

**Someday this could be
The AO User's Guide
But now it's just
Tony's notes.**

2. Taking and Reducing Primary Interaction Matrix data (PR_IMAT)

The primary interaction matrix records the signal values (sensor), while we individually exercise primary.out (actuators). Here are some notes on collecting the primary imat data, and how you can calculate the inverse matrix.

2.1 Collecting PR IMAT Data. – The basic steps to collect the PR IMAT data are:

1. Select the IMAT Notebook tab on the XUI.
2. Set Lp.State to IDLE
3. Check parameter – Set all the imat.* parameters. Probably helpful if you had a macro to do this.
4. Select the Lp.State to Pr.Imat.
5. You can monitor progress in the status area. Wait until the IMAT is done.
6. Enter the path and root name of by the Imat.Save button. I suggest /home/ao/data/imat/YYMMDD as the directory. Note that /home/ao is the same on aoic, aoui, and IRTF suns. Hit the Imat.Save button to save you data.
7. 3 files are created during Imat.Save (using 'p01' as my rootname):
 - p01.imat.fits – fits files of IMAT array
 - p01.imat.txt – Text file of IMAT array.
 - p01.info.txt – Text file listing the parameter used during the IMAT state.

2.2 Determining the Inverse Matrix

If you need to fix up the data (because of a bad channel or something), I do something like:

```
nedit imat.txt - edit text file.  
text2fits -o imat.fits imat.txt 36 36 - use text2fits to convert imat.txt to a fits files.
```

2.3 Determining the Inverse Matrix

1. Login to aoui (or a IRTF workstation) as the user 'ao'.
2. Change to your imat data directory: cd data/imat/yymmdd
3. Run the IDL imat2inv procedure using the FITS file as input:

```
> idl  
IDL> imat2inv, "imat.fits"
```

By default, a condition number to screen 1/w value is defaulted to 1e-2. You can enter this optional Parameter. Ie: imat2inv, "imat.fits", 0.02
This should produce the following:

U.fits, V.fits, W.fits – These are the output produces of the singular value decomposition (SVD) procedure as FITS.

