : Advanced Search Tool](#)

So first fill information I know currently like following image

NRAO Science Data Archive : Advanced Search Tool

Historical VLA, Jansky VLA, VLBA and GBT Data Products

Output Control Parameters :

Choose Query Return Type :

- ☒ Download Archive Data Files
- ☐ VLA Observations Summary
- ☐ List of Observation Scans
- ☐ List of Projects

[Output Tbl Format](#)

[Max Output Tbl Rows](#)

[Sort Order Column 1](#)

[Sort Order Column 2](#)

General Search Parameters :

[Telescopes](#)
☒ All
 ☐ Jansky VLA
 ☐ Historical VLA
 ☐ VLBA
 ☐ GBT

[Project Code](#)

GBT: AGBT12A_055
JVLA: 12A-256

[Project Session](#)

[Dates From](#)

[Observer Name](#)

[Archive File ID](#)

(partial strings allowed)

[To](#)

(2010-06-21 14:20:30)

and click the **Submit** button, I get a list of results, and using searching function of the web browser, I can find two files:

| File Name | Access | Project | Session | Start Time | End Time | Size | Format | Compression | Transfer | Status | Actions |
|---|--------|---------|---------|--------------------|--------------------|---------|--------|-------------|----------|--------|---|
| VLA/J102156.4+300140/4.89F27CC_AT205_1997JUL20_1.uvfits | public | AT0205 | A | 97-Jul-20 00:00:00 | 97-Jul-21 00:00:00 | 12.53MB | VLA-x0 | C | FITS/IPS | cal | OK Scans Logs |
| VLA/J102230.2+304104/4.89F27CC_AT205_1997JUL20_1.uvfits | public | AT0205 | A | 97-Jul-20 00:00:00 | 97-Jul-21 00:00:00 | 13.42MB | VLA-x0 | L | FITS/IPS | cal | OK Scans Logs |
| VLA/J103626.8+132652/4.89F27CC_AT205_1997JUL20_1.uvfits | public | AT0205 | A | 97-Jul-20 00:00:00 | 97-Jul-21 00:00:00 | 13.17MB | VLA-x0 | C | FITS/IPS | cal | OK Scans Logs |

Choose both files, fill in my email and do some choices finally click **Get My Data** button, then I get this page:

NRAO Archive - Data Delivery Options

There are now two ways to deliver your archival NRAO data :

- by direct ftp as in the past
- or if your data set is very large, it may be shipped to you on a hard disk

You have selected (checked) these file sets for retrieval :

| Archive File | Status | File Type | File Size |
|---|--------|-----------|-----------|
| VLA/J103626.8+132652/1.45F27CC_AT205_1997JUL20_1.uvfits | public | MS | 15.0304MB |
| VLA/J103626.8+132652/4.89F27CC_AT205_1997JUL20_1.uvfits | public | MS | 14.7504MB |

Total file set size selected = 0.0297808 GBytes

| Estimated Download Time | Network Transfer Rate |
|-------------------------|---|
| 1.2 hours | Transfer rate 56Kb/sec - Dial up modem |
| 0.1 hours | Transfer rate 1Mb/sec - low to mid-level broadband |
| 0.0 hours | Transfer rate 10Mb/sec - high-level broadband |
| 0.0 hours | Transfer rate 100Mb/sec - very high-level broadband |

You have selected public domain data for downloading. Public domain data is eligible for hard disk shipping, but you must pay for the hard disk and the shipping costs.

Retrieve over internet

If you choose to download your data to the archive ftp area or a local destination in the DSOC (AOC), hit this button. This is the same data retrieval option that has been used in the past. You may then download your data directly over the internet.

Send on Hard Disks

If you choose to have your data shipped to you on a hard disk, the full policy and instructions for data shipment can be accessed here : [data shipping](#).

I choose **Retrieve Over Internet**:

NRAO Data Archive - data download report

CGI program e2ftp.cgi version : 2.12.16

You submitted the following name/value pairs :

- EMAILADDR = krk18@mails.tsinghua.edu.cn
- COPYFILEROOT = /home/e2earchive
- TIMEAVG = 0s
- SPECTAVG = x1
- CONVERT2FORMAT = MS
- FLAGGING = FLAG
- SCANS = ALL
- CASA_HOST = aocngas-master.aoc.nrao.edu

Successfully test pinged your output directory. The archive download process has write permission there. Proceeding with downloads.

The download processes have been spawned. Your files should appear in the directory that you specified.

