The VLA Pipeline and VLA Pipeline System

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The *VLA Pipeline* is a data pipeline that operates within AIPS. The pipeline automates flagging, calibration, imaging, and self-calibration of some types of VLA data.

A *superset* of the VLA Pipeline, called the *VLA Pipeline System*, extends the automated functionality of the pipeline to include:

- communication with and data downloading from the VLA raw data archive,
- loading raw data files into AIPS (filling),
- preparing VLA Pipeline parameters for each data set,
- automatic execution of the VLA Pipeline,
- image preparation for archiving,
- and archiving of images, calibrated data, diagnostic plots, execution scripts, and log files.

The AIPS Pipeline

The *VLA Pipeline* is an AIPS procedure, called VLARUN, now included in the standard AIPS distribution. The procedure was written by Lorant Sjouwerman and made public in 2003. The VLA Pipeline performs calibration, editing, and imaging on VLA continuum and spectral line data. It does not calibrate or image polarization data or moving targets (for example, solar system objects).

The pipeline system, described below, uses a modified version of VLARUN, called AVLAPIPE. AVLAPIPE is not distributed with AIPS, but is available from the NVAS web page[1]. However, here I will ignore the minor differences between these two procedures and refer to VLARUN as the VLA Pipeline.

The pipeline is documented in greater detail in AIPS Memo 112, also by Lorant (see URL below).

Operating the Pipeline

VLARUN is operated in similar fashion to an AIPS task. There are 26 parameters whose values may be set by the user. (For an exhaustive list, see AIPS Memo 112.) These parameters tell VLARUN what data to work on, and

[1] `http://www.aoc.nrao.edu/~vlbacald`

what operations to perform. Suggested parameter values for a user new to the pipeline are provided in AIPS Memo 112.

The degree of automation of the pipeline is variable. There are 3 parameters that affect the interactive features.

- DOIMAGES allows the user to select calibration And imaging or only calibration.
- SLFCAL allows for interactive self-calibration.
- NOPAUSE introduces pauses in the pipeline to allow the user to check calibration of secondary calibrators.

All other parameters affect what VLARUN does, but not the interactive nature of the procedure.

Demo: VLA Pipeline

1. Show the contents of the AIPS catalog. There should be only the raw data files.
2. Show the inputs to VLARUN, and point out the interactive parameters.
3. Execute VLARUN, if it doesn't take too long!
4. Show the output image and diagnostic plots.

The Pipeline System

The "Pipeline System" extends the automated functionality of the AIPS Pipeline, and allows for fully automated data reduction. The system consists of Perl and C-shell scripts and AIPS run files that are invoked either by the user or by the cron demon. The system has been designed specifically to generate the NRAO VLA Archive Survey.

The pipeline system divides into 4 stages:

1. Data acquisition,
2. Data processing (the VLA Pipeline),
3. Image finalization and export to the image archive,
4. Image validation via web interface.

Now I will elaborate on each of these 4 stages.

Stage 1. Data Acquisition

The data acquisition stage involves several steps.

1. The raw data archive is queried for data files on a specified day.
2. Data files are selected and downloaded to the local machine.

3. The data are loaded into AIPS.
4. AIPS data are prepared for subsequent calibration and imaging.
5. C-shell scripts are generated which will invoke AIPS and VLARUN. These scripts are executed in Stage 2 by the cron demon.

Stage 2. Data Processing

After waiting for a "safety" period, during which the user could edit or remove the files generated in Stage 1, the cron demon executes the C-shell script waiting to be processed. The script invokes AIPS and starts the AIPS Pipeline described above.

Stage 3. Image Finalization and Export

Prepare the image and other output data products for archiving.

1. Correct for circular primary beam
2. Crop the image at some distance from the phase center
3. Export all files from AIPS, providing standardized names.
4. Copy all files to the output data archive.

4. Image Validation

This part of the pipeline process is different from the three above in that it is necessarily interactive. Here the user must decide whether or not the output data is acceptable. The pipeline system uses a web interface to allow the user to view images and diagnostic plots (Visibility amplitude vs. uv-distance, Real vs. Imaginary visibilities, and uv coverage) quickly, and to flag for removal any data that is not of sufficient quality.

Demo: Pipeline System

1. Query the archive.
2. Load one project group with ArchPreps
3. Show the .run file generated by ArchPreps
4. Manually execute Arch_Runs. (optional: don't necessarily wait to finish)
5. Show the data in validation web tool.
    a. To show the data I just ran, I may need to manually run the export script.
    b. Or, I could process the data on the previous day,
    c. Or, I could just show some other data, and not worry about getting the same data.

References

Capabilities of the VLA pipeline in AIPS, AIPS Memo 112, L. Sjouwerman, Mar 2007. http://www.aips.nrao.edu/aipsmemo.html

VLA Archive Imaging Pilot, L. Sjouwerman, Feb 2007. http://www.aoc.nrao.edu/~vlbacald/

NRAO VLA Archive Survey Pipeline System Users Manual, J. Crossley, Nov 2007. http://www.aoc.nrao.edu/~jcrossle/