6. Configuring Radar TASKS

A radar TASK is a set of operating parameters for the radar antenna, transmitter, receiver and signal processing systems. The TASK Configuration menu allows you to create or modify radar TASKS. After configuring and saving a TASK, you use the TASK Scheduler menu to execute the TASK (see Chapter 7). The data acquired during the TASK are stored on disk as ingest files, which serve as the data base for subsequent product generation. Examples of TASKS include:

- A surveillance PPI scan at a single elevation angle.
- A complete volume scan at multiple elevation angles.
- A PPI sector scan at either single or multiple elevation angles.
- An RHI scan at either single or multiple azimuth angles.

In all cases, the TASK Configuration menu allows you to specify the antenna scanning, as well as other radar parameters, such as pulse width, PRF, number of samples to average and the type of data to process (Z, V, or W).

Hint: Appendix B provides suggested TASK configurations to start from.

To enter the TASK Configuration menu:

Choose **Menus–>Task Configuration** from the IRIS menu bar or from any of the IRIS menus. You can also enter the TASK Configuration menu from the TASK Scheduler. Position the mouse cursor over a TASK name or ID, and choose **–>Edit** from the pop-up menu.

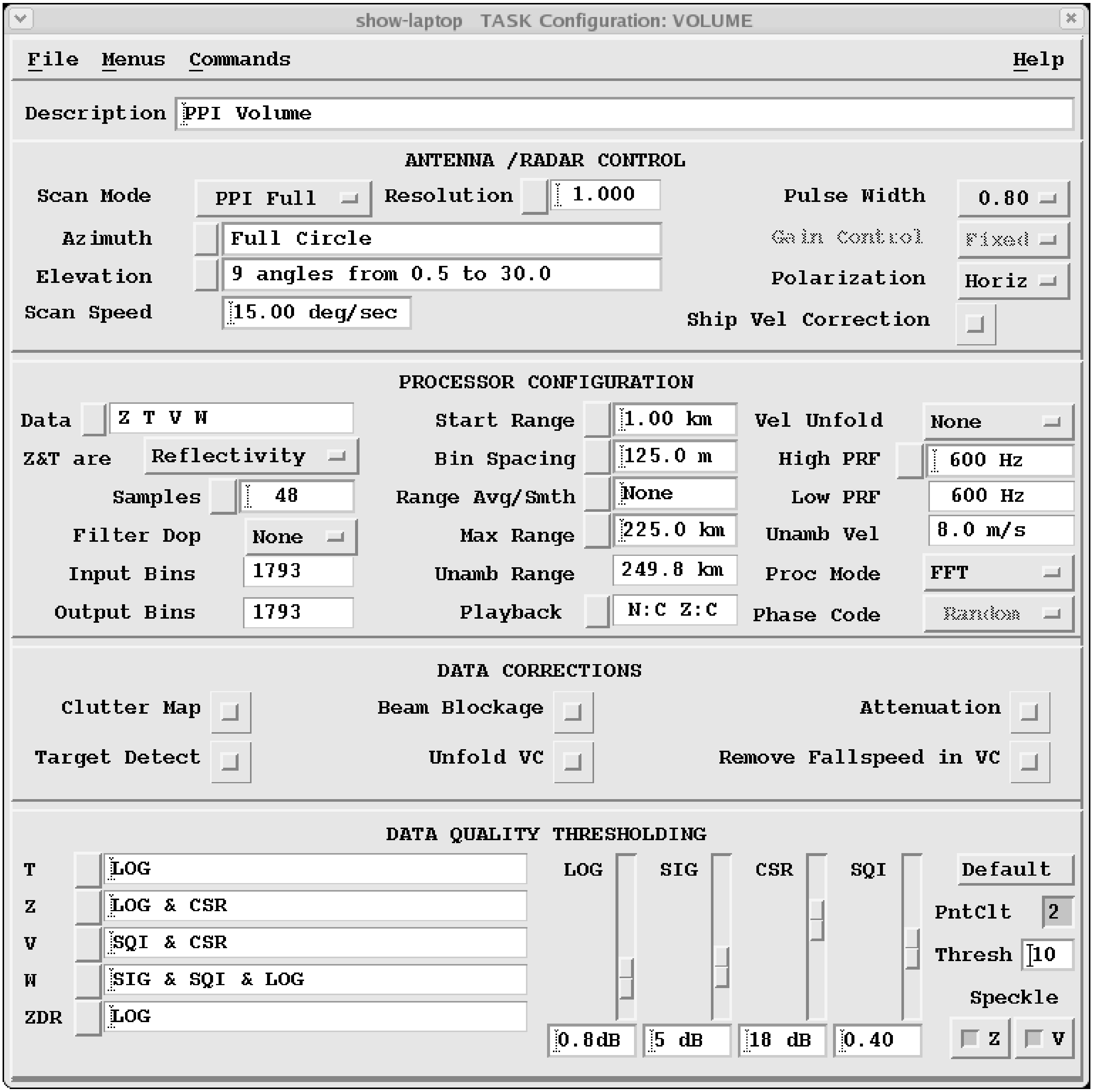
The TASK Configuration menu may be accessed by any user. Because it does not control any real time processes until a TASK is scheduled, more than one copy of a TASK can be in use at any time. The only constraints are:

- If a TASK is scheduled, it cannot be modified.
- Only one user can edit a particular TASK at a time.

These constraints prevent possible conflicts among users.

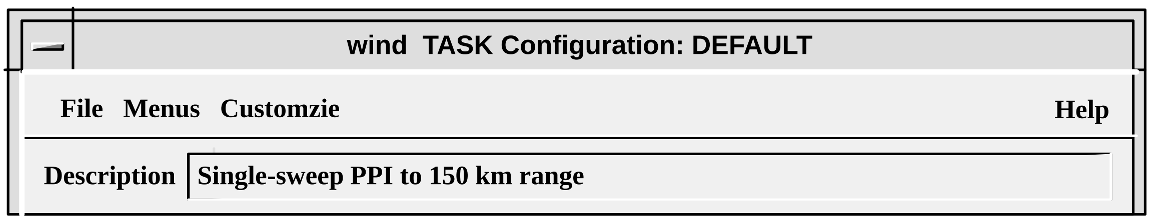
In this chapter:

6.1 TASK Configuration Menu



Antenna/Radar Control Section 6.1.2	Sets up radar and antenna operations.
Processor Configuration Section 6.1.3	Sets up the output data, ranges and averaging used by the signal processor.
Data Correction Section 4.1.4.	Determines corrections made fro output data.
Data Quality Thresholding Section 4.1.5	Sets up the threshold levels and criteria for real time data quality control.

