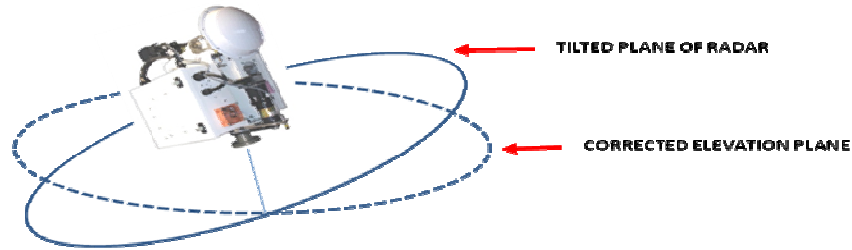


4.2.8.2 Tilt Compensation

The checkbox *Correct for Radar Tilt* enables the software to recalculate the horizon by creating a new array of elevation settings based upon the tilt information provided by the compass (if installed).

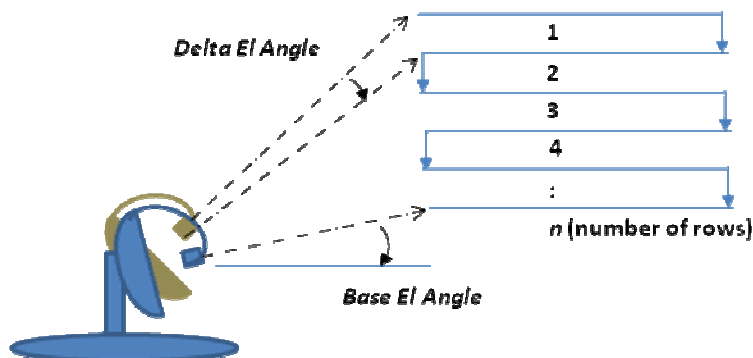


4.2.8.3 Elevation Scan

Elevation scan is used to search an area in the elevation domain where the area being search is broader than the vertical beamwidth of the antenna. On the completion of each azimuth scan range, the elevation is adjusted by the *Delta Elevation Angle*. Upon the completion of *Number of Rows*, the direction of elevation scan is reversed (up-down-up-down...)

The elevation scan is defined by:

- Base Elevation Angle
- Number of Rows
- Delta Elevation Angle



4.2.9 Zones Tab

Zones Tab

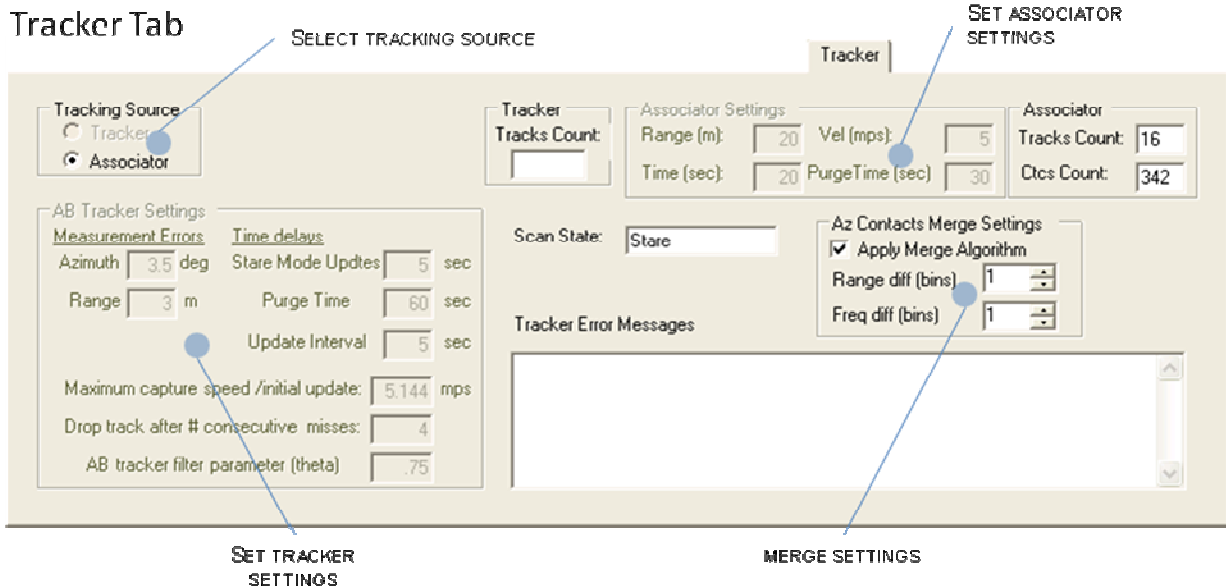
NOTE: ZONES CAN ONLY BE SETUP THROUGH THE CLIENT INTERFACE. ONCE SETUP, THE SERVER INTERFACE CAN VIEW THE ZONE CONFIGURATION, BUT CANNOT MAKE ANY CHANGES

The screenshot shows the 'Zones' tab in the AIMS Fast-Scan Radar client interface. It features a 'Zone Status' section with a table for defining and enabling zones. Below this is a 'Zones Test Panel' for testing specific zones. To the right, there are controls for displaying the zone map, including a 'Show Zone Map' button, a 'Zone to Display' dropdown (currently set to 'Nulls'), and a 'Scale (m)' dropdown (currently set to '1000'). A checkbox for 'Enable Null Zones' is also present. The main area on the right displays a radar map with a red, irregularly shaped zone highlighted.

Zones are setup through the client interface and this panel only allows the user at the AIMS radar server to view the zone definitions. Setup and configuration of zones are discussed in the AIMS Client operating manual.

4.2.10 Tracker Tab

The Tracker Tab (shown below) is used to set the settings of the tracker software.



Please note that only the Associator is currently enabled and all the features that uniquely affect the performance of the AB Tracker have been temporarily grayed out (inoperable).

4.2.10.1 Merge Settings

The merge settings are used to help reduce redundant contact reports from the same detected target (item of interest). When applied, the merge algorithm collapses a stream of contiguous contacts to a single contact report located where highest detection value was reported. The merge settings include;

- *Apply Merge Algorithm.* Enable/disable the merge algorithm.
- *Range difference.* Defines the size of the area (in range bins) to include in the merge set.
- *Frequency difference.* Defines the speed variance (in freq guard bins or indices) of detections to include in merge set.

4.2.10.2 Select Tracking Source

The tracking source can be either the Tracker (AB Tracker) or the Associator;

- The Associator is an elemental tracking algorithm that builds basic tracks on adjacent contact detections (within defined range).
- The Tracker is a more sophisticated alpha-beta tracking algorithm that includes track projection and probability of error for track continuation (discussed in detail in separate application note).

4.2.10.3 Set Tracker Settings

The Tracker settings include;

- Azimuth
- Stare Mode Update
- Range
- Purge Time
- Update Interval
- Max capture speed
- Drop track after # consecutive misses
- AB Tracker filter (theta)

4.2.10.4 Set Associator Settings

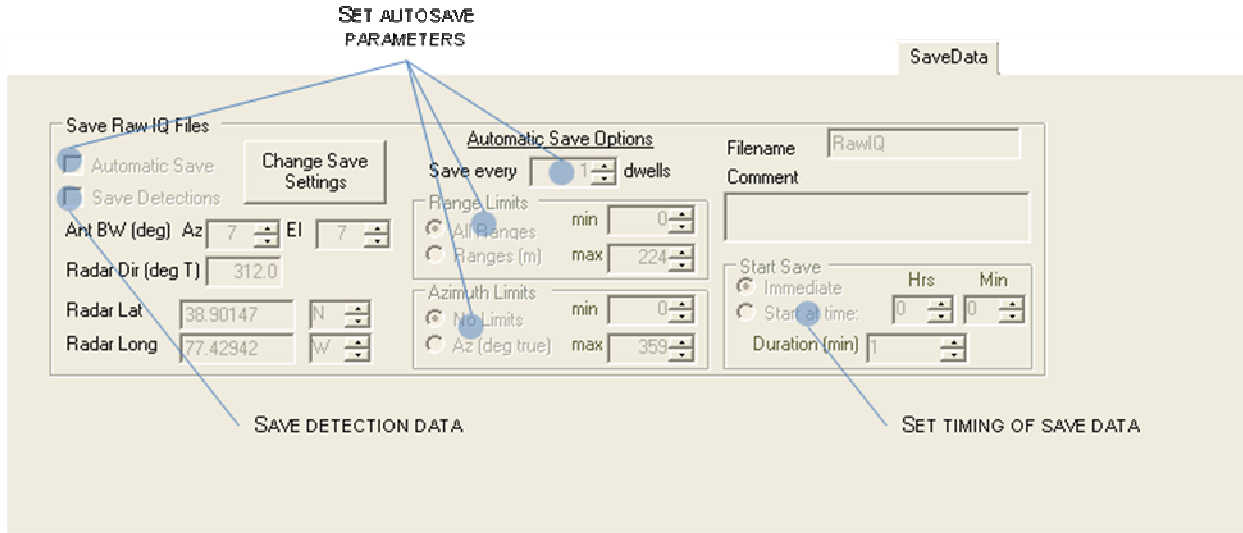
The Associator settings include;

- *Range.* Defines the maximum range between points to associate.
- *Velocity.* Defines the speed differential
- *Time.* Defines the maximum time between contiguous detections for association.
- *Purge Time.* Defines the time to “age out” an Associator track.

4.2.11 SaveData Tab

The SaveData Tab is fairly self-explanatory as this tab is used to establish the conditions and filename attributes that define how Raw IQ data files are saved.

SaveData Tab



4.2.11.1 Autosave Parameters

The Autosave settings include;

- Automatic Save
- Save Every x dwells.
- Range Limits.
- Azimuth Limits

4.2.11.2 Manual Save Parameters

The manual save settings include;

- Save Detections
- Start Save
 - Immediate
 - Timed.
 - Start Time

- Duration

4.2.11.1.3 RawIQ File Saves

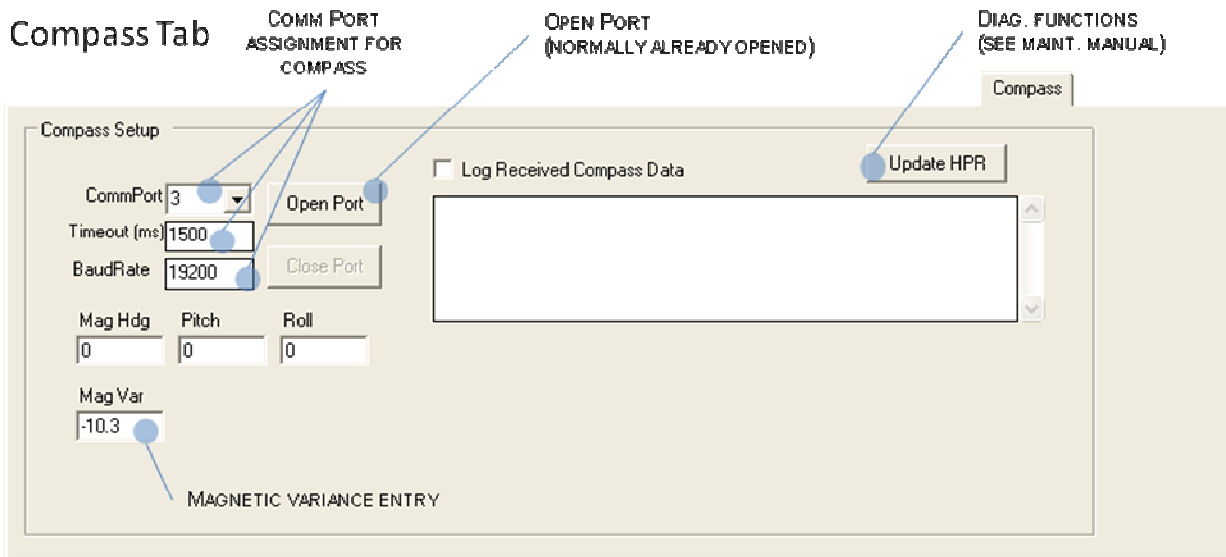
The file saving option allows raw IQ data to be stored on the local hard drive in the directory, c:\Data. The file names used will be the system time preceded by the string value listed in the text box, “File Name Base”. Enter the desired file name and check the Save RawIQ File box. Uncheck the box to stop saving data files.

4.2.11.1.4 Other Parameters

The following values are annotations that are stored with the saved data file(s);

- *Ant BW*
 - *Az* – Azimuth. The horizontal (or azimuth) beamwidth of the antenna.
 - *El* – Elevation. The vertical (or elevation) beamwidth of the antenna.
- *Radar Dir.* The absolute bearing of the radar home position. If a digital compass is installed, this information is updated on initialization or when *Update HPR* (Compass Tab) is selected.
- *Radar Lat.* The geo-positional latitude coordinates of the radar installation. If a GPS is installed, this information is periodically updated.
- *Radar Long.* The geo-positional longitude coordinates of the radar installation. If a GPS is installed, this information is periodically updated.

4.2.12 Compass Tab

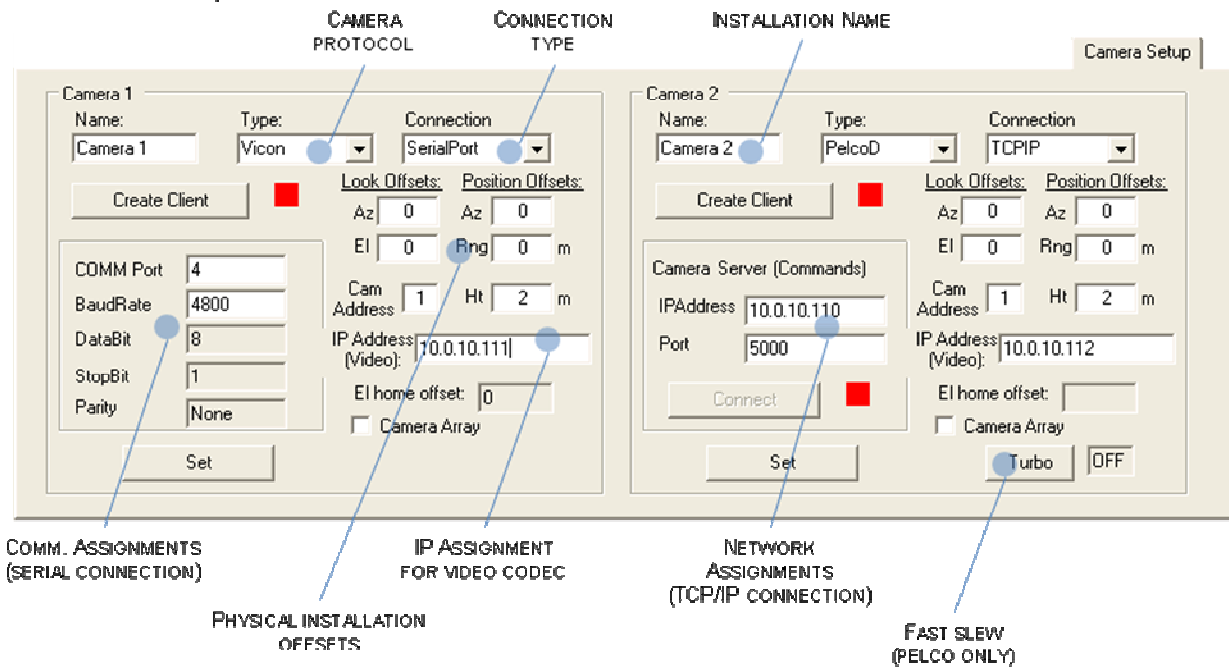


The Compass Tab settings include;

- **Comm. Port Assignment.** The compass communicates over a serial I/O link
 - *CommPort.* Sets the serial port connected to the compass.
 - *TimeOut.* Communications timeout value.
 - *BaudRate.* Data communications rate.
- *MagVar.* The magnetic variance, if available, should be entered for the specific region of activity.
- *Log Received Compass Data.* Selecting this box enables the saving of received compass data into the log file.
- *Update HPR.* To receive updated heading, pitch, and roll information from compass, click on this tab.