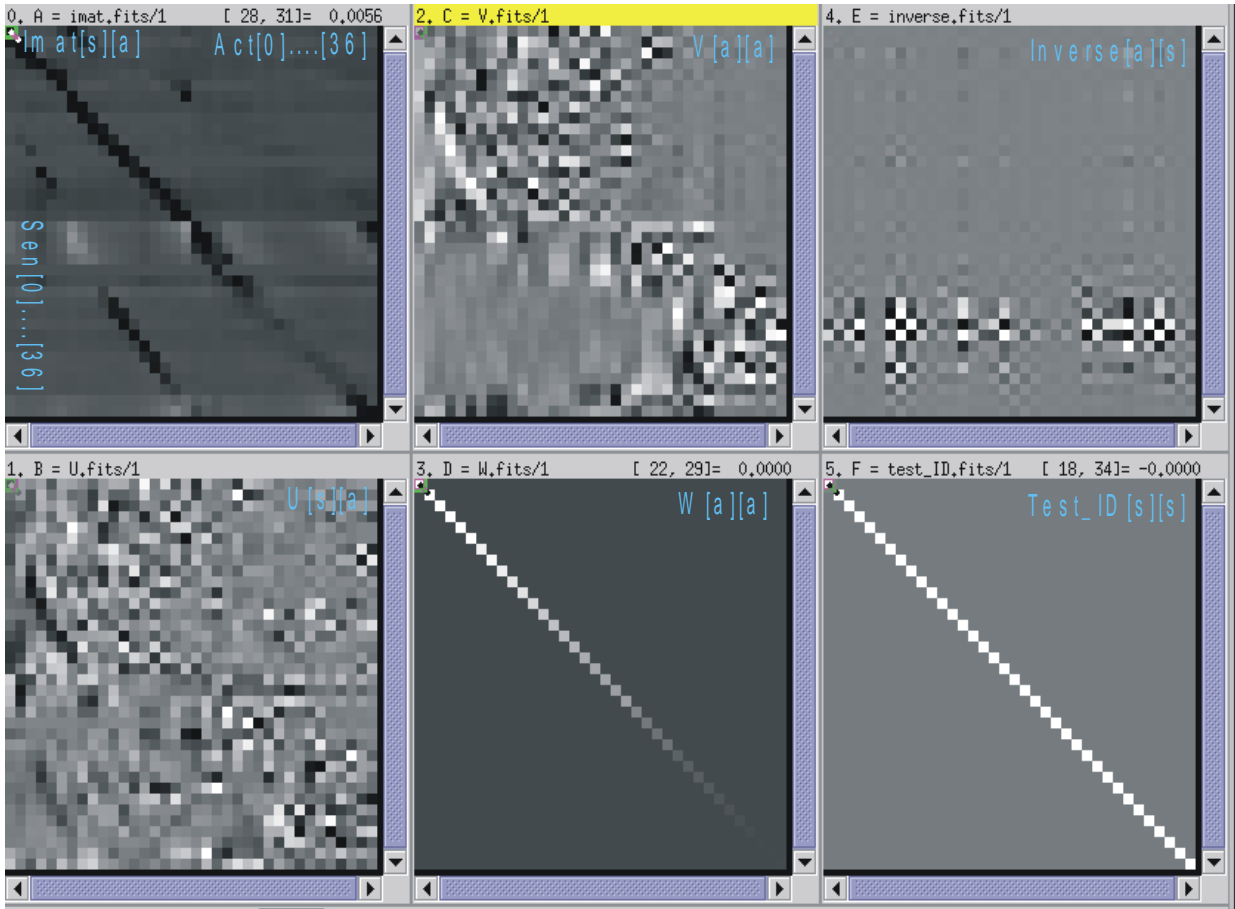
inverse.fits – The inverse matrix as FITS.

testID.fits – The produce of imat * inverse. This should be the Identity matrix in FITS.

2.4 Viewing the data in DV

Start DV in medium mode: dv -m
Use the path command or open dialog box to make your data directory the default data path.
Run the *read_imat_image.m* macro.

Here is an example of what you should see in DV:



Note the Matrix notation of $M[r][c]$, or $M[y][x]$

2.6 Using the IMAT

1. Use the Pr.Inverse.File command to read in the primary imat, ie: Pr.Inverse.File /path/filename.txt
2. The latest default primary imat is stored in: /home/ao/data/imat/default/inverse.txt.

3. Taking and Reducing Tip-Tilt Interaction Matrix Data (TT_IMAT)

The tip-tilt interaction matrix records the signal values (primary.out), while we individually exercise tt.out (actuators). Here are some notes on collecting the tt_imat data, and how you can calculate the inverse matrix.

3.1 Collecting TT IMAT Data. – The basic steps to collect the TT IMAT data are:

1. Start the Feedback loop.
2. Select the IMAT Notebook tab on the XUI.
3. Check parameter – Set all the tt_imat.* parameters. Probably helpful if you had a macro to do this.
4. Select the Lp.State to TT.Imat.
5. You can monitor progress in the status area. Wait until the IMAT is done.
6. Enter the path and root name of by the TT.Imat.Save button. I suggest /home/ao/data/tt_imat/YMMMDD as the directory. Note that /home/ao is the same on aoic, aoui, and IRTF suns. Hit the TT.Imat.Save button to save you data.
7. 3 files are created during TT.Imat.Save (using ‘tt01’ as my rootname):
 - tt01.imat.fits – fits files of IMAT array
 - tt01.imat.txt – Text file of IMAT array.
 - tt01.info.txt – Text file listing the parameter used during the IMAT state.