6.1.1 TASK Names and Descriptions



TASK names make it easy to save and load configurations. You give the TASK its name when you save the TASK configuration. The TASK name is used extensively by IRIS, so it is a good idea to select a name that summarizes the task. For example:

PPI_VOL	Denotes a volume scan.
RHI_230	Denotes an RHI at azimuth 230.
SURV_500	Denotes a 500 km surveillance scan.
PPI_A	The first SUBTASK of a hybrid TASK (see below).

Up to 12 characters may be used for a TASK name. Because these names are also used to name the disk files that store the TASK configurations, no spaces are allowed. In the examples above, the underscore character is used instead of a space.

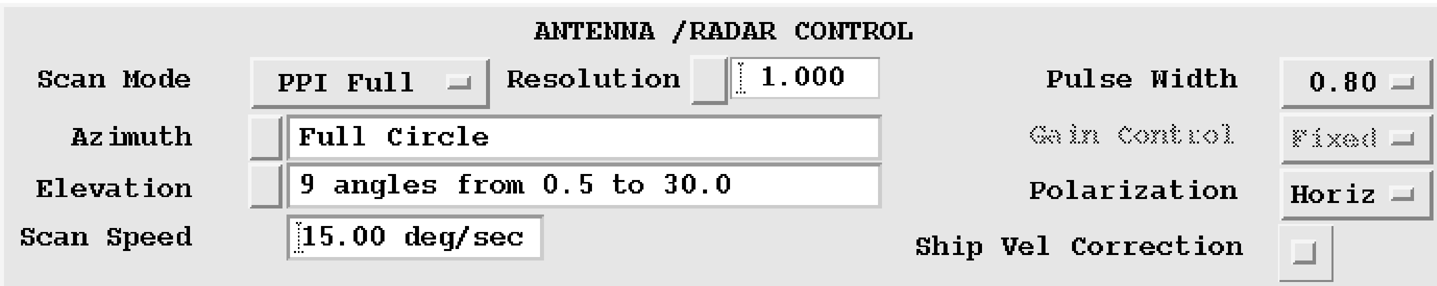
i

Helpful Hint: While not required, it is convenient to use the text “RHI” when naming an RHI TASK. This makes it easier to associate the RHI TASKS with the RHI products during product configuration.

The TASK Scheduler supports hybrid TASKS, which are made up of up to three SUBTASKS. The TASK configuration file names for these must end in _A, _B and _C to denote the first, second and third SUBTASKS. See Chapter 7 for information on scheduling hybrid TASKS.

The TASK description is a brief (less than 65 character) text description of the task. It is displayed as the first field in the TASK Configuration menu. You can enter any text into this field.

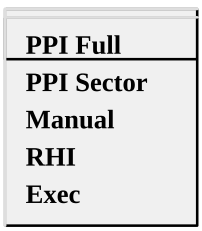
6.1.2 Antenna/Radar Control



The Antenna/Radar Control area of the menu sets up radar and antenna operations. From this portion of the menu, you control the TASKS and products that run.

Scan Mode

The Scan Mode button lets you choose one of the following modes:



PPI Full — The antenna scans continuously in azimuth without stopping during the TASK.

PPI Sector — The antenna starts and stops at azimuth boundaries that you specify.

Manual — You control the antenna while the real time display shows live weather updates.

RHI — The antenna scans in elevation at a specified azimuth.

Exec — Execute any shell command, see section 6.3.

For PPI scans, IRIS holds the elevation constant and scans in azimuth. For RHI scans, IRIS holds the azimuth constant and scans in elevation between specified limits.

Manual scans are used for interactive real time applications, observation of tornado or microburst signatures.

Azimuth and Elevation

For the PPI Sector and RHI scans, it is necessary to specify start and stop limits for the swept antenna coordinate, and a list of discrete angles for the unswept coordinate. There is a duality between the PPI and RHI scans in that the lists and limits that apply in one case can be carried over to the other case by reversing the roles of azimuth and elevation.

To set up the antenna azimuth limits for a PPI Sector scan, the start and stop angles are entered by positioning the cursor on Azimuth field and typing the desired limits to the nearest whole or 1/10 degree. The sector is defined to be in the clockwise direction from the first limit to the second limit. For example:

Azimuth	90.0	270	Scans the southern half of the radar circle.
Azimuth	270.0	90.0	Scans the northern half of the radar circle.

For PPI Full scans, the Azimuth field shows “Full Circle.”

For both Full and PPI Sector scans, you must enter the list of elevation angles to be used on successive sweeps. Click on the Elevation button to pop up a window containing up to 40 elevation angles. When you finish editing them, click first on the Apply button, then on the Exit button. (The Clear button erases the list of angles, if you want to start over.) After editing is complete, the menu entry shows the number of tilt angles that were specified and the minimum and maximum angles.

When a PPI Sector scan runs, the antenna scans back and fourth between the azimuth limits at a rate that achieves the requested azimuthal resolution between each processed ray. The first sweep of the scan is performed using the first elevation angle from the elevation list; the second sweep using the second angle, and so on. For PPI Full, the antenna scanning is continuous in azimuth.

For RHI scans, the set-up procedure is similar to the PPI Sector case, except that the start and stop limits are entered in the Elevation field, and the angle list is entered in the Azimuth field. Note that the elevation limits for RHI scans are constrained by the limits specified in the **setup** utility. (See the *IRIS Utilities Manual.)*

For manual scans, the Elevation and Azimuth fields show “NA.” These fields are not applicable because the antenna is controlled interactively.

Resolution

The resolution is the required spacing between successive data rays in the scanned direction. For PPI’s, specifying 1.0 degree resolution means that for every degree of azimuth there is a new set of samples of, for example, the reflectivity at all ranges.

You can choose a resolution from a pop-up menu or enter the value directly into the field. For PPI’s, the range is limit to between 0.352 and 2.000. For RHI scans, IRIS picks and displays the closest choice among 0.2, 0.4, 0.6, and 0.8. For manual scans, IRIS picks and displays the closest choice among 90, 180, 270, and 360, either continuous or non-continuous.