4.2.13 Camera Setup Tab

Camera Setup Tab

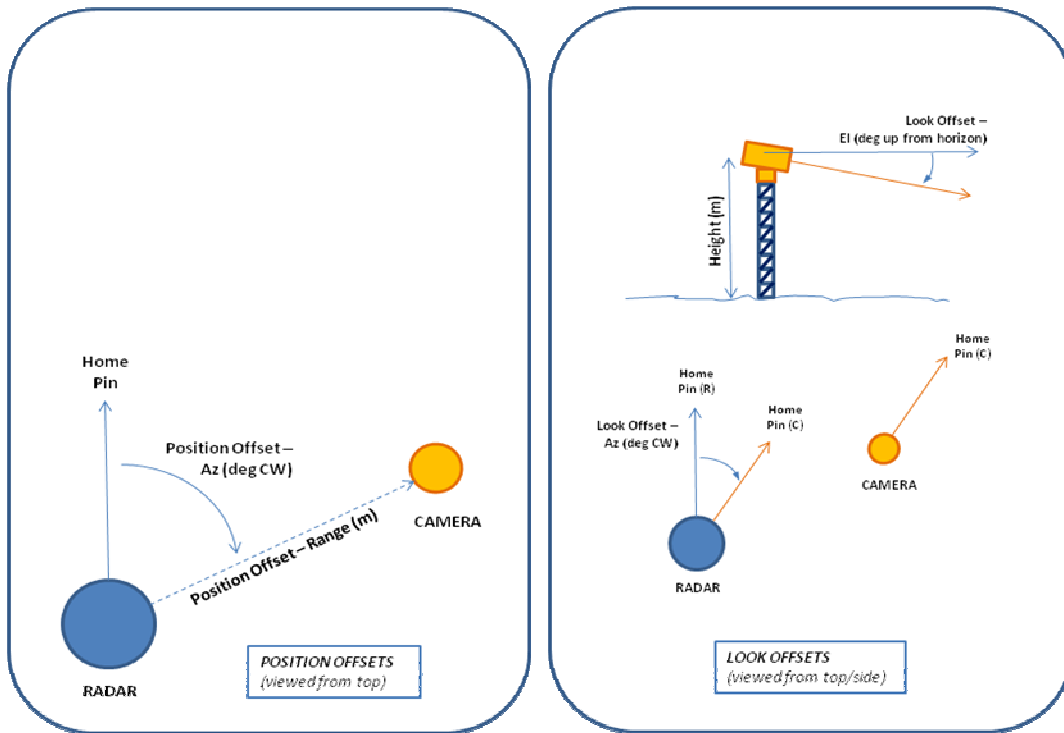


4.2.13.1 Camera Parameters

For each camera, the settings include;

- *Name*. Unique name to identify camera setup.
- *Type*. Camera type (Vicon, Pelco, Pelco-D... etc.). The type identifies the communications protocol, configurable attributes and default communications parameters. At current, the AIMS software supports the following types;
 - None
 - DI5000
 - TASS
 - QuicksetN2
 - Vicon
 - PelcoD. If Pelco is selected, the Turbo button is enabled to allow the user to activate a fast slew.
 - LRAD
 - SentryII
 - Vumii
- *Connection*

- SerialPort
 - COMM Port
 - BaudRate
 - DataBit
 - StopBit
 - Parity
 - Cam Address.
- TCPIP
 - IPAddress
 - Port
- *Offsets.*
 - *Look Offset – Az.* This offset value defines the azimuth angle difference between the home pins of the radar and the camera (see drawing below).
 - *Look Offset – El.* This offset value defines the difference in degrees between the camera look angle (at 0° elevation) and the horizon (up is positive).
 - *Position Offset – Az.* This offset value defines the location (in degrees clockwise) the camera is positioned relative to the radar home pin.
 - *Position Offset – Rng.* This offset value defines the absolute distance the camera is positioned relative to the radar (in meters).
 - *Height.* This offset value defines the height the camera is positioned above the ground.
- *IP Address (Video).* The IP address of the video codec/server that digitizes the camera's output video stream (usually inside the UCM).
- *Camera Array.* This selection is used to support a very specific application involving four cameras installed at 90° angles and communicating on a single multidrop serial communications line. More detail may be found in the DMT document, "Camera Alignment and Operation Procedures for AIMS EA-System" (dated 1/23/2008).



4.3 Required Configuration Settings

As mentioned previously, the configuration of most all of the AIMS Fast-Scan system features should be performed through the client interface. There are, however, a few features that must be setup directly through the server interface; these include;

- Setting the network parameters
- Configuring the Cameras
- Configuring the Compass
- Configuring the GPS

Normally, optional hardware (such as cameras, compass and GPS) is ordered at the time of original sale. In which case, their physical installation and configuration would be completed and operationally tested at the factory prior to shipment. Sometimes, however, these options were either not available or foreseen as a requirement at the time of order.

4.3.1 Setting the Network Parameters

The network configuration parameters are used to set the IP address for the AIMS Fast-Scan Server. Unless the network parameters are known before the time of shipment, these values will have to be changed to reflect the individual need for each site.

In order to set the network parameters, the user must first login into the server computer using Remote Desktop (on original configuration, Remote Desktop services are enabled). You must know the current address setup on the server to enable a remote desktop connection – which should be indicated on unit (tape with IP address written on it) or provided on the paperwork received with unit.

Remote Desktop can usually be found under Start - All Programs – Accessories.

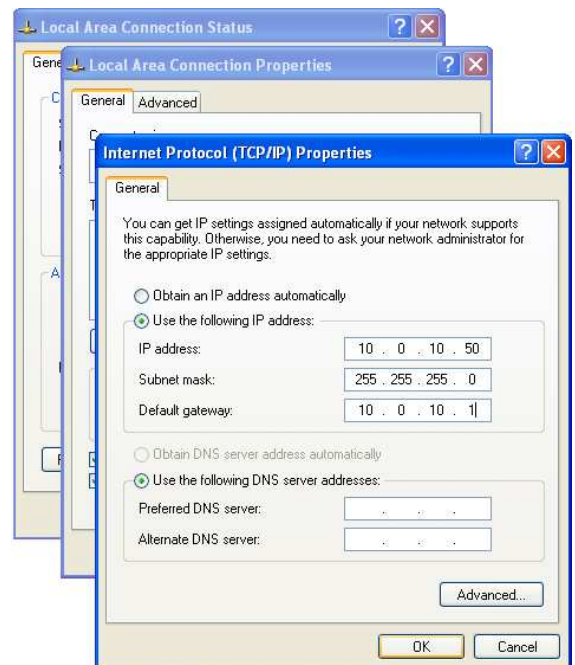
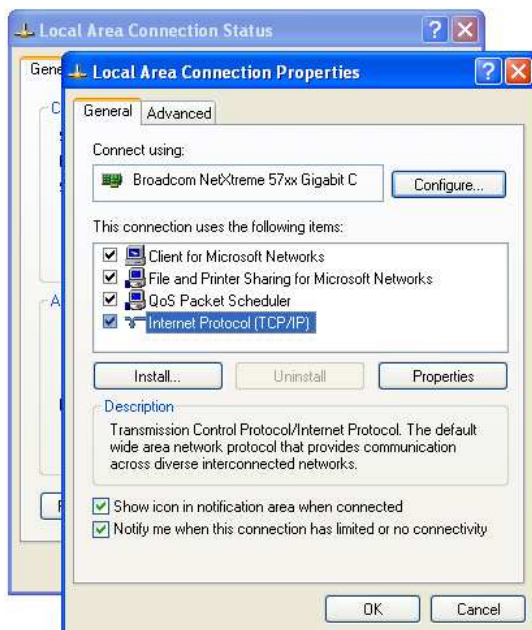
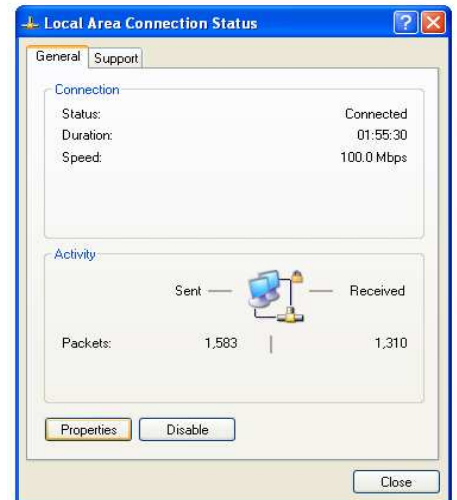


Enter in the IP address of the AIMS radar server and click on Connect. You will then be asked for your Username and Password. On all DMT units, an account is created for “DMT Tech” with a password “dmtllc” (case – sensitive).

The network parameters are set using the standard Windows XP local area network configuration screen, accessed by selecting Control Panel - Network Connections - Local Area Connection, which should generate a screen similar to the one shown at right.

To modify the network parameters, select the button Properties and scroll down to select Internet Protocol (TCP/IP) and select Properties (again). This will generate a new window that will allow you to enter the new IP address, subnet mask and gateway (lower right).

Be very careful entering this information and record the new values – once set, your Remote Desktop connection will be terminated and you will need to login again with the new IP address to verify it has been properly set.



4.3.2 Cameras

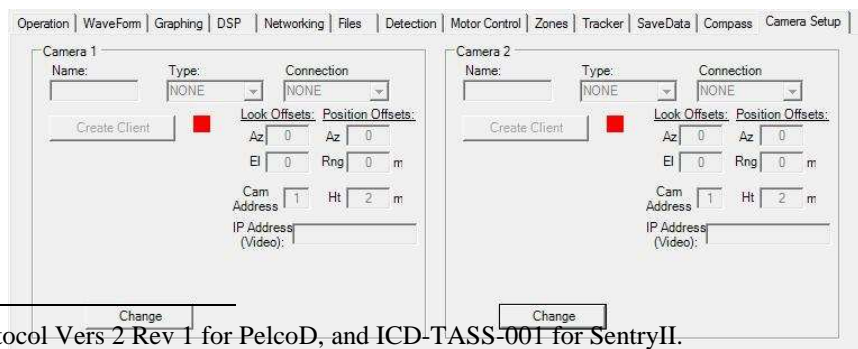
The standard AIMS camera controls provide functionality for connecting to a camera's pan/tilt device (via either serial port or TCPIP connection), sending pointing commands to that device, and displaying the video feed from the associated camera. The connection details required for accomplishing these tasks are determined by the camera "type" selected and the setup parameters entered in the Camera Setup control boxes, as described later. Note that the camera type selection will automatically set the proper communications protocol for that camera.¹

There are two separate cameras defined and controlled by each AIMS Radar, referred to as *Camera 1* and *Camera 2* throughout the Radar and Client programs. All camera commands generated by either the Client program or the Radar program are directed to one or both of these cameras depending on selections made by the user. Note that these camera designations (*Camera 1* and *Camera 2*) actually represent a camera type and a communications path for that camera. For example, *Camera 1* (or *Camera 2*) represents a single camera type (i.e., DI5000, SentryII, PelcoD, etc.) connected to a camera controller through a TCPIP or serial port connection. For a serial port connection, *Camera 1* (or *Camera 2*) may actually represent multiple cameras connected in a daisy-chain arrangement.² In this case, each individual camera in *Camera 1* is addressed by a second parameter (*Camera Address*) which is selectable on the Radar or Client control panels.

4.3.2.1 Camera Setup

The camera setup is performed by entering the appropriate information in the *Camera 1* or *Camera 2* setup box located on the *Camera Setup* tab on the Radar program's control panel. Normally, this setup is performed only once, and is automatically restored on subsequent starts of the AIMS Radar program as described later.

Note in the figure (below) the *Camera Setup* tab page on the Radar program control panel with no selections made for either *Camera 1* or *Camera 2* (the default setup state).



¹ Pelco D protocol Vers 2 Rev 1 for PelcoD, and ICD-TASS-001 for SentryII.

² This is the control arrangement for the Pelco cameras in the EA-System configuration. *Camera 1* is the pathway used to communicate with any one of the four of the Pelco cameras.

The camera setup starts by clicking on the “Change” button to activate the controls in the *Camera 1* setup box. A camera type (such as PelcoD) may then be selected from the “Type” dropdown box. Next, a connection type is selected in the “Connection” dropdown box. The connection type refers to the camera’s pan/tilt controller (Serial or TCPIP). For the Pelco cameras, a serial port connection is selected (COMM 3).

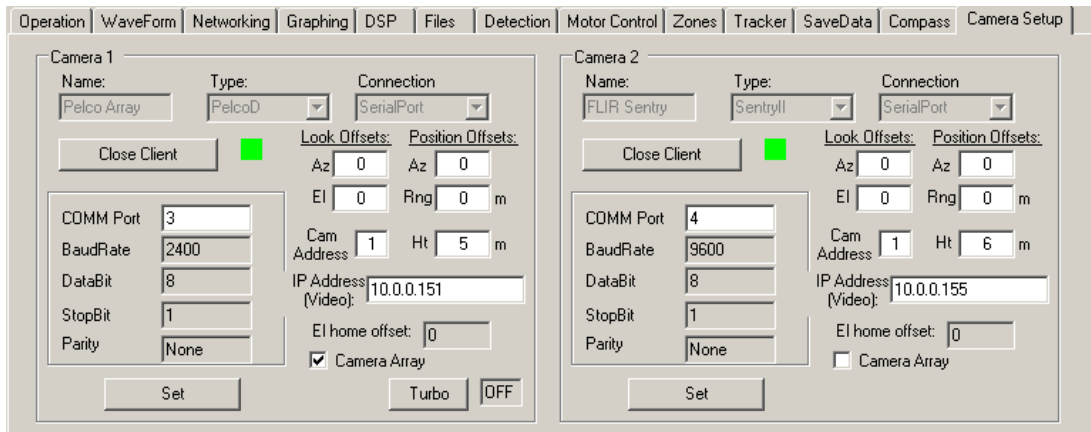
Camera 2 may be setup the same way.