3.2 Determining the Inverse Matrix

If you need to fix up the data (because of a bad channel or something), I do something like:

```
nedit imat.txt - edit text file.  
text2fits -o imat.fits imat.txt 3 36 - use text2fits to convert imat.txt to a fits files.
```

3.3 Determining the Inverse Matrix

1. Login to aoui (or a IRTF workstation) as the user ‘ao’.
2. Change to your imat data directory: cd data/tt_imat/yymmdd
3. Run the IDL imat2inv procedure using the FITS file as input:

```
> idl  
IDL> imat2inv, “imat.fits”
```

By default, a condition number to screen 1/w value is defaulted to 1e-2. You can enter this optional Parameter. Ie: imat2inv, “imat.fits”, 0.02
This should produce the following:

U.fits, V.fits, W.fits – These are the output produces of the singular value decomposition (SVD) procedure as FITS.

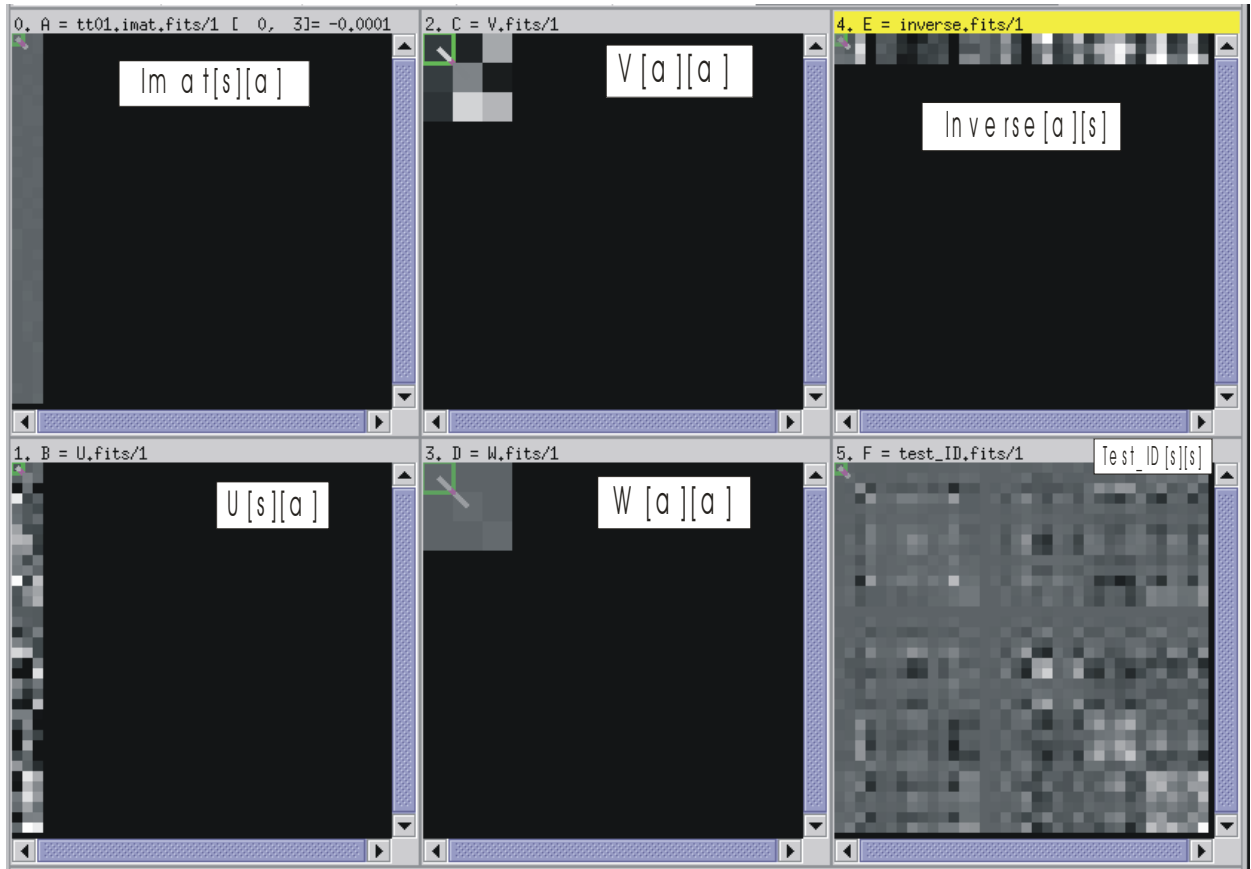
inverse.fits – The inverse matrix as FITS.