During PPI scanning, the antenna and signal processing are coordinated so that data are collected at the specified resolution interval. Sampling is the nearest N*(Resolution) starting with 0 degrees. For example, if the resolution is 1.0, then rays of data are collected at 0, 1, 2, ... degrees. The PPI antenna scan rate is adjusted automatically to scan as rapidly as possible to achieve the requested resolution. (Look at the Radar Status menu for a display of the scan rate that is actually achieved.)

The Resolution field has a somewhat different meaning for RHI scans, because the elevation angular velocity used for the scan is not constant. A fixed velocity would result in too much time being spent at high elevation angles where only the initial 20 km (or so) of the ray contains useful data. Likewise, too little height resolution would be obtained for low elevation angles and far ranges.

To compensate for these effects, the elevation velocity for RHI scans is a function of the elevation angle itself — the velocity increases as the angle increases. The resolution you select represents the desired angular ray spacing at zero degrees elevation. This generally corresponds to a small elevation velocity near zero degrees, but by the time the antenna reaches its zenith the elevation velocity is approximately ten times greater. The RHI velocity algorithm attempts to maintain constant distance spacing along the maximum range and height boundaries of the scan. This tends to produce a properly filled color display presentation of the data.

If you plan to use manual scanning at your site, configure a scan so that it is ready when the situation arises. Specify the number of rays of data that you want stored (up to 1024 angles or rays) and how long IRIS should continue to collect data, as follows:

Continuous The manual scan continues indefinitely until it is halted manually in the TASK Scheduler. New rays overwrite the old ones on disk such that the maximum number of rays is fixed at the requested number.

Non-Continuous The manual scan stops automatically after the prescribed number of rays has been collected.

In most cases, you probably want to use the continuous data collection option so that the TASK does not stop in the middle of your observation. For more information on running manual scans, see Section 7.5.

Scan Speed

The scan speed of the antenna can be automatically computed by IRIS to match the sampling to the requested resolution, or the user can specify the scan speed. The selections are as follows:

Auto Recommended for RHI scans. Enter the text Auto or 0 to have IRIS automatically match the scan speed to the requested resolution.

Numerical value degrees/sec Enter the scan speed in degrees per second. Note that 6 deg/sec is 1 RPM, 12 deg/sec is 2 RPM, etc.

When testing a Task, use the Radar Status Menu to observe the actual scan rate. If you are in the Auto mode and the scan rate is not exactly what you want you can tune the scan rate by changing the various fields in the radar status menu and then retesting. To increase the scan rate in Auto mode you can do any of the following:

- Increase the PRF
- Decrease the number of Samples
- Decrease the scan Resolution

For additional fine tuning of the scan rate you can adjust the AZ and EL Scan Speed Multipliers. Refer to the setup/ingest utility in the *IRIS Utilities Manual*.

Pulse Width

Some systems support multiple pulse widths. The desired pulse width can be selected from a menu or entered directly into the field in microseconds (for example 1.0 microseconds). IRIS picks the closest available value. Typical systems support one or more of 0.50, 1.00, 2.00, and 6.00 (in microseconds).

The PRF is automatically reduced to the maximum permissible value if the new choice exceeds the duty cycle limit of the transmitter.

Gain Control

This field selects the type of gain control used to adjust the gain of the linear (Doppler) channel receiver. It is accessible for Doppler systems only. The choices in the pop-up menu are only available for the RVP6 processor. The RVP7 does not require gain control.

The choices are:

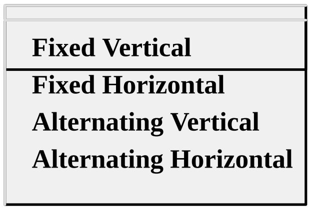
- **AGC —** Automatic gain control dynamically adjusts each sampling period (over the specified number of pulses) to match the receiver gain with the measured reflectivity vs. range.
- **STC —** A $1/R^2$ gain vs. range profile. This works to attenuate strong clutter targets at close range.
- **Fixed —** You specify the attenuation in dB. A new field appears to the right of the Gain Control field. Position the cursor at this field and enter the desired attenuation in dB (sign is ignored).

The optimal choice is the AGC approach because AGC adjusts the receiver gain at each range for the echo that is actually measured.

Fixed @00.0 is typically used if the radar is configured with IF limiting. Otherwise, STC should be used to reduce the effects of strong clutter at close range. Note that with STC, the gain is typically set to full after the first 50 km. (See also the **stcwave** utility in the *IRIS Utilities Manual*.)

Polarization

This field is accessible for systems that have a polarization switch and the ZDR Option Package software and hardware. Polarization is chosen from a pop-up menu.



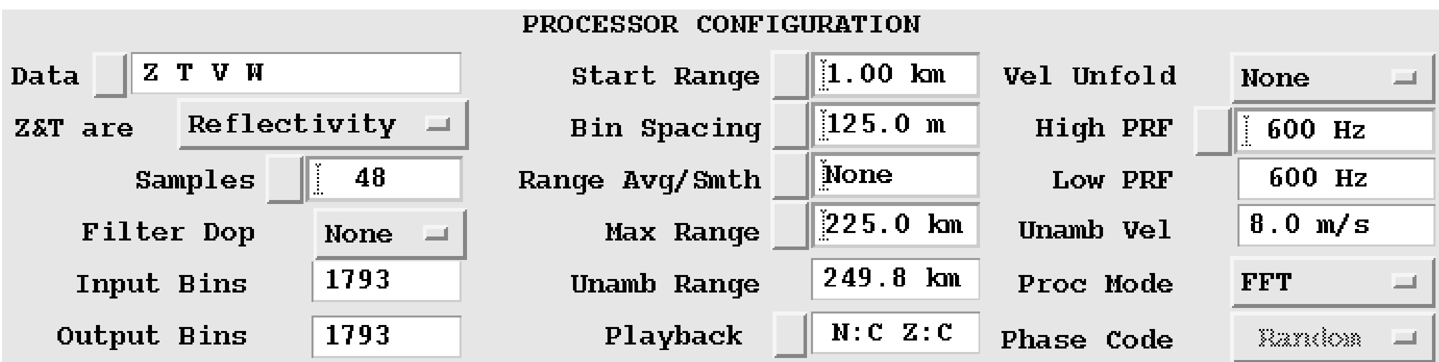
The polarization may be either fixed, as for a standard radar, or alternating between horizontal and vertical from pulse-to-pulse. When the polarization is fixed, you specify which polarization to use for sampling. Typically, horizontal is selected because of the slightly greater returned power from meteorological targets. In the case of alternating polarization, you still select the polarization required for the standard output parameters.