Note that the camera and type selections will automatically select and enter the serial port settings for each camera (*BaudRate*, *DataBit*, *StopBit*, and *Parity*). Other entries must be entered by the user to complete the setup process. These entries include the following:

- *Name*: (Optional) A convenient name used to identify the camera assigned as *Camera 1* or *Camera 2* (This name entry appears in the Client Video selection box, described later)
- *COMM Port*: The Pelco cameras are controlled through COMM 3; the FLIR Sentry camera is controlled through COMM 4. (These values must be entered as shown).
- *Look Offsets*:³ Enter the *LookOffAz*, *LookOffEl* values for each the cameras as described in section “4.3.2.5 Camera Look Offsets”.
- *Camera Height*: Enter the height of the camera above ground level in the *Ht* textbox.
- *Camera Address*: Used for multi-drop serial applications. Enter the camera address (1..4) for the camera that will react to commands sent to *Camera 1*. (Can be left as “1” at initial setup. This camera address value is normally set with other controls in the Radar and Client software).
- *IP Address (Video)*: Enter the IP Address of the video converter for the desired camera.
- *Camera Array*: Usually not checked, used for special application; detailed in “Camera Alignment and Operation Procedures for AIMS EA-System (dated 01/23/2008)”.

³ The Look Offsets (as well as the Position Offsets) affect the accuracy of the camera pointing commands generated by the AIMS Client (*move to mouse click*) and the AIMS Radar (*slew to detection*) programs. The default values of “0” indicate that the Radar and camera are co-located and have home positions aligned.

After completing these setup entries, the next step is to create a camera client object by clicking on the “Create Client” button. This action creates the client object which opens the specified serial port and provides two-way serial communications with the camera controller. The setup box now appears as shown in the figure below.



The screenshot shows the 'Camera Setup' tab of the AIMS Radar software. It contains two panels for 'Camera 1' and 'Camera 2'. Each panel has a 'Name' field, a 'Type' dropdown, and a 'Connection' dropdown. Below these are 'Look Offsets' and 'Position Offsets' for Azimuth (Az), Elevation (El), and Range (Rng). There are also fields for 'COMM Port', 'BaudRate', 'DataBit', 'StopBit', and 'Parity'. A 'Set' button is at the bottom of each panel. A 'Close Client' button is also present, with a green light indicator next to it. The 'Camera Array' checkbox is checked for Camera 1 and unchecked for Camera 2.

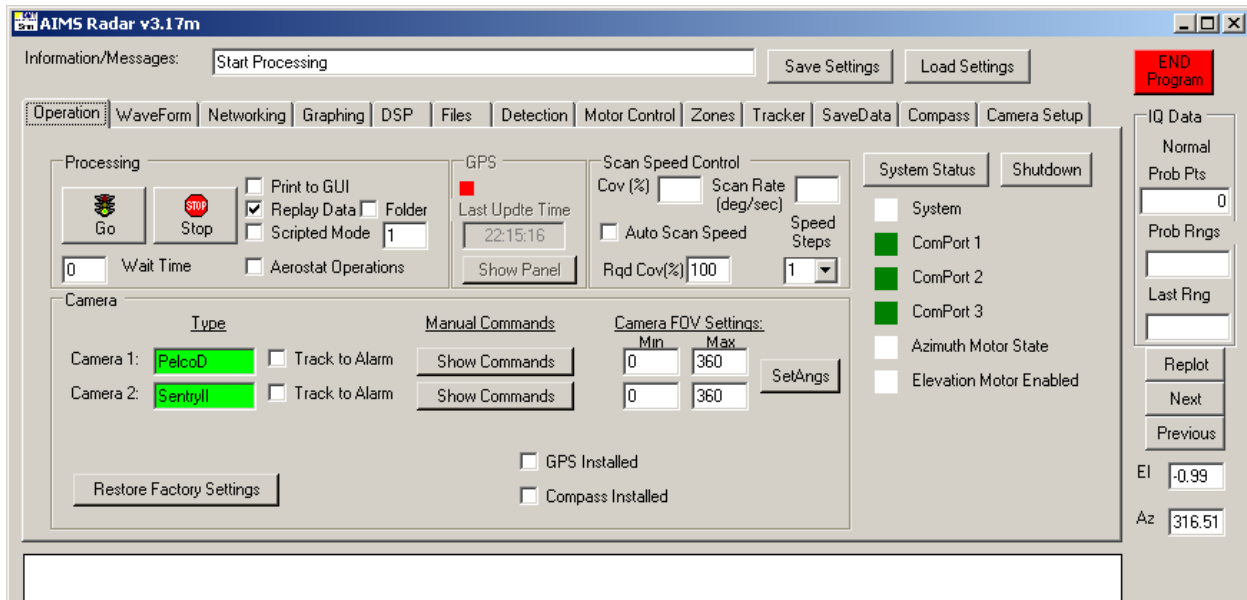
Parameter	Camera 1	Camera 2
Name	Pelco Array	FLIR Sentry
Type	PelcoD	SentryII
Connection	SerialPort	SerialPort
Look Offsets: Az	0	0
Look Offsets: El	0	0
Position Offsets: Rng	0 m	0 m
COMM Port	3	4
BaudRate	2400	9600
DataBit	8	8
StopBit	1	1
Parity	None	None
Cam Address	1	1
Ht	5 m	6 m
IP Address (Video)	10.0.0.151	10.0.0.155
El home offset	0	0
Camera Array	<input checked="" type="checkbox"/>	<input type="checkbox"/>

AIMS Radar / Camera 2 setup box after creating camera client objects

If the camera object is created successfully, the caption on the create button changes to “Close Client” and the light next to the button turns green.

After entering all setup parameters in the camera setup boxes, click on the “Set” buttons to complete the *Camera 1* and *Camera 2* setup and update the internal settings in the new camera objects. (The “Set” button causes two actions to occur: (1) the camera client object is updated with the setup parameter entries, and (2) all connected AIMS Clients are updated to show the new parameter values).

The main camera controls on the AIMS Radar, located on its *Operation* tab, will now change to show the new setting for *Camera 1* and *Camera 2* as shown in Figure 2.4:



Once a camera has been defined, the camera type selection will appear in the “Type” textbox (next to the *Camera 1* or *Camera 2* label) with a green background, and a “Show Commands” button will appear on the Operation tab page. The Show Commands button activates a pop-up window containing a set of controls for sending commands to that camera type.

At this point, the user should save the camera setup details by clicking on the *Save Settings* button at the top of the Radar control panel. This action will update the AIMS Radar’s configuration file, which will restore these settings with the next load or restart of the AIMS Radar program.

The camera setup information is sent automatically to the AIMS Client when it connects to the AIMS Radar. The AIMS Client display has similar camera setup controls which allow the user to perform some but not all of the camera setup tasks described earlier.

4.3.2.2 Camera Pointing Commands

The AIMS Radar and Client programs are capable of generating movement commands for all cameras integrated with an AIMS Radar. This feature allows the user to “point” *Camera 1* and/or *Camera 2* using one of three basic control methods.

The basic control methods are listed as follows, and are described in the next subsections:

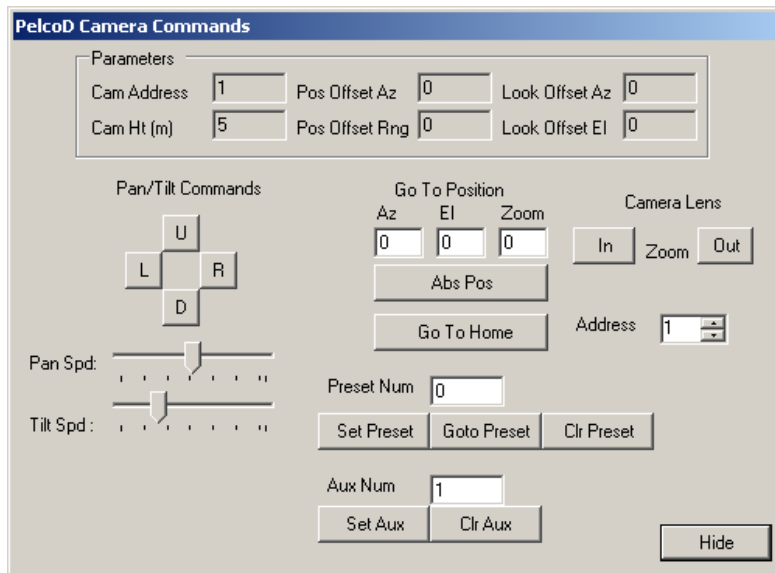
- Manual Pan/Tilt controls

- Point to Mouse Click
- Point to radar detection

4.3.2.2.1 Manual Pan/Tilt Controls

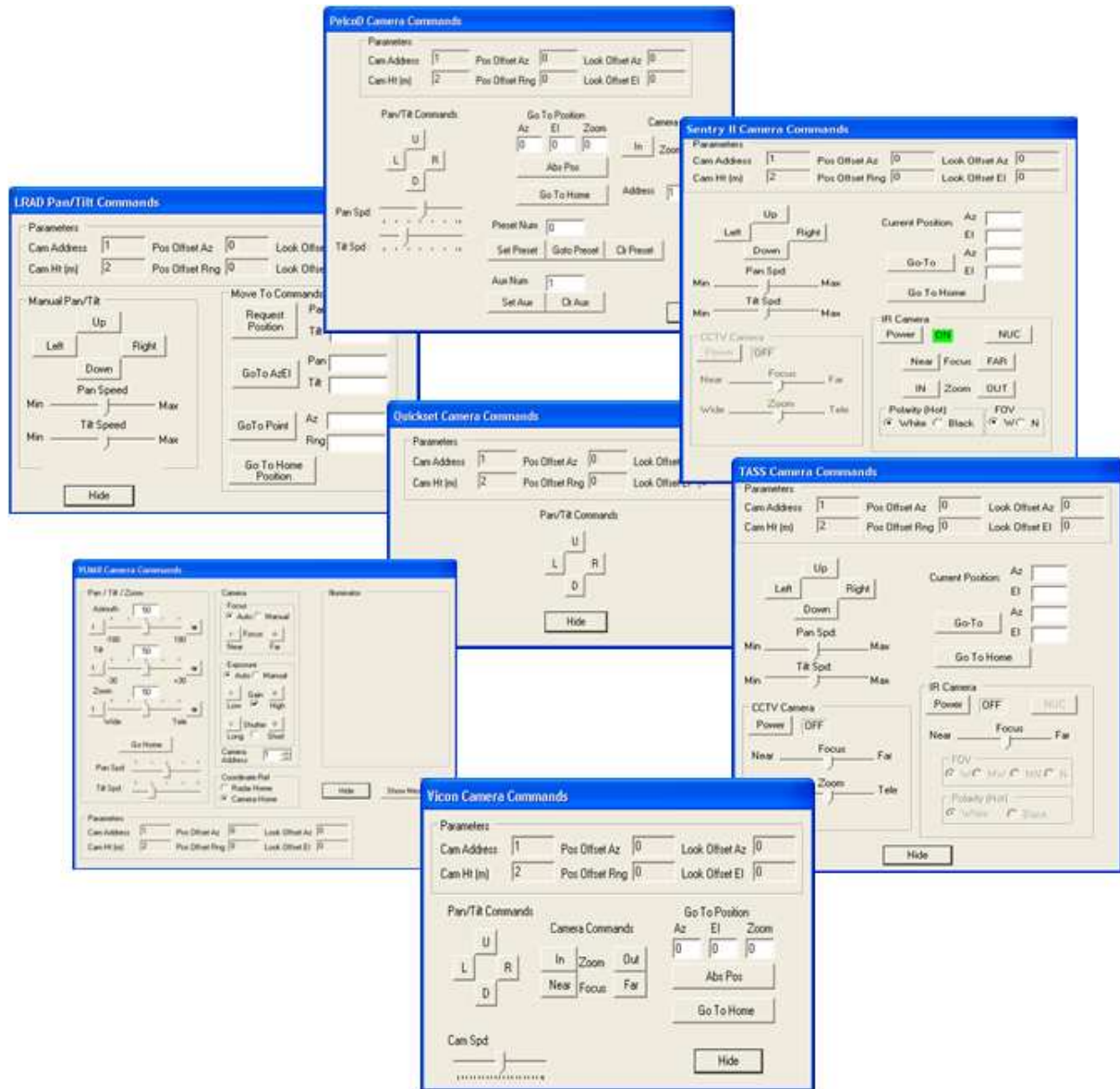
Both the Client and Radar programs provide a set of manual pan/tilt controls to continuously move a camera while a button is depressed (slew left/right, up/down) or to move the camera to specified azimuth and elevation location.

The manual controls on the Radar program are located on pop-up command windows, which are activated by clicking on the *Show Commands* button for *Camera 1* or *Camera 2* located on the Radar's *Operation* tab page. The figure below shows the command window for the Pelco camera.



AIMS Radar / Pop-up window for Pelco cameras pan/tilt controls.

All camera pop-up command windows contain a Parameters box, which shows the current settings for various parameters in the camera client object. Otherwise, the controls are generally different for each camera type integrated into the AIMS software (see example screens below).



AIMS Radar / Pop-up windows for pan/tilt controls on various camera *Types*

The manual pan/tilt controls consist of four button controls (*Up- Down –Left- Right* or *U-D-L-R*) which operate the same as the Client controls. The pan and tilt speed can be adjusted using the *Pan Spd* and *Tilt Spd* slide bar controls.

Both command windows provide a “GoTo” control which will command the camera to move to an absolute azimuth and elevation position. The values for these commands are entered as azimuth and elevation angles relative to the Radar home position. That is, the cameras move to

the specified look direction as measured in the Radar's local coordinate system (and not the camera's local coordinate system). The *Look Offset* values entered earlier with the camera setup account for any differences in the Radar coordinate system and the individual camera coordinate system.

Selecting the *Go To Home* button causes the camera to move to a look direction which is aligned with the Radar home position.

4.3.2.2.2 Point to Mouse Click

This feature allows the user to quickly point any Camera attached to an AIMS Radar to a geographic point on the Client's PPI display. This action is performed by selecting the desired camera for this command, and then clicking the mouse at the point on the PPI display. This feature is discussed in more detail in the AIMS Client Manual.