An email will be sent to : krk18@mails.tsinghua.edu.cn notifying you of the success or failure of the data transfer.

Public Domain Data :

The public domain files you selected are being written into the public ftp area (/e2earchive) at the NRAO AOC in Socorro, NM.

Your data files will be automatically deleted after two days.

The public ftp area may be accessed by anonymous ftp : <ftp://ftp.aoc.nrao.edu/e2earchive>

Before you attempt to download your data files, **wait for the arrival of an email notifying you when the copy process is complete.**

copy public project data : AT205 from this archive file : /home/archive_surveys/pipeline/position/J103626.8+132652/1.45F27CC_AT205_1997JUL20_1.uvfits
to this output file 4 x: /home/e2earchive/1.45F27CC_AT205_1997JUL20_1.uvfits

copy public project data : AT205 from this archive file : /home/archive_surveys/pipeline/position/J103626.8+132652/4.89F27CC_AT205_1997JUL20_1.uvfits
to this output file 4 x: /home/e2earchive/4.89F27CC_AT205_1997JUL20_1.uvfits

Then I received an email from NARO:

Archive Data Copied

发件人: NRAO Arc... <archmgr@nrao.edu>

时 间: 2019年09月16日 21:48:06 (星期一)

收件人: krk18@mails.tsinghua.edu.cn

Data download results from the NRAO Data Archive System

If you directed your public file downloads to the default ftp directory, /home/ftp/e2earchive, you may log into the ftp server at the AOC in New Mexico. Connect to the ftp server [ftp.aoc.nrao.edu](ftp://ftp.aoc.nrao.edu), this is an anonymous/guest account. After you login to the ftp area, change the default directory to /pub/e2earchive. You should find your files there. The file names are in this email.

Files in the ftp area are automatically deleted after 2 days.

The VLA data files are provided in the VLA Export format, and are read into AIPS using the task FILLM. If you have an old version of AIPS (older than 7APR2003) you will need to upgrade your AIPS to be able to read the data correctly.

Upgrades can be obtained at the AIPS Home Page : <http://www.nrao.edu/aips>

Public File available : ftp://ftp.aoc.nrao.edu/e2earchive/1.45F27CC_AT205_1997JUL20_1.uvfits

Public File available : ftp://ftp.aoc.nrao.edu/e2earchive/4.89F27CC_AT205_1997JUL20_1.uvfits

/bin/cp: cannot create regular file `/home/e2earchive/1.45F27CC_AT205_1997JUL20_1.uvfits': File exists

I use `lftp` command to access the data:

`lftp ftp://ftp.aoc.nrao.edu/e2earchive/`

There are lots of data files, which implies many people are accessing data from NARO!
After following operation I finally download the data:

```
lftp ftp.aoc.nrao.edu:/e2earchive> lcd .  
lcd ok, local cwd=/home/anything/THU/astro/astro_books/radio_astronomy/Softwares/difmap/data/J1036  
lftp ftp.aoc.nrao.edu:/e2earchive> get 1.45F27CC_AT205_1997JUL20_1.uvfits  
13720320 bytes transferred in 17 seconds (772.0 KiB/s)  
lftp ftp.aoc.nrao.edu:/e2earchive> get 4.89F27CC_AT205_1997JUL20_1.uvfits  
13461120 bytes transferred in 19 seconds (679.9 KiB/s)  
lftp ftp.aoc.nrao.edu:/e2earchive> exit  
  
# anything @ anything-China in ~/THU/astro/astro_books/radio_astronomy/Softwares/difmap/data/J1036 [22:01:38]  
$ ls  
1.45F27CC_AT205_1997JUL20_1.uvfits  4.89F27CC_AT205_1997JUL20_1.uvfits
```

5.3 Loading Data

Get Error:

```
$ difmap  
Caltech difference mapping program - version 2.5e (30 May 2019)  
Copyright (c) 1993-2019 California Institute of Technology. All Rights Reserved.  
Type 'help difmap' to list difference mapping commands and help topics.  
Started logfile: difmap.log_1 on Mon Sep 16 22:14:36 2019  
0>observe 1.45F27CC_AT205_1997JUL20_1.uvfits  
Reading UV FITS file: 1.45F27CC_AT205_1997JUL20_1.uvfits  
get_fits: Error: Primary header does not contain random-groups.  
Error occured in command: observe  
  
0>□
```

Maybe I need go to AIPS to export the correct data?