For a standard radar at fixed horizontal polarization, the field appears as “N/A.”

Ship Velocity Correction

This button turns on/off a radial velocity correction to account for moving radar platforms. The velocity correction used in IRIS allows for two different types of ship motion sensing, an Inertial Navigation Unit (INU) or a Gyro System with GPS. Refer to the Appendix C in the *IRIS Product & Display Manual* for more information concerning this correction.

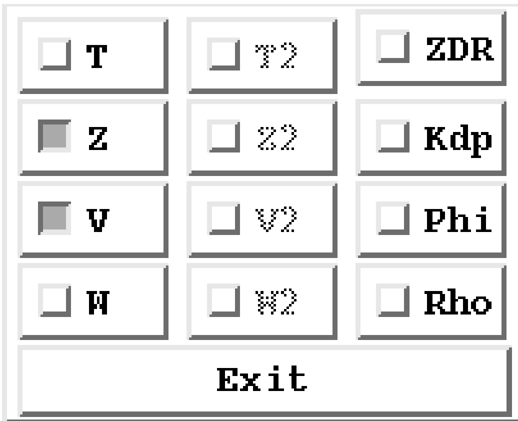
6.1.3 Processor Configuration



The Processor Configuration area of the menu lets you set up the output data, ranges and averaging used by the signal processor.

DSP Data

This field is used to select the types of data output by the signal processor and stored in the ingest files. Click on the DSP Data button to pop up a list of types. Naturally, you can only select data types available in your system: Doppler parameters V and W only in Doppler systems and the parameters in the third column only in dual–polarization systems. If the default is used in the **setup** utility, only the left column with 8-bit options will be useable. If, output data is set to 16-bit, the types ending in “2” will be available.



T – Total reflectivity (not clutter corrected)	ZDR – Differential reflectivity
Z– Reflectivity (clutter corrected)	K – Specific differential phase
V – Doppler mean velocity	Phi – Cross channel differential phase.
W – Doppler spectrum width	Rho – Cross channel correlation coefficient

Refer to the *Signal Processor User's Manual* for details on the algorithms that compute these parameters. You may select any combination of parameters from the menu. After your choices are made, exit from the menu, and the choices are displayed in the field.

If T (the uncorrected reflectivity) is the only selection, the signal processor operates in the intensity-only processing mode without performing any Doppler processing. This allows more range bins to be processed because of the lower processing difficulty. The number of parameters selected here affects directly to the size of your Ingest and Raw product files.

T&Z are

Here you can select whether T and Z are calibrated radar "Reflectivity" factors or simply the measured signal-to-noise ratio or "SNR". The Reflectivity choice is almost always the right one. SNR is used for diagnostic/troubleshooting purposes and for radar antennae with non-standard beam patterns. Note that when SNR units are selected, the clutter correction is still applied to Z and not to T.

Samples

This field allows you to specify how many pulses are averaged (from 2 to 256, continuously selectable) to obtain the final estimates of the radar parameters for each ray.

As a rule of thumb, approximately 40 samples are required to obtain acceptable averages and reliable clutter cancellation. In general, the number of samples should be as large as possible. The drawback is that the bigger number of samples is, the more slowly antenna scan speed must be. This classical dilemma is discussed in chapter 4.2.2

Filter Dop

These fields are used to specify a clutter filter type. There are eight filters available, including "no filter". Specify an integer between 0 and 7, where 0 is no filter.

See the *Signal Processor User's Guide,* which shows how to configure the clutter filters. Typically this is done so that filter 1 is the least aggressive and filter 7 is the most aggressive.

The selection of a clutter filter depends on the scan rate, antenna beamwidth and the operational objectives. In general, the narrower the filter the better, since a broad clutter filter has a greater adverse effect on the weather echoes. Some experimenting with the best combination of clutter filters and thresholds is usually required (see Section 6.2.1). By trying different clutter filters on a rainy day, and comparing Z and T (the corrected and uncorrected reflectivity) on the real time display, you can determine which filters best reduce the effects of clutter while doing the least damage to the weather. Be sure that when you optimize the Doppler filter, the CSR threshold is not used as the Z threshold criterion.

Aside from IRIS, the **ascope** utility can measure the actual width of clutter Doppler spectra as a function of the scan rate (which can be controlled via the **antenna** utility). This is the best way to determine the appropriate filter. (See the *IRIS Utilities Manual.)*

Start Range

The Start Range field specifies the required range of the first data bin to the nearest 1/10 km. Usually this is set to 0.0 so that sampling starts at the closest possible range. However, when two TASKS are used to define a sampled volume, it is sometimes useful to have one TASK sample an inner range at a high PRF, and the other TASK sample an outer range at a low PRF.

Bin Spacing

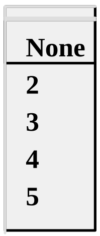
The Bin Spacing field specifies the desired range resolution of the data. Selection is made by entering the desired value to the nearest meter or by choosing from a list of values. IRIS then picks and displays the allowable bin spacing that is closest to your choice. This depends on the processor, with a typical value of 125 meters.

For the RVP6, the minimum bin spacing (125 or 62.5 m) is selected in the **setup** RVP section and must match the internal configuration of the signal processor. Refer to the *IRIS Utilities Manual* and the *RVP6 User's Manua*l (TTY Non-Volatile Setups).

Range Averaging, Input Bins, and Output Bins

Range averaging means that the data obtained at the output bins is obtained by averaging two or more (16 max) input bins. The number of input bins is a display parameter.

The pop-up menu choices for range averaging are:



None — No range averaging. In this case the Input Bins and Output Bins fields are identical.

2 – 5 — Range averaging over 2 to 5 bins.

For “None,” no range averaging is performed, and single-point sampling is done for each of the output bins. If 2 is selected, IRIS doubles the number of input bins by placing new bins halfway between each of the output bins, then averages two bins together to obtain each of the final output bins. For 3 bins, IRIS creates three times as many input bins as output bins. Data at each output bin is the result of averaging three equally spaced input bins. The total number of input bins is limited by your processor (3072 bins for RVP8, less for RVP7&6). If you specify a range average that results in greater than 3072 input bins, IRIS reduces the maximum range to be consistent with 3072 input bins.