4.3.2.2.3 Point to Radar Detection

Either or both *Camera 1* and *Camera 2* can be selected to point automatically at detections reported by the controlling AIMS Radar. This selection can be made by checking the *Track to Alarms* checkbox adjacent to the desired camera on the Client or on the Radar. When *Track to Alarms* is selected for a camera, that camera will automatically point at each Radar detection as it is declared.

The function is deactivated by un-checking the *Track to Alarms* checkbox.

4.3.2.3 AIMS Radar and Camera Alignment

The AIMS Radar software requires that several "alignment" parameters be determined for the system configuration and entered into the Client and Radar control programs. This section describes these parameters and illustrates the general procedure for determining their values.

These key alignment parameters are the Radar Direction (*RadDir*), the Look Offsets for each camera (*LookOffAz*, *LookOffEl*), and the Position Offsets for each camera (*PosOffAz*, *PosOffRng*). They are described briefly as follows:

- Radar Direction – The azimuth angle in degrees, measured positive clockwise, from True North to the Radar's look direction⁴ at its home position. That is, the *RadDir* is the true bearing of the Radar beam centerline at the Radar home position. This parameter is used by the AIMS software to calculate the Latitude and Longitude values for detections and

⁴ The Radar look direction is the outward direction of the Radar beam centerline.

other display symbols on the Client PPI display. If the *RadDir* is not entered properly in the AIMS Client and Radar programs, then Latitude/Longitude values calculated by the Radar will be incorrect.

- Look Offsets – These angles measure the difference (azimuth and elevation) between the Radar look direction at its home position and the camera look direction at its home position. The *LookOffAz* is the azimuth angle in degrees, measured positive clockwise, from the Radar to the camera. The *LookOffEl* is the elevation angle in degrees, measured positive up, from horizontal to the camera look direction. These parameters are used by the Radar software to calculate the proper pointing commands for the camera. Errors in the *LookOffAz* and *LookOffEl* values will result in incorrect pointing commands sent to the camera.
- Position Offsets – These offsets account for a camera being located at a different position than the AIMS Radar. The *PosOffAz* is the azimuth angle (measured positive clockwise) from the Radar look direction at its home position to the point where the camera is located. The *PosOffRng* is the range in meters from the Radar to the camera position. Errors in these values will result in incorrect pointing commands sent to the camera.

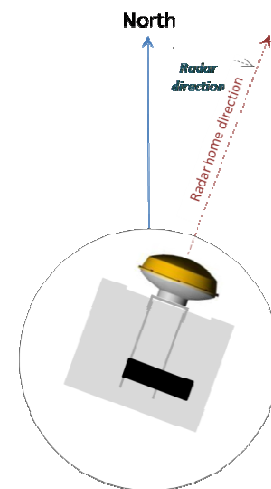
The AIMS control software will utilize the alignment parameters defined above to generate correct geographic positions (Latitude and Longitude) and to generate the correct azimuth and elevation angles for commanding cameras to point at radar detections and at geographic points on the AIMS Client PPI display.

The next sections will describe how to measure the various alignment parameters using this general diagram.

4.3.2.4 Radar Direction Measurement

The Radar Direction (*RadDir*) parameter measures the geographic orientation of the Radar. The figure below shows the plan view with the radome removed, the base plate exposed, and the AIMS Radar visible and located at its home position.

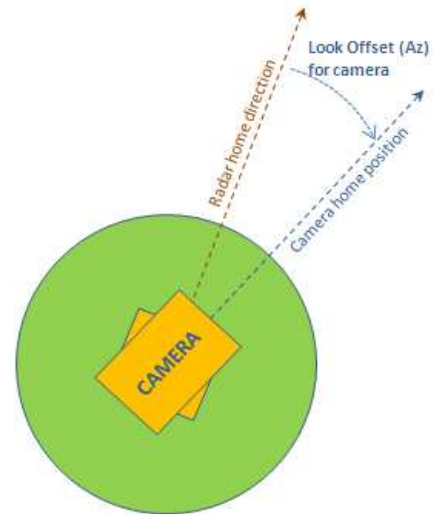
The Radar Direction is the angle in degrees between True North and the Radar home position. It is recommended that this direction be marked on the base plate so that it can be seen once the radome is replaced.



4.3.2.5 Camera Look Offsets

The figure at right illustrates the geometry for measuring the Look Offset azimuth (*LookOffAz*) for a camera mounted on top of the AIMS radome, with the Radar and the camera home positions indicated.

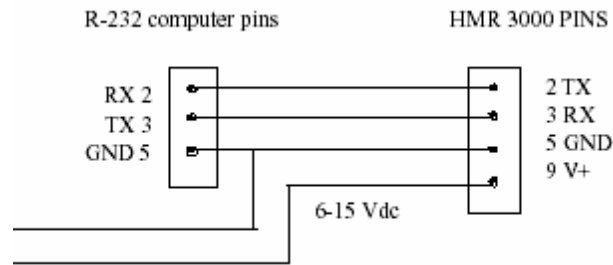
The Look Offset elevation (*LookOffEl*) should also be set to “0.” Note that the Radar orientation is expected to be level.



4.3.3 Compass

DMT has selected the Honeywell HMR3000 as the preferred compass device. The Honeywell compass uses a 9-pin serial connector for communications with the AIMS radar. Power is also provided via this connector (see drawing). The serial communications lines should be attached to the serial I/O port on the CPU stack via the Molex connector block (pins 7,8 and 9).

Name	In/Out	Pin	Description
TxD	Out	2	RS232 Transmit / RS485 TxRx+
RxD	In	3	RS232 Receive / RS485 TxRx-
GND	In	5	Power and signal common
5V	In	8	Regulated power input
6-15V	In	9	Unregulated power input
Caution: Do NOT exceed +5.5V at regulated power input (pin 8). Higher voltages will damage components.			



The HMR3000 should already be wired and attached to the stand-post behind the antenna, ready for configuration.

After installation is completed, you will need restart the AIMS Radar server software and check the box “Compass” on your Operation tab to begin using your Compass. The communication parameters should be set on the Compass Tab to the following values;

- Port. COM5
- Baud Rate. 19200
- Data Bits. 8
- Parity. None
- Stop Bits. 1

4.3.4 GPS

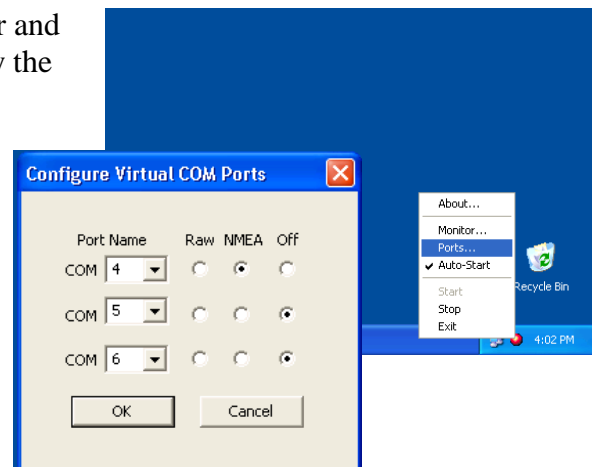
DMT has selected the DeLorme Earthmate GPS LT-40 as the preferred GPS device. The GPS uses a USB port on the computer stack for communications and power. The GPS draws approximately 500ma of 5VDC power; a substantial portion of the available power from the USB ports. It is assumed that the GPS unit is already mounted on a stand-post that is designed to support the installation of the GPS and compass. Please insure that the GPS unit is secured with either a tie-wrap or double-sided tape.

The GPS requires the support of a serial software emulation package; DeLorme Serial Emulator. This software should already be installed on your system. If not, the installation software should be available on your server hard disk drive under the subdirectory “C:\Setup\DeLorme”. Simply run the installation file and your GPS unit will be available for operation.

Locate the DeLorme icon (red ball) on your lower toolbar and right-click to run the DeLorme Monitor function to verify the GPS is operational. If data does not appear to be passing to/from the GPS device, check the serial emulation tab to be sure that at one of the available three ports are enabled (this is the port that the AIMS software should be directed to) and its NMEA tab is checked.

After installation is completed, you will need restart the AIMS Radar server software and check the box “GPS” on your Operation tab to begin using your GPS. The GPS communication parameters are;

- Port. Note the Virtual COM Port (above)
- Baud Rate. 4800
- Data Bits. 8
- Parity. None
- Stop Bits. 1



4.4 Motor Software (SMI)

The elevation and azimuth motors are ‘smart’ motors and must be loaded with software to properly function. The SMI Motor Terminal software is used to load the subroutines into the motors at the factory on original configuration. The SMI Motor Terminal software is also loaded onto each server CPU stack to support future maintenance, if required. The use and features of this software may be referenced in a separate document, titled “Transferring Motor Codes” (Instr_XferMotorCodes.pdf).

5 Client Software

As previously stated, although most all of the software parameters may be modified through the server interface it is recommended that the normal use and modification of the system parameters be performed from the client interface where more comprehensive error-checking and boundary conditioning is performed to prevent the user from configuring an abnormal operating condition.

As configuration changes are made, the client interface sends sequences of instructions to the server often momentarily stopping the current radar operation until the changes are completed.

5.1 Configurable Features

The table below provides a brief overview of the configurable parameters within the AIMS client software.

Waveform Generation	Signal Processing	Motion Management	Display / Save Data	Other
PRF Rate	A/D Sample Rate	Mode <ul style="list-style-type: none"> Positional Velocity 	Graphing <ul style="list-style-type: none"> FFT Data Line Graph 	Network <ul style="list-style-type: none"> IP Addr Port
Pulse Width	Range Bins <ul style="list-style-type: none"> No of bins Zero range bin 	Scripts	Segment Trunc.	
No. of Pulses	Filters <ul style="list-style-type: none"> Smoothing Matched Ramp Lobe Removal <ul style="list-style-type: none"> Main Lobe 2nd Lobe 3rd Lobe 	Limits <ul style="list-style-type: none"> Azimuth Elevation 	Saving IQ Data <ul style="list-style-type: none"> Autosave Save Detections Duration 	Cameras <ul style="list-style-type: none"> Track to Alarm FOV Comm. Video Svr Offsets
	Tracker <ul style="list-style-type: none"> AB Tracker Simple Tracker 	Offsets	Broadcast Interval	BITE <ul style="list-style-type: none"> Check A/D Limits
		Autoscan	Save Settings	
	TX Frequency	Tilt Compensation	Restore	
	Zones	Motion Compens.	Start/Stop	
	Sensitivity			
	Speed Threshold		Normalization	

Basically, the configurable features entail;

- Defining the transmitted pulse (waveform generation)
- Selecting how to process the received signal (signal processing)

- Aiming the antenna (motion)

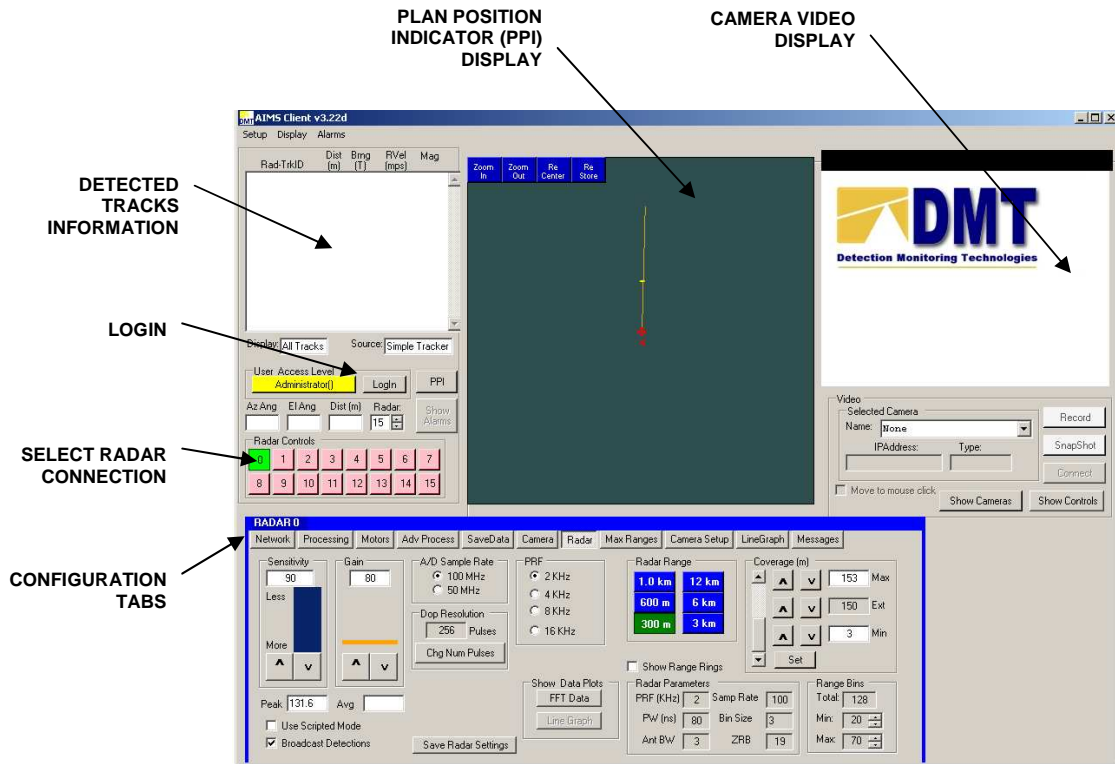
Additional configurable features include;

- Navigating cameras and viewing video streams
- Saving/replaying captured data

These configurable features are organized in an array of ‘tabs’ that provide user friendly check boxes and option lists and are described in the following section, “User Interface Screens”.

5.2 User Interface Screen Overview

The basic client screen appears like (picture below):



5.2.1 Login

In order to effect any changes to the display or configuration, a user must login; requiring both a Username and Password (Username is logged in the activity audit trail). There are three levels of authority; Administrator (complete rights), Supervisor () and Guard ().

Operators, supervisors and administrators must log in to the client before using. Pressing the login button will cause a pop-up window to appear. The user must enter their login level (operator, supervisor or administrator) and their password and optionally their name. The button to the right will illuminate green for operators and yellow for administrators when login is successful. At the end of a shift, the user should press the illuminated button. This logs them out.

5.2.2 Select Radar Connection

Clicking on the Radar Controls Window will cause a pop-up window to appear. The window will permit the user to add or delete a radar. Radars are assigned an index as added.