testID.fits – The produce of imat * inverse. This should be the Identity matrix in FITS.

3.4 Viewing the data in DV

Start DV in medium mode: dv -m
Use the path command or open dialog box to make your data directory the default data path.
Run the *read_imat_image.m* macro.

Here is an example of what you should see in DV:



3.5 Using the IMAT

3. Use the TT.Inverse.File command to read in the tipilt imat, ie: TT.Inverse.File /path/filename.txt
4. The latest default primary tt_imat is stored in: /home/ao/data/tt_imat/default/inverse.txt.

4. Using AO Data Capture

While the RT loop is in operation, you can capture data values into a buffer. Then save this data as a FITS file. This is called Capture.

The procedure to capture data is:

1. Start the loop

2. Enable Capture

On the Eng Tab, Press Capture.Enable to start the capture. After the capture is done (Label said 'off'), You can save the data.

Saving the data. To save the data, use the edit the text box to name the file to be saved, and press the *capture.save* button.

Data Format. Data is saved as a fits file. The file dimension are:

```
NAXIS = 3
NAXIS1 = 36 / Number of Sensors
NAXIS2 = 4 / PhaseA, PhaseB, Primary_out, tt_out
NAXIS3 = 30000 / Number of samples
```

3. Capture Data Graph. There are some IDL procedures to graph your captured data. To run graphic programs:

- 3.1 Login to an IRTF workstation as AO
- 3.2 Change to the data directory: `cd data/capture`
- 3.3 Run IDL: `idl`
- 3.4 Run the graphing routines, for example:

```
IDL> c_ac, "mydata.txt"
IDL> c_ch_graph, "mydata.txt", ch=0
```

4. List of IDL capture programs?

<code>c_ac, 'filename'</code>	plots AC (phaseA – PhaseB) for all sensors.
<code>c_phasea, 'filename'</code>	plots all PhaseA data, 1 plot per sensor.
<code>c_phaseb, 'filename'</code>	plots all PhaseB data, 1 plot per sensor.
<code>c_plot_all, 'filename'</code>	plots PhaseA, PhaseB, prout, and AC (phaseA-PhaseB) for each output. Hit <RETURN> to page to a new sensor plot.
<code>c_prflat, 'filename'</code>	produces a FITS fits called <code>prflat.fits</code> with consist of the mean values from the <code>pr_out</code> capture data. The min, max, and mean <code>primary_out</code> values are graphed.
<code>c_ttout, 'filename'</code>	plots all <code>tt_out</code> data, 1 plot per sensor.

5. Idle.A – Idle Algorithms for AO Engineering

The Idle.a command allows you to exercise the hardware in IDLE mode.

1. **Idle.A off** – Turns off any idle algorithm.
2. **Idle.A cap2prout** – You can exercise the DM using capture data in this mode, but outputting the data from capture.pr_out[] to pr_out[].

a. Load data in the computer buffer on aort

```
> login aort -l ao
aort> cd /home/ao/current/util
aort> fits2capture /home/ao/data/fits2capture/dm_dr0_40-x3.fits
```

Note, the fits file should have the following format

```
SIMPLE = T /
BITPIX = -32 /
NAXIS = 2 /
NAXIS1 = 36 /
NAXIS2 = 30000 /
END
```

- b. Turn on mode
To Start: Idle.a cap2prout
To Stop: Idle.a off

3.