Max Range

The Max Range field defines the maximum range in km of data collection. Whenever fields such as the PRF, Range Averaging or Bin Spacing are changed, IRIS attempts to fill in range bins to the full unambiguous range. If this is successful, the Max Range field is equal to the unambiguous range. There are two limitations that sometimes cause the Max Range field to be less than the Unambiguous Range field:

Processing Speed	IRIS reduces the number of range bins (and hence Max Range) so that the average range bin spacing over the unambiguous interval is within the real time processing constraints of the processor. See the *Signal Processor User’s Manual* for details.
Total Number of Range Bins	Limited to 2048. For a single-board RVP6, limited to 1024.

The Max Range field will turn red if it exceeds the unambiguous range. A Max Range that exceeds the unambiguous range is allowed for users using their own major processing mode. It is also useful to allow the Max Range to exceed the unambiguous range by 1 range bin to make the Max Range an even value, for example 150 km instead of 149.9 km. In all other cases data that exceeds the unambiguous range will be nulled so it is recommended for most users to keep the Max Range less than the unambiguous range.

Regarding the processing speed constraint, a rule of thumb is that the RVP6 can operate at a 375 m bin spacing for Doppler mode and 250 m bin spacing for reflectivity only mode for up to 1024 bins.

For example, at 500 Hz PRF, the unambiguous range is 300 km. The RVP6 can process no more than approximately 800 range bins of Doppler data over this interval. If you specify 250 m output bin spacing, IRIS reduces the max range to approximately 200 km, so that 800 bins are processed at 250 m resolution. You can further trim this range, if required, by entering a lower value. The max range can be extended by increasing the bin spacing so that the 300 range bins are spread over a wider range. The start range can be increased to provide a larger max range. Also, the start range can be increased so that the available number of bins can be placed at greater range.

Unambiguous Range

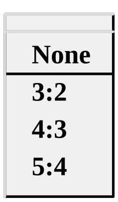
This is a display-only field. The unambiguous range is the maximum range for "first trip" echoes — the maximum range from which an echo can be received before the next pulse is issued. It is affected whenever the PRF is changed.

Playback

The Playback field is used to determine which noise floor and calibration level used by the RVP8 when playing recorded time series data. The possible options are to use the current noise floor and calibration level of the RVP8 or the values recorded in the time series. The Playback field will have no effect on the noise floor and calibration level of the RVP8 during normal operations.

Velocity Unfolding

For Doppler systems, this field determines whether dual PRF control and processing are performed. Pop-up menu choices are:



None — Single PRF operation with no velocity unfolding.

3:2 — Dual PRF with ratio of 3:2. This provides 2X velocity unfolding as compared to the unambiguous velocity for the larger PRF.

4:3 — Dual PRF with ratio of 4:3. This provides 3X velocity unfolding as compared to the unambiguous velocity for the larger PRF.

5:4 — Dual PRF with ratio of 5:4. This provides 4X velocity unfolding as compared to the unambiguous velocity for the larger PRF.

For more information on velocity unfolding, refer to the *Signal Processor User's Manual*. Note that IRIS does not permit dual PRF operation except when velocity is selected as an output parameter under Processed Data. The Unambiguous Velocity and the Low PRF are display fields on this menu. The High PRF is specified as described in the next section. For LOG-only systems, this selection is fixed at "None."

High PRF and Low PRF

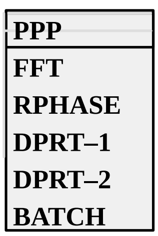
This is specified by entering the desired value to the nearest whole Hz, or by choosing one of the values from the pop-up menu. The computed Low PRF is displayed in the adjacent column (display only). The maximum and minimum values depend on the duty cycle limit of the transmitter for the selected pulse width. If you enter a PRF that exceeds either of these limits, IRIS inserts the limited value.

Unambiguous Velocity

This is a display-only field. It is effected whenever the High PRF or Velocity Unfolding fields are changed.

Major Mode

This field determines the processor mode. Choose from the following options:



PPP — Pulse pair processing.

FFT — Fast Fourier transform.

RPHASE — Random phase.

DPRT–1 — Dual PRT mode 1.

DPRT–2 — Dual PRT mode 2.

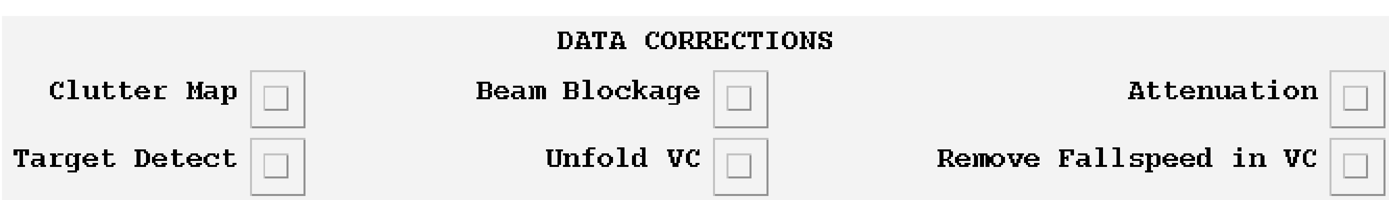
BATCH — Batch Mode Processing.

Phase Code

The transmission phase of a Magnetron transmitter is always random. For Klystron and TWT amplifier transmitters the phase of the transmission may be controlled using a phase shifter. This field allows the signal processor to specify the phase of each pulse.

“Fixed” is the legacy mode for Klystron and TWT amplifier transmitters. “Random” allows a Klystron or TWT amplifier to mimic the pulse phase of a Magnetron which is useful for second trip echo cancellation. “SZ 8/64” is a predetermined phase code algorithm which mitigates range ambiguities and allows for better recovery of weak 1^{st} trip spectral moment estimates which have been contaminated by stronger 2^{nd} trip estimates.

6.1.4 Data Corrections



Clutter Map Z

When no Doppler filtering is available, clutter mapping is one of the few tools to remove clutter. For a clutter map, you make a volume scan in a weather situation without any precipitation, thus representing typical clutter in your images. Then you tag this product as Clutter Map in the Ingest Summary Menu, and turn on this bit in the task configuration. It will modify the Z data to remove any signal weaker than the clutter scan. If the goal is removing clutter from the RAIN1 products, then another option is to tag a RAIN1 product as clutter map.

Target Detect Zc

This computes Zc with uniform weather removed. Any input signal of more than 2 range bins in a row is smoothed and then only peaks are passed. The goal is to pick out targets against a weather background. Only use this for target tracking.