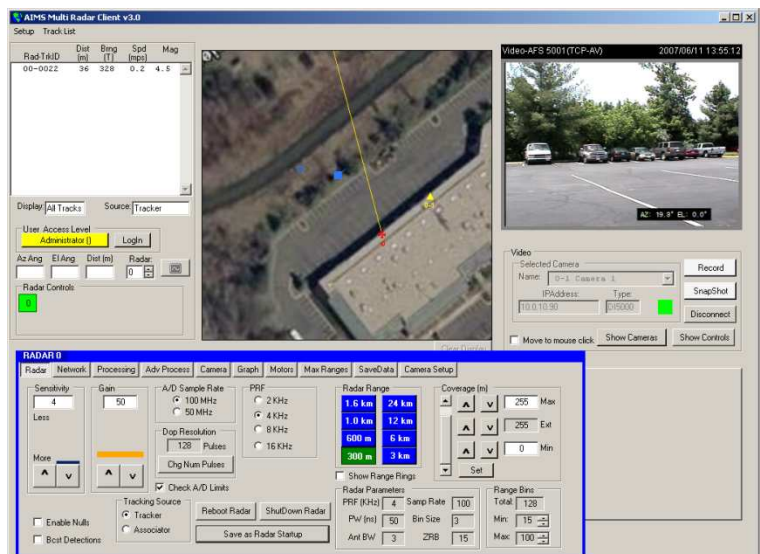
The client may connect to as many as 16 radar servers at one time. Adding a radar is as simple as clicking on the Radar Controls area and select “Add a Radar.” This version can add up to 16 radar systems. Each new radar is given a button in the Radar Controls area, and the tab set associated with that radar is given an index from 0 to 15. For instance, **Error! Reference source not found.** shows 3 radar systems have been added and radar #1 parameter tab set is open. Deleting a radar is also straightforward. Click on the Radar Controls area and select “Delete a Radar.” When a radar is deleted, the button is removed from the Radar Controls area. All other radar indices remain the same, even if the radar being removed is not the last radar. There is no reshuffling of the indices when a radar is removed. For example, if there are 3 radars (indexed 0, 1 and 2) and radar #1 is removed, the other 2 radars keep their index (0 and 2).

Cameras are added to the interface by assigning them to a given radar. The current version 3.22 permits 2 cameras to be controlled by a single radar server. Controlling more than one camera requires that each of the cameras is addressable. Cameras that use serial communications (such as RS-232/422/485) often set addresses using dip switches. Network cameras use IP addresses. Cameras that are not addressable must have a serial port assigned to each camera, which limits the number of cameras to 2. The radar server code has the appropriate port setup parameters if this is required.

Only one video stream to be displayed at a time. The camera video being displayed is indicated in the Video Server Control window and the camera’s position is illuminated as a triangle on the PPI Display. (See **Error! Reference source not found.**).

5.2.3 Plan Position Indicator (PPI)

The Plan Position Indicator, or PPI, provides the user a bird’s eye view of where the detected activity is relative to the radar locations. The PPI display plots detection and track symbols over a digital map. If no map exists, then a compass rose (bearing markers and range rings) are displayed. Radar locations are indicated with red crosses; camera locations as yellow triangles. Yellow vectors from the camera or radar indicate current look direction. Clicking on the display will manually override slew-to-cue (automated pointing of camera by radar and point the camera.



5.2.4 Camera Video Display

The video from any attached camera is shown in the video display window. If there is no video or if there is a loss of video, this window defaults to a white background with the DMT logo.

Video Servers convert analog video streams to digital streams and then pass them over a network. The video server control allows the user to connect/disconnect and to select the video feed shown in the Video Display Window. The video server controls provides the TCP/IP address and camera type. TCP/IP and camera types are set under the Camera Setup Tab of the particular radar for which the camera is linked.

If selected, “Move to mouse click” allows the user to navigate the camera using the mouse. Simply by pointing to a location on the PPI display and clicking the left button, the camera is instructed to change it elevation, azimuth and zoom to look at the location selected.



5.2.5 Detected Tracks Information

Sustained detected activity that meets the guidelines for a “track” are created and updated in this screen display area.

Tracks are identified by Track ID (Rad-TrkID), Distance (Dist), Bearing (Brng), Radial Velocity (RVel), and Magnitude (Mag). As new activity is detected the tracker either updates an existing track or the foundation of a new track is created. Tracks that do not have continued updates eventually expire and are removed from this list.

Rad-TrkID	Dist (m)	Brng (T)	RVel (mps)	Mag
00-0906	159	225	0.0	152
00-0907	465	225	0.0	164
00-0908	69	225	0.0	193
00-0909	39	225	0.0	153
00-0910	105	225	-0.3	148

Display: All Tracks Source: Simple Tracker

5.3 Configuration Tabs

The initial values and selected options on the Configuration Tabs indicate the state of the AIMS Radar once a network connection is established. Changes to the AIMS Radar parameters are made by selecting (clicking) on option buttons and check boxes. Administrator privilege is required to access most of the Setup Tab controls. Controls not available will be grayed out.

Caution: Users should not change values if they are unsure of the consequences. When experimenting with new settings do NOT save the radar parameters as default until performance has been verified.

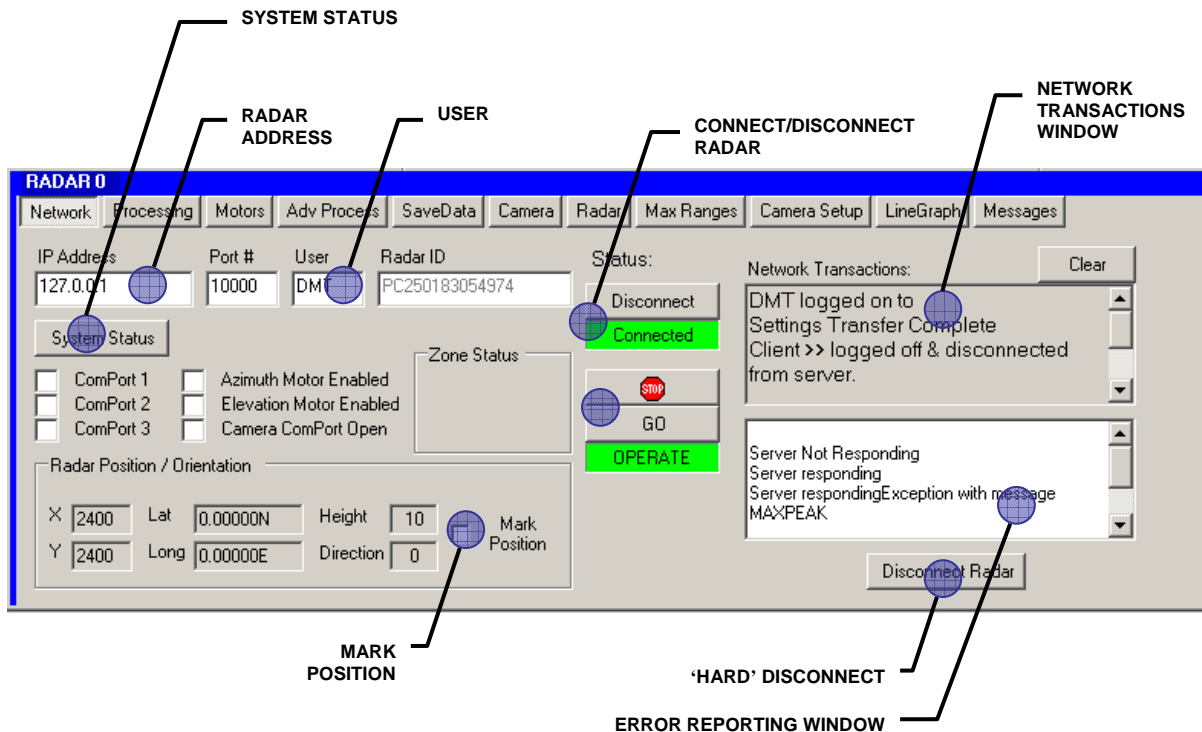
The tabs provide access to the various features that may be changed to configure the system. The tabs include;

- Network
- Processing
- Motors
- Adv Process
- SaveData
- Cameras
- Radar
- Camera Setup
- LineGraph
- Messages



The following subsections briefly discuss each tab and its parameter settings.

5.3.1 Network Tab

The Network Tab primary function is to provide the interface to connect and disconnect from the currently selected radar server.



5.3.1.1 System Status

When selected, the System Status button forces the built-in-test function to verify the operational status of the serial communications ports, azimuth/elevation motors, and camera ComPort. If properly operating, the relevant box is filled green, . If not, the box is filled red, .

5.3.1.2 Radar Address

The IP Address and Port # of the currently selected radar must be properly entered here before the client may connect to it.

5.3.1.3 User

A unique User name must be entered here prior to attempting to connect to the current radar server. If another client is connected to the radar server under the same username, the server will reject the connect request.

5.3.1.4 Connect/Disconnect Radar

When selected the client request to connect/disconnect from the radar server. When connected, only the disconnect button is active and when disconnected only the connect button is active. When attempting to connect/disconnect, both buttons will temporarily be disabled until the server verifies the change in status back to the client.

5.3.1.5 “Hard” Disconnect

Rarely used, this button forces the immediate termination of the client connection to the radar and does not wait for verification from the server. This should only be used if there is an unnatural suspension of the connection status.

5.3.1.6 Network Transactions Window

This windows displays all the major network transaction activity between the client and the server. The window may be cleared by selecting the Clear button on the upper right hand corner of the window.

5.3.1.7 Error Reporting Window

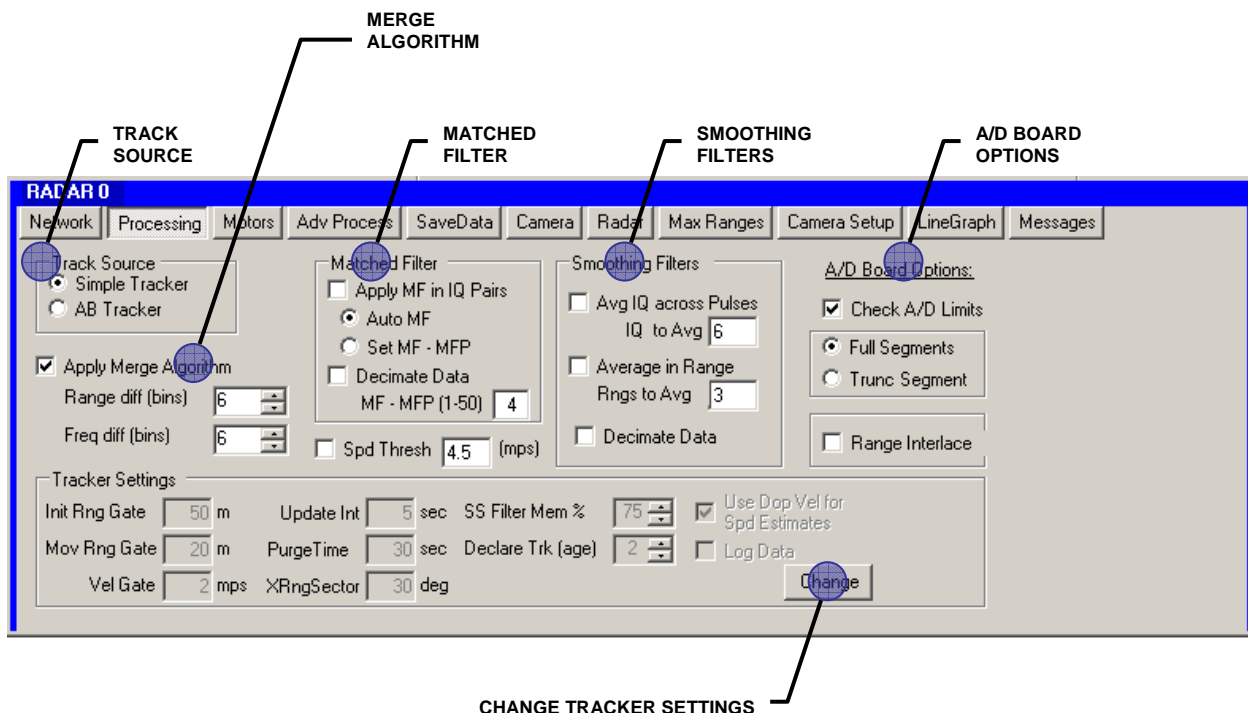
This window displays both error reporting and special messaging from the server to the client. The window may be cleared by double clicking the mouse in the window space.

5.3.1.8 Mark Position

When selected, the mark position checkbox allows a user to position the icon of the current radar on the map background by placing the mouse on the location for the radar and clicking the select button. This function only works when a map has been placed unto the background of the display. (for details on how to make maps for AIMS, refer to document “Map Making for AIMS”).

5.3.2 Processing

All of the items on the Processing Tab and Advanced Processing Tab are designed to reduce signal from the environment (known as clutter), reject internal noise and false alarm generators, and increase intruder signal strength.



5.3.2.1 Track Source

5.3.2.2 Merge Algorithm

5.3.2.3 Matched Filter

The **Matched Filter** is a digital signal processing technique that matches the receiver characteristics to the transmitted characteristics. More directly, the pulse width and pulsed shape are matched. Since the radar pulse for AIMS is very square (that's a good thing), the matched filter can be generated by simply matching receiver gate width to the transmitted pulse width. This is accomplished by coherently summing the range bins until the sum equals the pulse width. Since pulse width is in nanoseconds, it must be converted to meters ($\text{pw (meters)} = \text{pw (nanoseconds)} * 3\text{E}8$). This implementation is sometimes referred to as a "boxcar" matched filter. The result is improved range performance and clutter rejection. The size of the filter is a function of the pulse width or length and can be set for Auto calculation (**Auto MF**) or set manually (**Set MF - MFP**). Auto MF will allow the radar to calculate the appropriate number

of range bins needed to match the pulse width automatically. Set MF allows the user to override the automated calculation. DMT have found that performance for the radar is often better when the MF constant is a little lower than the value calculated by the Auto MF procedure. The MF constant value is set and reported in the text box in the lower right corner of the Matched Filter settings box. The matched filter routine is implemented before the FFT algorithm.

When the matched filter is applied to the data, it generates as a *sliding* window filter. For instance, if the matched filter is set to 4, then the first application is range bin 1 = range bins 1+2+3+4, the second application is range bin 2 = 2+3+4+5, the third application is 3+4+5+6, and so on. **Decimate Data** should be implemented as a method for speeding up processing. When enabled, it applies the matched filter as stepped filter – not sliding. For example, if the matched filter is set to 4, then the matched filter will be applied for range bin 1 = range bins 1+2+3+4, then range bin 2 = range bins 5+6+7+8, range bin 3 = ranges bins 9+10+11+12, and so on. In this example, the overall number of bins to be processed by the FFT will be one-fourth as many. This would result in significantly faster processing, which in turn permits the radar to spin faster.