Beam Blockage Zc

Because of obstructions to the radar horizon (towers, buildings, mountains) the radar beam can be partially or totally obstructed. This feature allows the Ingest process to compute Zc by correcting the measured Z values for partial beam blockage. Note that corrections up to 10 dB can be done. Larger corrections (e.g., more than 90% of the beam power lost) are not practical.

The configuration of this feature is via a file (beam_block.conf) in the IRIS Configuration directory (e.g., /usr/sigmet/config) that contains the following for each elevation angle used in the volume scan:

- Azimuth angle span
- Range at which the blockage starts
- Blockage in dB up to 10 dB
- Elevation angle tolerance

The details are documented in the beam_block.conf file. These feature works best when dynamic angle synchronization is used so that the azimuth “rays” are collected over the same angle span every time (e.g., for 1 degree resolution, the angle spans would be 0.5–1.5, 1.5–2.5, etc.)

Unfold Vc

VVP unfolding can be used to unfold Doppler speeds in individual range bins, when the value is compared to a reference VVP product. Unfolding for IRIS corrected velocity, Vc, is especially important for NDOP (Multiple Doppler) product (See chapter 7.8.1).

NOTE that you need a VVP product to perform this correction – and that product has to exist before you run this task. See details in chapter 7.8.1.

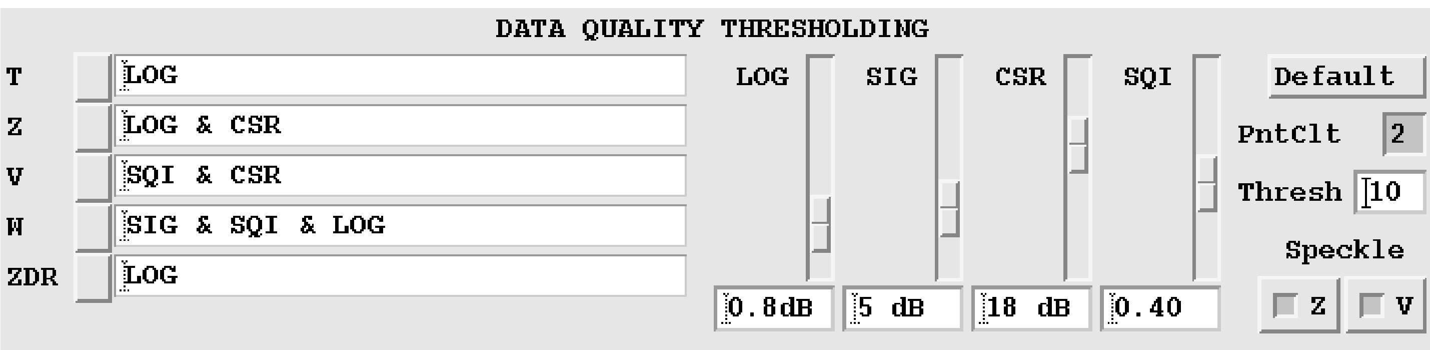
Attenuation Zc

This computes a Zc by correcting for the intervening attenuation. In the Ingest setups you can set a Z attenuation constant and exponent, maximum Z for correction and maximum cumulative correction. Here, you can select for each task if you want the attenuation correction to be used or not. Values are suggested for X and C bands. We recommend the attenuation option is not used in S band. If multiple corrections are turned on for Zc, the order of operations is: 1st Beam Blockage, 2nd Intervening Attenuation, then 3rd Target Detection.

Remove Fallspeed in Vc

Radial winds are assumed to be caused by the horizontal winds only. The fallspeed of the hydrometeors (of order 1 to 10 m/s) for rain) can make a significant contribution to the radial velocity. To estimate and remove this effect, the water phase (snow or rain) of hydrometeors must be known. If you use this correction, add the height of the melting level to the setup information (see setup manual). Even this correction is mainly used when making the NDOP product.

6.1.4 Data Quality Thresholding



An important feature of IRIS is that of real time data editing to remove range bins with weak signal power or unreliable estimates of the Doppler parameters. This process, called thresholding, is performed by the signal processor. IRIS provides a great deal of flexibility for thresholding to assure clean displays, promote efficient execution and transmission of the products, and reduce the amount of tape and disk space required to hold compressed data and product archives.

There are several concepts that are useful in understanding thresholding:

Threshold Parameters

LOG — The log receiver signal-to-noise ratio.

SQI — Doppler channel signal quality index.

CSR — Doppler channel clutter-to-signal ratio.

SIG — A measure of the power from weather targets, excluding noise.

Threshold Criteria

The parameter to use as the criterion.

For example, the Z values could be discarded whenever the log receiver signal is weak. Likewise, V values could also be discarded whenever the log receiver signal is weak. In both cases, LOG is the threshold criterion for thresholding Z and V.

Threshold Levels

Acceptable levels for the signal.

Using the same example, the threshold level for the LOG may be set at 1 dB above noise. In this case, the velocity and reflectivity are discarded if the LOG receiver power does not meet or exceed 1 dB above noise. This is done on a bin-by-bin basis.

Each of the four threshold parameters (LOG, SQI, CSR and SIG) has its own user-defined threshold level as described below:

LOG Level (dB)

The average LOG channel power in dB at each range is compared to the LOG threshold level (typically 1 dB). If the measured LOG power at a bin is greater than the threshold, the range bin is “passed” for LOG.

SQI Threshold [0,1]

The SQI is a measure of the coherence or Doppler power of the linear channel. The SQI is between 0 and 1, where 0 corresponds to a signal that is “white noise” (no coherent power) and 1 corresponds to a signal that is a perfect point Doppler target (all power is coherent). An SQI greater than approximately 0.4 is required to measure mean velocity and spectrum width. If the measured SQI at a bin is greater than the threshold, then the range bin is “passed” for SQI.

CSR Threshold (dB) The CSR (clutter-to-signal ratio) compares the ground clutter power to the meteorological signal power in the Doppler channel. The CSR is calculated for each range bin and compared to the user-defined threshold, typically set to 20 to 40 dB depending on the coherence of the transmitter/receiver system. If the measured CSR at a range bin is **less** than the threshold level, then the bin is "passed" for CSR.

SIG Level This refers to the weather signal power. That is, the signal to noise ratio corrected for clutter. This is typically set to about 10 dB, and used to threshold widths. This is because the spectrum width cannot be measured from a very weak signal. If the measured SIG at a range bin is greater than the threshold level, then the bin is "passed" for SIG.

For each range bin, actual values of the threshold parameters are computed and compared with the user defined threshold levels. The result is either a "pass" or "fail" for each threshold parameter.