5.3.2.4 Smoothing Filters

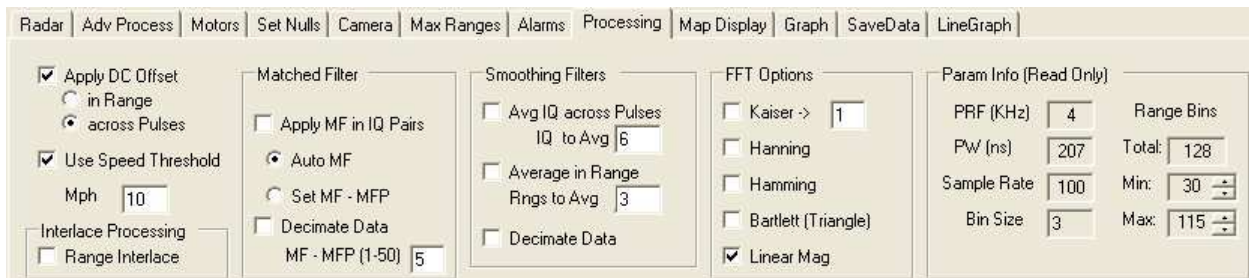
5.3.2.5 A/D Board Options

5.3.2.6 Change Tracker Settings

The Processing tab, Figure 1, contains options for the Matched Filter, FFT (Fast Fourier Transform) processing, applying a DC Offset, and a Speed Threshold. The Advance Processing Tab, Figure 19, contains Smoothing Filters, Ramp Functions, ClutterX options.

Apply DC Offset is an algorithm ensures that the In-phase and Quadrature (I/Q) channels of the radar are well balanced and centered and 0 volts. Unbalanced and non-centered channels will result processing sidelobes, which can generate false alarms. The **in-Range** option is a traditional implementation of the algorithm, whereas, the **across-Pulses** is a better performing implementation of the algorithm. *DMT recommends that Apply DC Offset is always enabled (checked) and across-Pulses is selected.*

The **Use Speed Threshold** is an option that can be used to focus on targets of interest. The threshold limits reported detections to targets traveling slower than the threshold speed; for example only targets traveling 10mph or slower.



The screenshot shows the 'Processing' tab selected in the software interface. The settings are as follows:

- Apply DC Offset:** Checked. Radio buttons for 'in Range' and 'across Pulses' are present, with 'across Pulses' selected.
- Use Speed Threshold:** Checked. A text box shows 'Mph 10'.
- Interlace Processing:** Unchecked. A text box for 'Range Interlace' is empty.
- Matched Filter:**
 - ☐ Apply MF in IQ Pairs
 - ☒ Auto MF
 - ☐ Set MF - MFP
 - ☐ Decimate Data MF - MFP (1-50) [5]
- Smoothing Filters:**
 - ☐ Avg IQ across Pulses IQ to Avg [6]
 - ☐ Average in Range Rings to Avg [3]
 - ☐ Decimate Data
- FFT Options:**
 - ☐ Kaiser -> [1]
 - ☐ Hanning
 - ☐ Hamming
 - ☐ Bartlett (Triangle)
 - ☒ Linear Mag
- Param Info (Read Only):**
 - PRF (KHz): [4]
 - PW (ns): [207]
 - Sample Rate: [100]
 - Bin Size: [3]
 - Range Bins: Total: [128], Min: [30], Max: [115]

Figure 1 - Processing Options

Decimate Data does affect (reduces) the resolution of the system by elimination of the sliding window. *DMT recommends that Decimate Data be disabled for most sites and should only be enabled when high rotation speed becomes critical.*

Range Interlacing is an algorithm that mimics the methods used by search and rescue teams to quickly scan large areas in less time. DMT has added this algorithm to speed up search by reducing the number of range bins that must be processed. Figure 8 illustrates the principle. *The process should only be used with rotation speed of the radar becomes critical.*

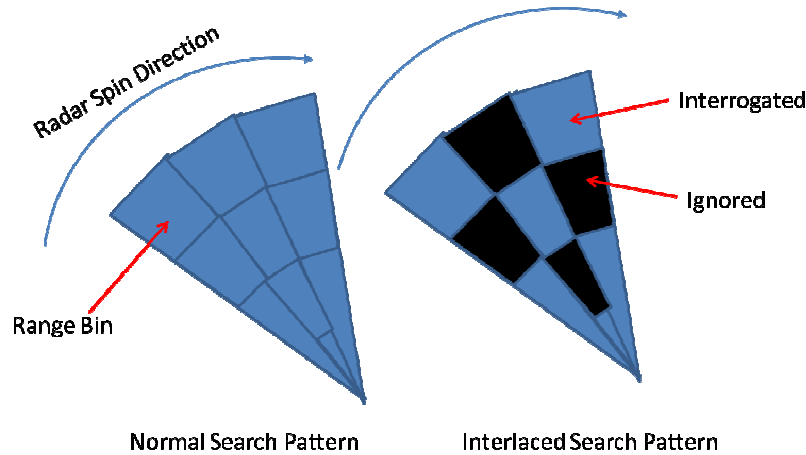


Figure 2. Range Interlacing.

The Fast Fourier Transform (FFT) is used to generate Doppler signatures. Doppler is the measure of frequency shift in a signal that is reflected off a moving object. An object moving towards the radar results in a positive shift. A positive shift is a compression of the wavelength, which translates to a resultant frequency higher than the transmitted frequency. An object moving away from the radar results in a negative shift (a stretching of the wavelength), which translates to a frequency lower than the transmitted frequency. Doppler can be converted to object relative speed. That is, the Doppler can tell the user the speed of an object relative to the radar. And the direction of the object relative to the radar can be instantly obtained by the sign of the Doppler (positive means its heading toward the radar, negative means its heading away from the radar). The FFT enables the radar calculate all Doppler frequencies for a given look direction and for a single range bin. DMT's software calculates thousands of FFT's in a second. To facilitate real-time operation, DMT has employed the fastest FFT algorithm available.

Since every look at an object is over a finite time, processing artifacts arise. One such artifact is known as processing sidelobes. Sidelobes are normally displaced from the real Doppler frequency, so the detection of these lobes can result in false Doppler readings. These sidelobes have typically 20 times less power than the main lobe (real Doppler). So for the most part, these sidelobes are not detected. For large objects, however, the integration gains from the FFT can result in detectable sidelobes. If large objects are expected, then *weighting* of the raw radar data can result in suppressed sidelobes. **Kaiser, Hanning, Hamming, and Bartlett** are weighting algorithms. *DMT does not normally invoke these algorithms when the radar is searching long ranges.* The reason is because there is a penalty in the true Doppler signal level when used.

The magnitude (strength) of radar signals is normally presented as either linear units (of voltage) or in dB (decibels). Traditionally, dB is used in radar applications because it allows fine details of small signals to be seen with clarity even when very large objects are present. However, *DMT uses **Linear Mag** (linear magnitude) for most site installations.* Linear magnitude offers finer control of threshold settings. The units for Sensitivity are set as by the selection of Linear Mag. If checked, Sensitivity increments are in linear units. If not checked, then Sensitivity is adjusted in dB units.

Param Info is a read-only section of the Processing Tab. The parameters listed in the box are repeated elsewhere and are included as a reference.

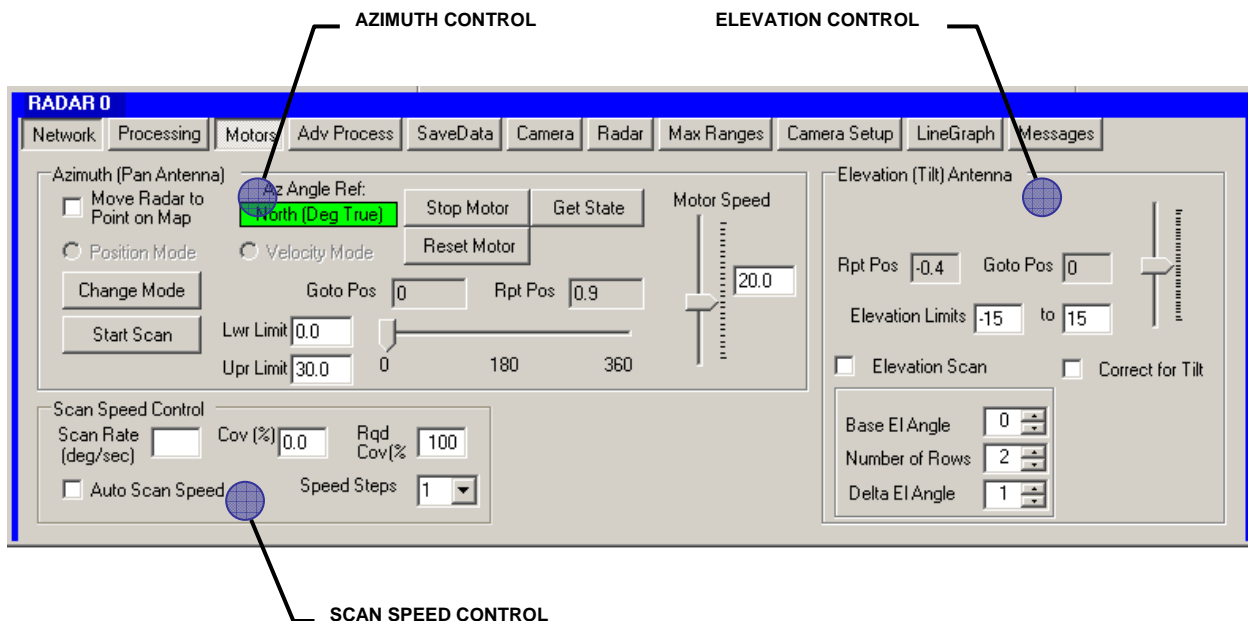
Additional Processing and Advanced Processing options shown in Figure 3 provide options to apply **Smoothing Filters**, **Ramp Functions**, and **ClutterX**. The smoothing filters and ramp functions are used to digitally lower signal strength over a given range swath. They are particularly useful for reducing the affects of processing artifacts generated from very large objects located at close ranges. Large objects at close ranges can reflect so much energy that it saturates the radar at that range. Saturation can cause false target detection. Ramp functions lower the signal strength to levels below alarm thresholds. The **Beginning Range** indicates the first range bin for which the function is applied and the **Ending Range** indicates the final range bin. The **Ramp Percent** represents that maximum percentage applied to the measured magnitude (signal strength). So a *Ramp Percent* value of 30 means that the signal strength will be reduced to 30% of its current value. **Linear Ramp in Range** means the reduction is applied over a linear slope from 0 to *Ramp Percent*, which the above example is 30%. This linear slope is applied over the *Beginning Ranges* to *Ending Ranges*. **Step Ramp in Range** means the reduction is an equal percentage over the entire range swath defined (*Beginning Range* to *Ending Range*). Clutter X allows for the removal of nuisance alarms around zero Doppler (very slow or non moving objects). Clutter X (sometime referred to as a clutter notch), sets all values in and around 0 Hertz = to the text box in the lower right hand corner. Appropriate settings for this text box are usually 0 or negative numbers. [Note: A negative number lowers the plotted color of the notch to black and thereby, is easier to see when looking at Doppler Plots.] The number in the upper left corner text box represents the number of Doppler bins (frequency slices) around 0 Hertz that are set. “0” in this text box equals to 0 Hertz only. “1” in this text box represents one Doppler bin on either side of 0 Hertz is set. Commonly set values are 0 to 2. Clutter X is very useful for removing the response from swaying trees, moving water, or windblown heavy brush. Setting Clutter X too high can reduce the ability of detecting walking humans.

The screenshot shows the 'Advanced Processing Options' window of the AIMS Fast-Scan Radar v3.22 software. The window has a tabbed interface with the following tabs: Radar, Adv Process (selected), Motors, Set Nulls, Camera, Max Ranges, Alarms, Processing, Map Display, Graph, SaveData, and LineGr. The 'Adv Process' tab is active, displaying three main sections: 'Velocity Signs', 'Ramp Functions', and 'Clutter X'. The 'Velocity Signs' section contains two radio buttons: 'Negative (toward)' and 'Negative (away)', with 'Negative (away)' selected. The 'Ramp Functions' section contains two columns of settings. The left column is for 'Linear Ramp in Range' (checkbox is unchecked) and the right column is for 'Step Ramp in Range' (checkbox is unchecked). Both columns have three input fields: 'Beginning Range' (0), 'Ending Range' (50), and 'Ramp Percent' (30). The 'Clutter X' section contains a numeric input field set to 1, a checkbox, a yellow highlight bar, a numeric input field set to -20, and two arrow buttons (up and down).

Figure 3 - Advanced Processing Options

5.3.3 Motors

Antenna movement and position can be controlled using the commands on the Motors tab. This is primarily intended for use during initial setup, sensor tuning, and troubleshooting. When in position mode the radar can be moved to a specific location (azimuth and elevation) by clicking on the map. To operate in this mode select the Move Radar to Point on Map check box and simply click on the map. Caution: Verify the Azimuth motor is in the Position Mode before selecting this option. Problems with the antenna motors are indicated by AIMS Server via a message to the AIMS Client. The AIMS Client will display “Error” for the reported position (Rpt Pos), Figure 10.



5.3.3.1 Azimuth Control

There are several commands available for working with the Azimuth motor. The primary commands are Change Mode and Start/Stop Scan. Change Mode is used to transition the azimuth motor between Position and Velocity modes. When in Position mode a sector scan can be accomplished by setting lower and upper limits and clicking Start Scan. The button text will change to Stop Scan and the azimuth motor will move between the lower (Lwr) limit and upper (Upr) limit continuously until Stop Scan is clicked. Scan limits should be entered using negative angles so that the minimum scan angle is always less than the maximum. For example, to scan from 350 degrees to 20 degrees enter -10 to 20 for the minimum and maximum scan limits respectively. The commands; Stop Motor, Get State, and Reset Motor were added for safety. The Stop Motor command will send an immediate stop command to the motor. Once stopped the

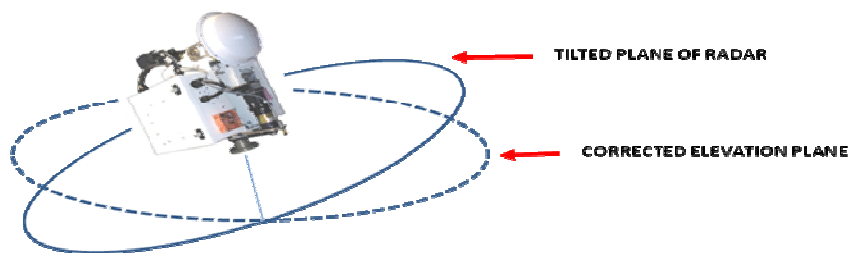
Reset Motor command must be issued before any positioning or Change Mode commands can be issued. The Reset Motor command starts the motor and sends it to the home or 0° position. Once the motor has reached the home position it will automatically enter the position mode. The Get State command will provides a status message that indicates the current mode of the motor; position or velocity. The Position Mode and Velocity Mode options are intended to reflect the status on the server only. The mode is changed by clicking on the Change Mode button. The Change Mode button in the Azimuth antenna control toggles the Azimuth or Panning antenna between the Constant Velocity mode (continuous spinning) and the Position mode. When leaving the Constant Velocity mode the antenna will first return to the home position, 0°, before entering the Position mode. Absolute position commands should not be issued until the antenna has returned to the home position (Position Mode option is on). In position mode the slider can also be used to position the antenna. As the slider is moved by clicking and holding the mouse left button the angle is reported in the Goto Pos text box. When the slider is released, left mouse button up, the go to position is transmitted to the AIMS Radar (server).