The second part of thresholding is to decide whether a particular type of data (T, Z, V and W) should be accepted for each range bin. You define which thresholds to apply to each of these output parameters. This is the threshold criterion. For example, the reflectivity is usually set so that the Z values (and T) is accepted if the LOG test passes. As a further constraint, you can accept the corrected reflectivity values (Z) only if both the LOG and CSR tests pass. This assures not only that the signal is strong enough for a good estimate, but that the ground clutter is not so strong that the estimate is unreliable.

Threshold Levels and Criteria

To set the threshold levels, position the cursor on the appropriate level field and type the value or move the slider within the scale until the desired value is displayed in the field. Typical values for a magnetron system are described at the end of this chapter.

The threshold criteria are changed by entering a Boolean expression directly into the field or by selecting an option for each parameter from a list of choices in pop-up menus:

T Threshold

- **All Pass**
- **LOG**
- **LOG & CSR**
- **SQI**
- **SQI & CSR**
- **SQI & LOG**
- **SQI & LOG & CSR**

Z Threshold

- **All Pass**
- **LOG**
- **LOG & CSR**
- **SQI**
- **SQI & CSR**
- **SQI & LOG**
- **SQI & LOG & CSR**

V & Polarimetric Thresholds

- **All Pass**
- **LOG**
- **LOG & CSR**
- **SQI**
- **SQI & CSR**
- **SQI & LOG**
- **SQI & LOG & CSR**

W Threshold

- **All Pass**
- **LOG**
- **LOG & CSR**
- **SQI**
- **SQI & CSR**
- **SQI & LOG**
- **SQI & LOG & CSR**

ZDR Threshold

- **All Pass**
- **LOG**
- **LOG & CSR**
- **SQI**
- **SQI & CSR**
- **SQI & LOG**
- **SQI & LOG & CSR**

"All Pass" means that any value is accepted, in effect turning off thresholding. Note that the polarimetric variables are treated identically to V, with the exception of ZDR.

Defaults

Clicking on this button resets thresholding to the default values.

Point Clutter Filter

Point Clutter is a target that has some velocity and strong reflectivity data in one or two successive range bins but is bordered on either side in by bins that do not have valid data (empty bins). Meteorological targets rarely appear this way, but aircraft and ships do. The Point Clutter Filter is very effective in removing small, strong targets having some velocity causing standard clutter suppression to not work as well.

The Point Clutter Filter is applied in the signal processor using the autocorrelation data (R_0, R_1, and R_2) after the Doppler spectrum clutter filtering. A range bin will be flagged as containing clutter if it's power (R_0) exceeds that of its neighboring range bins by more than a specified detection threshold (in dB). The neighboring range bins may be configured to be up to 3 bins away from the central bin. This is used when having small bin resolution, such as 25 meters, as some point targets will appear in more than one successive range bin. When a range bin is flagged, the averages of the autocorrelation values from its neighbors are assigned to the flagged range bin. In this way point clutter can effectively be removed from data, even when contained within valid meteorological data.

The PntCtl button in the menu toggles on or off the Point Clutter suppression feature of the signal processor. The number in the toggle selects how far away the neighboring range bin should be along the radial for the comparison. The detection threshold is defined in the Thresh field and may have a value between 0 and 20 dB.

Z and V Speckle Filters

A speckle is a range bin that has valid data but is bordered on either side in range by bins that do not have valid data (empty bins). Meteorological targets rarely appear this way, but towers, aircraft and "lucky noise" do.

One final thresholding feature of the signal processors is the Speckle Filters buttons, which can be toggled on or off in the menu. There is a separate filter for the LOG channel parameters (labeled Z for Z, T and ZDR) and the linear channel parameters (labeled V for V and W). It is recommended that the speckle filters be toggled off initially and that the number of samples be adjusted so that there are only a few speckles on the real time display. At this point, the speckle filters can be toggled on to achieve a cleaner display.

6.2 Obtaining High Quality Data

6.2.1 Optimizing thresholds

In defining the thresholds for your system, it is important to experiment to obtain the best combinations for your application. Here are some simple rules to assist in making the tradeoffs that are inherent in signal processing:

- Use large numbers of samples (>>50). The greater the number of samples, the better the estimates of all parameters. The tradeoff is that the antenna must scan more slowly when the number of samples is larger and a slow scan rate may not be consistent with the operational objectives. A scan rate of 1 to 3 RPM is typical for good estimation, but the slower the better.
- Use a large PRF. All of the Doppler estimates tend to be better when the PRF is large. The tradeoff is that the larger the PRF, the shorter the unambiguous range.
- Do not use a clutter filter that is broader than necessary to remove the ground clutter. A clutter filter that is too broad can damage weather information without improving the clutter cancellation. The required filter width depends on the selected scan rate. Use the **ascope** utility to observe the width of Doppler spectra at close range to estimate the width of the clutter filter that is required. Note that the **antenna** utility can be used to scan the antenna while **ascope** is running so that actual IRIS operation can be simulated. (**ascope** and **antenna** are described in the *IRIS Utilities Manual*.)

A recommended starting point is:

T	LOG	LOG Level	0.8
Z	LOG & CSR	SQI Level	0.4
V	SQI & CSR	CSR Level	18.0
W	SIG & SQI & LOG	SIG Level	10.0
ZDR	LOG	Speckle filters	on

IRIS and the **ascope** utility make it easy to experiment with different configurations so that the best combination can be determined.

To really find the right threshold values for your system you have to watch data from different weather situations. It helps to have independent sources of weather information (satellite images, synoptical maps, images from other radars) to determine what kind of situations you have: clutter only, rain, snow, convective or widespread precipitation. Also, you might want to make special monitoring products such as low elevation PPIs with color scale down to –20 dBZ, and RAINN products over a long period. In the following table is a collection of some common problems and the first guess for how to cure them.

If you have this problem...	..try first to change this threshold
Mountains	Filter Dop bigger or CSR smaller
Underestimation of rain over mountains	CSR bigger
Doppler snake (no echo at side wind)	Filter Dop smaller
Noise at all elevations	Log bigger
Dots at low elevations	Speckle filter on
Second trip echoes	SQI bigger
Vanishing strong showers	SQI smaller

6.2.2 Compromising samples, antenna speed and PRF

Acquisition limits

To determine the right number of samples is balancing two factors: the bigger number of samples you have, the better the Doppler speed estimate and clutter filters work. On the other hand, taking many samples means you can’t move your antenna so fast.

Setting of PRF tells how many pulses you send per second. Scan rate tells how many degrees the antenna moves in second. Resolution tells how long sector is scanned for a single ray, and number of samples tells how many pulses you include in one ray. Thus maximum number of samples can be calculated

SAMPLES = PRF * RESOLUTION / SCAN RATE

IRIS lets you determine all four parameters in this equation, and then determines which parameter it should adjust in each case. That logic is discussed in the following chapter.

Determining the number of samples per ray

The fundamental unit of data output from the signal processor is a **RAY** of data. A ray is a collection of pulses (samples) that are integrated together into a single data output. Because of flexibility of the RVP signal processor, there are several parameters that influence exactly what samples are included in a ray. The key parameters that determine the number of samples in a ray are **Angle Syncing**, **Major Mode**, and **Dual PRF Velocity Unfolding**. Below is a listing that describes exactly what constitutes a ray based on the setting of the above three parameters. In these listings, it should be noted that Manual Tasks are always done with angle syncing off, regardless of the IRIS setting for angle syncing. And the operation of RPHASE mode is equivalent to FFT mode in terms of this discussion.

- **ANGLE SYNCING ON, PPP MODE, SINGLE or DUAL PRF:** A ray of data is output by the signal processor every RESOLUTION degrees of antenna motion. Each ray consists of the integration of all pulses during the previous

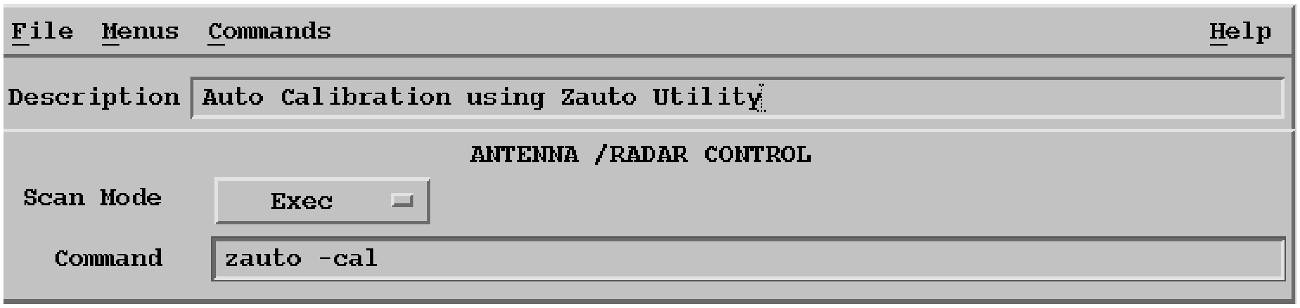
RESOLUTION degree of antenna motion. Thus all radials are RESOLUTION degrees wide. The pulses selected for integration are centered on the position (N * RESOLUTION); where N is the number of this radial. In the case of RESOLUTION = 1.0 degrees, this causes rays to be centered on integer values with ray starting and ending values on 0.5 degree boundaries. The setting of SAMPLES is ignored for this case.

- **ANGLE SYNCING ON, FFT MODE, SINGLE PRF:** A ray of data is output by the signal processor every RESOLUTION degrees of antenna motion. Each ray consists of SAMPLES number of pulses. This implies that the width of each radial is not necessarily equal to RESOLUTION. A ray may be wider or narrower depending on the setting of SAMPLES. The pulses selected for integration are centered on the position (N * RESOLUTION); where N is the number of this radial.
- **ANGLE SYNCING ON, FFT MODE, DUAL PRF:** A ray of data is output by the signal processor every RESOLUTION degrees of antenna motion. The low PRF rays consist of SAMPLES number of pulses, unless there are fewer than SAMPLES number of pulses available during the previous RESOLUTION degrees of antenna motion. If there are fewer number of pulses available, then the ray consists of the integration of all pulses during the previous RESOLUTION degrees of antenna motion. The number of pulses integrated in the high PRF rays consists of SAMPLES multiplied by the DUAL PRF RATIO. The same limitation applies for the high PRF rays as described here for the low PRF rays. This implies that the width of a ray may be narrower than RESOLUTION, but never wider. The pulses selected for integration are centered on the position (N * RESOLUTION); where N is the number of this radial.
- **ANGLE SYNCING OFF, PPP MODE, SINGLE OR DUAL PRF:** A ray of data is output by the signal processor every SAMPLES number of pulses consisting of the integration of all of these pulses. IRIS reads all rays. For manual tasks, all rays are stored. For non–manual tasks, the rays with the best angular fit are stored every RESOLUTION degrees of antenna motion. If rays are too infrequent to fit every slot in the scan, some slots will have missing rays. If rays are made too frequently to fit every slot, the extra rays are discarded.. It should be noted that in the DUAL PRF case, rays made at the low PRF will be longer in time (and usually in angular distance) then the rays made at the high PRF.
- **ANGLE SYNCING OFF, FFT MODE, SINGLE PRF:** A ray of data is output by the signal processor at the CPU limit of the signal processor consisting of the integration of SAMPLES number of pulses. This implies that rays may be partially overlapping. Thus one ray may share many of the same samples with the previous ray. This sharing iterates among all rays. The amount of overlapping may be reduced by setting the “Free Running Ray Holdoff” in the RVP7 NVRAM setups. IRIS reads all rays. For manual tasks, all rays are stored.

For non–manual tasks, the rays with the best angular fit are stored every RESOLUTION degrees of antenna motion. If rays are too infrequent to fit every slot in the scan, some slots will have missing rays. If rays are made too frequently to fit every slot, the extra rays are discarded.

- **ANGLE SYNCING OFF, FFT MODE, DUAL PRF:** A ray of data is output by the signal processor every SAMPLES number of pulses consisting of the integration of all of these pulses. IRIS reads all rays. For manual tasks, all rays are stored. For non–manual tasks, the rays with the best angular fit are stored every RESOLUTION degrees of antenna motion. If rays are too infrequent to fit every slot in the scan, some slots will have missing rays. If rays are made too frequently to fit every slot, the extra rays are discarded.. It should be noted that rays made at the low PRF will be longer in time (and usually in angular distance) then the rays made at the high PRF.

6.3 Exec Tasks



Use this option to execute an arbitrary shell command scheduled by the task scheduler menu. Note that the signal processor is released from use before this runs. This allows the command to include programs which use the signal processor, such as **zauto**.