5.3.3.2 Elevation Control

The Elevation or Tilt motor remains in the Position mode. Adjustments in elevation (tilt) are made using the slider bar or by clicking on the map (assuming the Move Radar to Point on Map option is selected). To change the elevation using the slider bar click, hold and move the slider to the desired angle and release. As the slider is moved the angle will be reflected in the Set El Pos text box. When released this elevation position will be transmitted to the radar. As the Antenna moves to a new location the angle will be reported in the Current El Pos text box.

5.3.3.2.1 Tilt Compensation

The checkbox *Correct for Radar Tilt* enables the software to recalculate the horizon by creating a new array of elevation settings based upon the tilt information provided by the compass (if installed).



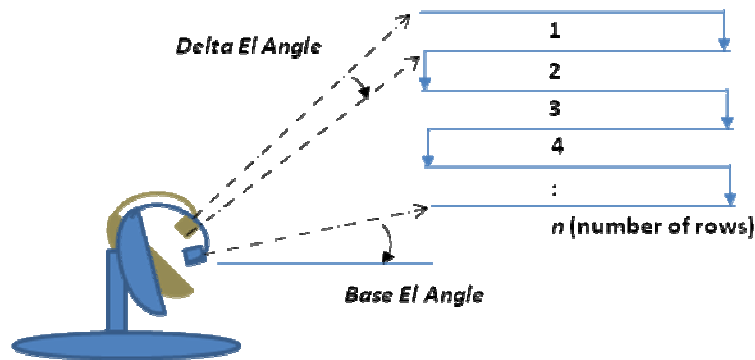
5.3.3.2.2 Elevation Scan

Elevation scan is used to search an area in the elevation domain where the area being search is broader than the vertical beamwidth of the antenna. On the completion of each azimuth scan

range, the elevation is adjusted by the *Delta Elevation Angle*. Upon the completion of *Number of Rows*, the direction of elevation scan is reversed (up-down-up-down...)

The elevation scan is defined by:

- Base Elevation Angle
- Number of Rows
- Delta Elevation Angle



5.3.3.3 Scan Speed Control

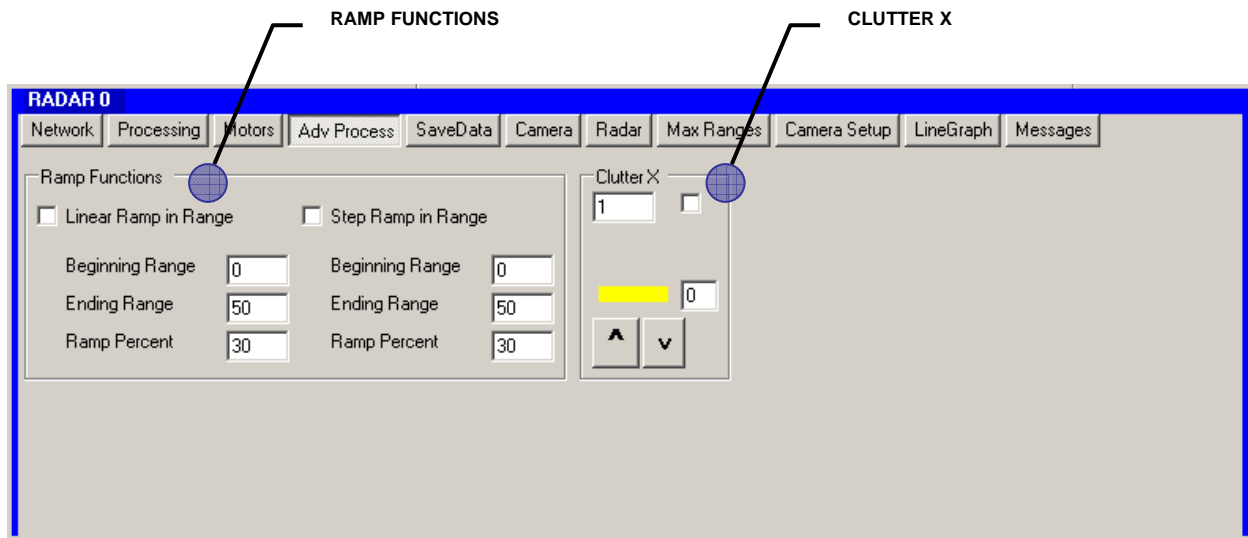
Auto Scan is a learning algorithm that tries to set the optimum motor speed dynamically to insure the desired overlap in azimuth beam positions. It evaluates the min and max ranges for each angle and the processing speed to determine the best speed setting. It works best for very wide sector scans and 360° rotation. The Auto Scan control parameters include;

- Enable/disable Auto Scan Speed
- Required Coverage% (1-100%)
- Speed Steps

Also displayed in this area are;

- Actual Coverage %
- Current Scan Rate (deg/sec).

5.3.4 Adv Process



5.3.4.1 Ramp Functions

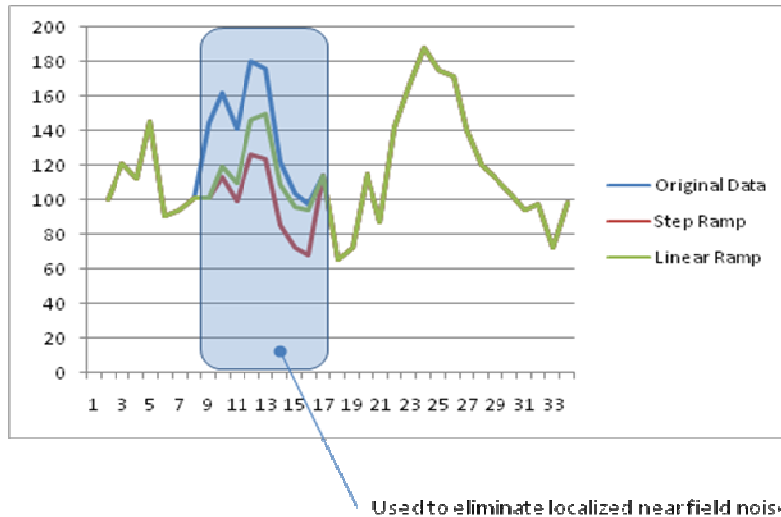
The ramp functions are used to digitally lower signal strength over a given range swath. They are particularly useful for reducing the affects of processing artifacts generated from very large objects located at close ranges. Large objects at close ranges can reflect so much energy that it saturates the radar at that range. Saturation can cause false target detection.

The ramp function options include;

- *Linear Ramp in Range*
 - *Beginning Range.*
 - *Ending Range*
 - *Percent*
- *Step Ramp in Range.*
 - *Beginning Range.*
 - *Ending Range*
 - *Percent*

Ramp functions lower the signal strength to levels below alarm thresholds. The Beginning Range indicates the first range bin for which the function is applied and the Ending Range indicates the final range bin. The Ramp Percent represents that maximum percentage applied to the measured magnitude (signal strength). So a Ramp Percent value of 30 means that the signal strength will

be reduced to 30% of its current value. Linear Ramp in Range means the reduction is applied over a linear slope from 0 to Ramp Percent, which the above example is 30%. This linear slope is applied over the Beginning Ranges to Ending Ranges. Step Ramp in Range means the reduction is an equal percentage over the entire range swath defined (Beginning Range to Ending Range).



5.3.4.2 Clutter X

Main Lobe Removal (also referred to as Clutter X or clutter notch) allows for the removal of nuisance alarms around zero Doppler (very slow or non moving objects) by setting all values in and around 0 Hertz to the Mainlobe Value. Clutter X is very useful for removing the response from swaying trees, moving water, or windblown heavy brush. Setting Clutter X too high can reduce the ability of detecting walking humans.

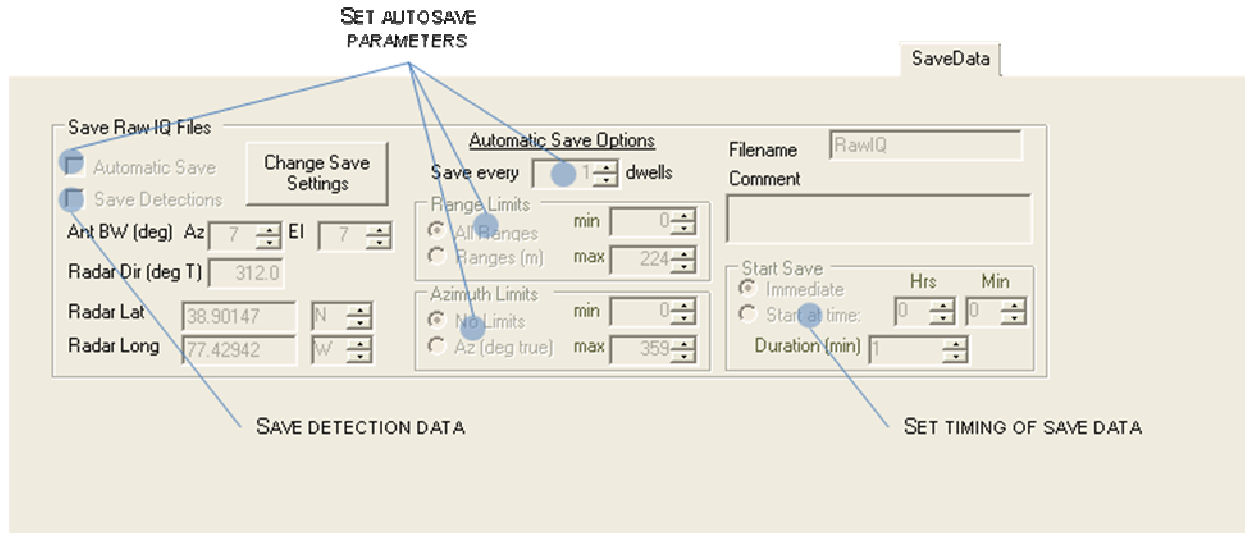
The Main Lobe Removal options include;

- *Remove Mainlobe.* Enables the main lobe removal.
- *Mainlobe Half-Width.* The Mainlobe Half-Width represents the number of Doppler bins (frequency slices) around 0 Hertz that are set. “0” in this text box equals to 0 Hertz only. “1” in this text box represents one Doppler bin on either side of 0 Hertz is set. Commonly set values are 0 to 2.
- *Mainlobe Value.* Appropriate settings for the Mainlobe Value are usually 0 or negative numbers. (Note: A negative number lowers the plotted color of the notch to black and thereby, is easier to see when looking at Doppler Plot). However, this value should be set to zero when Autolobe is being used.

5.3.5 SaveData

The SaveData Tab is fairly self-explanatory as this tab is used to establish the conditions and filename attributes that define how Raw IQ data files are saved.

SaveData Tab



The screenshot shows the 'SaveData' tab interface. At the top, it says 'SET AUTOSAVE PARAMETERS' and 'SaveData'. The interface is divided into several sections:

- Save Raw IQ Files:** Contains checkboxes for 'Automatic Save' and 'Save Detections'. Below these are input fields for 'Ant BW (deg) Az', 'EI', 'Radar Dir (deg T)', 'Radar Lat', and 'Radar Long'.
- Automatic Save Options:** Contains a 'Save every' field set to '1 dwells'. Below this are 'Range Limits' (All Ranges, Ranges (m) with min/max fields) and 'Azimuth Limits' (No Limits, Az (deg true) with min/max fields).
- Filename:** A text field containing 'RawIQ'.
- Start Save:** Contains radio buttons for 'Immediate' and 'Start at time:'. The 'Start at time' section has 'Hrs' and 'Min' fields, and a 'Duration (min)' field.

Annotations with blue lines point to specific elements:

- 'SET AUTOSAVE PARAMETERS' points to the 'Automatic Save' checkbox and the 'Save every' field.
- 'SAVE DETECTION DATA' points to the 'Save Detections' checkbox.
- 'SET TIMING OF SAVE DATA' points to the 'Start Save' section.

5.3.5.1 Autosave Parameters

The Autosave settings include;

- Automatic Save
- Save Every x dwells.
- Range Limits.
- Azimuth Limits

5.3.5.2 Manual Save Parameters

The manual save settings include;

- Save Detections
- Start Save
 - Immediate
 - Timed.
 - Start Time
 - Duration

5.3.5.3 RawIQ File Saves

The file saving option allows raw IQ data to be stored on the local hard drive in the directory, c:\Data. The file names used will be the system time preceded by the string value listed in the text box, “File Name Base”. Enter the desired file name and check the Save RawIQ File box. Uncheck the box to stop saving data files.

5.3.5.4 Other Parameters

The following values are annotations that are stored with the saved data file(s);

- *Ant BW*
 - *Az* – Azimuth. The horizontal (or azimuth) beamwidth of the antenna.
 - *El* – Elevation. The vertical (or elevation) beamwidth of the antenna.
- *Radar Dir.* The absolute bearing of the radar home position. If a digital compass is installed, this information is updated on initialization or when *Update HPR* (Compass Tab) is selected.
- *Radar Lat.* The geo-positional latitude coordinates of the radar installation. If a GPS is installed, this information is periodically updated.
- *Radar Long.* The geo-positional longitude coordinates of the radar installation. If a GPS is installed, this information is periodically updated.

5.3.6 Cameras

RADAR 0

Network Processing Motors Adv Process SaveData Camera Radar Max Ranges Camera Setup LineGraph Messages

Camera Viewing Limits

Az Angle Ref: **North (Deg True)**

☒ Apply Limits

	Min	Max
Camera 1	0.0	360.0
Camera 2	0.0	360.0

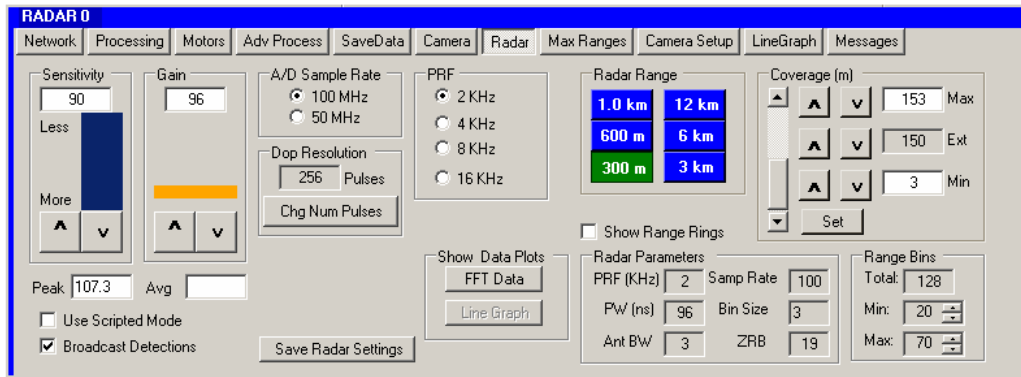
Change

Camera Control

	Type	Track to Alarms	Zone 1	Lock On Track	Control Panel	Cam Address
<input checked="" type="radio"/> Cam1	NONE	<input type="checkbox"/>	<input type="checkbox"/>	None		1
<input type="radio"/> Cam2	NONE	<input type="checkbox"/>	<input type="checkbox"/>	None		1

☒ Declared Triks

5.3.7 Radar



5.3.8 Max Ranges

RADAR 0

Network Processing Motors Adv Process SaveData Camera Radar Max Ranges Camera Setup LineGraph Messages

☒ Define Max Range Points
☒ Show Geometric Minimum Ring

Object Height: 1.5

Save File Tx File Ready

☒ Max Ranges
☐ Min Ranges

Update Hide List

☒ Update from Plot
☐ Update from List

Default Values:
 Max Ring (m): 300
 Min Ring (m): 50

Angle	Min Ring	Max Ring	EI Ang
000	50	203	-0.1
001	50	203	-0.1
002	50	201	-0.1
003	50	199	-0.1
004	50	197	-0.2
005	50	195	-0.2
006	50	193	-0.2

AIMS Client v3.22d

Setup Display Alarms

Rad-TrackID Dist (m) Ring (T) Spd (mps) Mag

Zoom In Zoom Out Re Center Re Store

Display: All Tracks Source: Simple Tracker

User Access Level: Administrator Login PPI

Az Ang EI Ang Dist (m) Radar Show Alarms

Radar Controls: 0

DMT
Detection Monitoring Technologies

Video: Selected Camera Name: None Record
 IPAddress: Type: Snapshot
 Move to mouse click: Show Cameras Show Controls

RADAR 0

Network Processing Motors Adv Process SaveData Camera Radar Max Ranges Camera Setup LineGraph Messages

☒ Define Max Range Points
☒ Show Geometric Minimum Ring

Object Height: 1.5

Save File Tx File Ready

☒ Max Ranges
☐ Min Ranges

Update Hide List

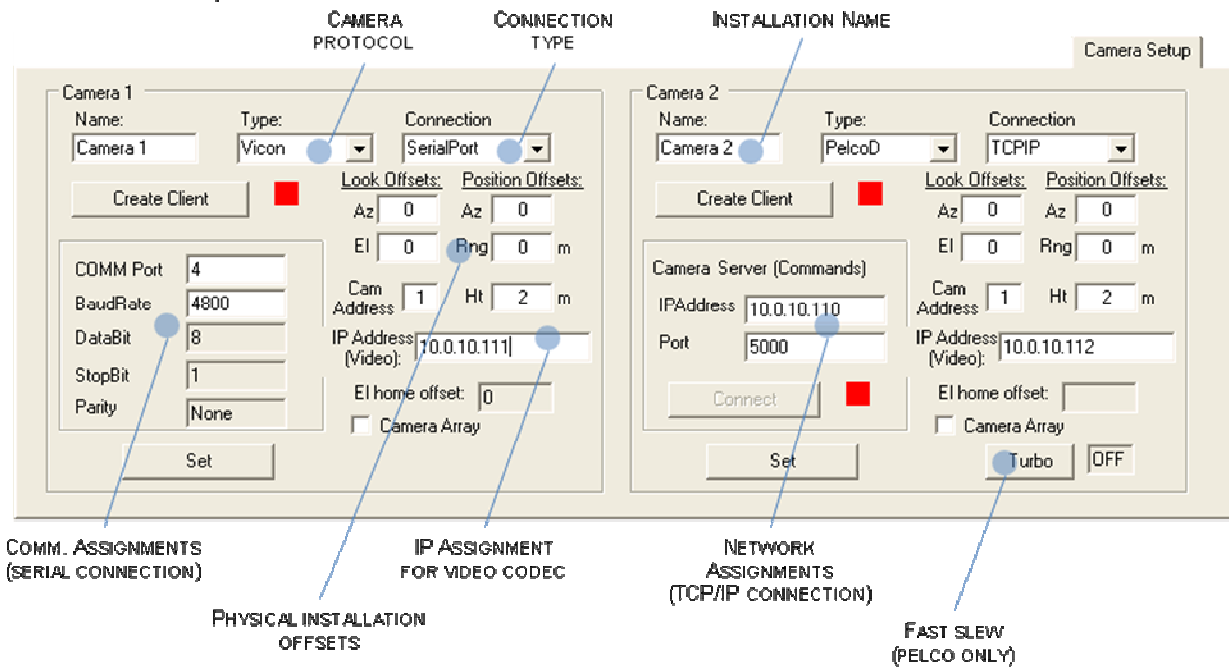
☒ Update from Plot
☐ Update from List

Default Values:
 Max Ring (m): 300
 Min Ring (m): 50

Angle	Min Ring	Max Ring	EI Ang
000	50	203	-0.1
001	50	203	-0.1
002	50	201	-0.1
003	50	199	-0.1
004	50	197	-0.2
005	50	195	-0.2
006	50	193	-0.2

5.3.9 Camera Setup

Camera Setup Tab



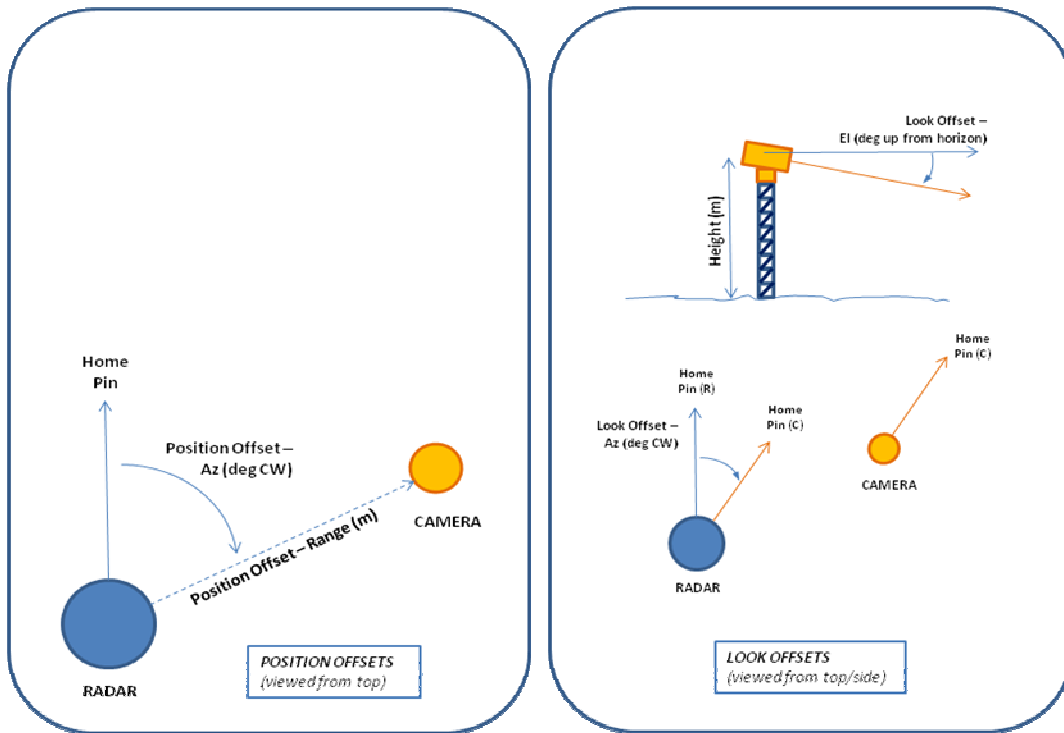
The screenshot displays the 'Camera Setup' tab with two camera configuration panels. Camera 1 is set to 'Vicon' type and 'SerialPort' connection. It includes a 'Create Client' button, a 'Set' button, and fields for 'Look Offsets' (Az: 0, El: 0, Ring: 0 m) and 'Position Offsets' (Az: 0, Ring: 0 m). Camera 2 is set to 'PelcoD' type and 'TCP/IP' connection. It includes a 'Create Client' button, a 'Set' button, and fields for 'Look Offsets' (Az: 0, El: 0, Ring: 0 m) and 'Position Offsets' (Az: 0, Ring: 0 m). Both cameras have 'Cam Address' (1) and 'Ht' (2 m) fields. Camera 2 also has a 'Camera Server (Commands)' section with 'IP Address' (10.0.10.110), 'Port' (5000), and 'IP Address (Video)' (10.0.10.112). A 'Turbo' button is present for PelcoD cameras. Blue callout lines identify various fields: 'CAMERA PROTOCOL' (Type), 'CONNECTION TYPE' (Connection), 'INSTALLATION NAME' (Name), 'COMM. ASSIGNMENTS (SERIAL CONNECTION)' (COM Port, BaudRate, DataBit, StopBit, Parity), 'PHYSICAL INSTALLATION OFFSETS' (Look Offsets, Position Offsets), 'IP ASSIGNMENT FOR VIDEO CODEC' (IP Address (Video)), 'NETWORK ASSIGNMENTS (TCP/IP CONNECTION)' (IP Address, Port), and 'FAST SLEW (PELCO ONLY)' (Turbo button).

5.3.9.1 Camera Parameters

For each camera, the settings include;

- *Name*. Unique name to identify camera setup.
- *Type*. Camera type (Vicon, Pelco, Pelco-D... etc.). The type identifies the communications protocol, configurable attributes and default communications parameters. At current, the AIMS software supports the following types;
 - None
 - DI5000
 - TASS
 - QuicksetN2
 - Vicon
 - PelcoD. If Pelco is selected, the Turbo button is enabled to allow the user to activate a fast slew.
 - LRAD
 - SentryII
 - Vumii
- *Connection*
 - SerialPort

- COMM Port
 - BaudRate
 - DataBit
 - StopBit
 - Parity
 - Cam Address.
- TCPIP
 - IPAddress
 - Port
- *Offsets.*
 - *Look Offset – Az.* This offset value defines the azimuth angle difference between the home pins of the radar and the camera (see drawing below).
 - *Look Offset – El.* This offset value defines the difference in degrees between the camera look angle (at 0° elevation) and the horizon (up is positive).
 - *Position Offset – Az.* This offset value defines the location (in degrees clockwise) the camera is positioned relative to the radar home pin.
 - *Position Offset – Rng.* This offset value defines the absolute distance the camera is positioned relative to the radar (in meters).
 - *Height.* This offset value defines the height the camera is positioned above the ground.
- *IP Address (Video).* The IP address of the video codec/server that digitizes the camera's output video stream (usually inside the UCM).
- *Camera Array.* This selection is used to support a very specific application involving four cameras installed at 90° angles and communicating on a single multidrop serial communications line. More detail may be found in the DMT document, "Camera Alignment and Operation Procedures for AIMS EA-System" (dated 1/23/2008).



5.3.9.2 Point to Mouse Click

This feature allows the user to quickly point any Camera attached to an AIMS Radar to a geographic point on the Client's PPI display. This action is performed by selecting the desired camera for this command, and then clicking the mouse at the point on the PPI display. This feature is discussed in more detail in the AIMS Client Manual.

5.3.9.3 Point to Radar Detection

Either or both *Camera 1* and *Camera 2* can be selected to point automatically at detections reported by the controlling AIMS Radar. This selection can be made by checking the *Track to Alarms* checkbox adjacent to the desired camera on the Client or on the Radar. When *Track to Alarms* is selected for a camera, that camera will automatically point at each Radar detection as it is declared.

The function is deactivated by un-checking the *Track to Alarms* checkbox.

5.3.9.4 AIMS Radar and Camera Alignment

The AIMS Radar software requires that several "alignment" parameters be determined for the system configuration and entered into the Client and Radar control programs. This section describes these parameters and illustrates the general procedure for determining their values.

These key alignment parameters are the Radar Direction (*RadDir*), the Look Offsets for each camera (*LookOffAz*, *LookOffEl*), and the Position Offsets for each camera (*PosOffAz*, *PosOffRng*). They are described briefly as follows:

- Radar Direction – The azimuth angle in degrees, measured positive clockwise, from True North to the Radar's look direction⁵ at its home position. That is, the *RadDir* is the true bearing of the Radar beam centerline at the Radar home position. This parameter is used by the AIMS software to calculate the Latitude and Longitude values for detections and other display symbols on the Client PPI display. If the *RadDir* is not entered properly in the AIMS Client and Radar programs, then Latitude/Longitude values calculated by the Radar will be incorrect.
- Look Offsets – These angles measure the difference (azimuth and elevation) between the Radar look direction at its home position and the camera look direction at its home

⁵ The Radar look direction is the outward direction of the Radar beam centerline.

position. The *LookOffAz* is the azimuth angle in degrees, measured positive clockwise, from the Radar to the camera. The *LookOffEl* is the elevation angle in degrees, measured positive up, from horizontal to the camera look direction. These parameters are used by the Radar software to calculate the proper pointing commands for the camera. Errors in the *LookOffAz* and *LookOffEl* values will result in incorrect pointing commands sent to the camera.

- Position Offsets – These offsets account for a camera being located at a different position than the AIMS Radar. The *PosOffAz* is the azimuth angle (measured positive clockwise) from the Radar look direction at its home position to the point where the camera is located. The *PosOffRng* is the range in meters from the Radar to the camera position. Errors in these values will result in incorrect pointing commands sent to the camera.

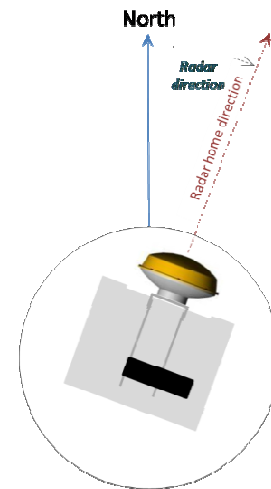
The AIMS control software will utilize the alignment parameters defined above to generate correct geographic positions (Latitude and Longitude) and to generate the correct azimuth and elevation angles for commanding cameras to point at radar detections and at geographic points on the AIMS Client PPI display.

The next sections will describe how to measure the various alignment parameters using this general diagram.

5.3.9.5 Radar Direction Measurement

The Radar Direction (*RadDir*) parameter measures the geographic orientation of the Radar. The figure below shows the plan view with the radome removed, the base plate exposed, and the AIMS Radar visible and located at its home position.

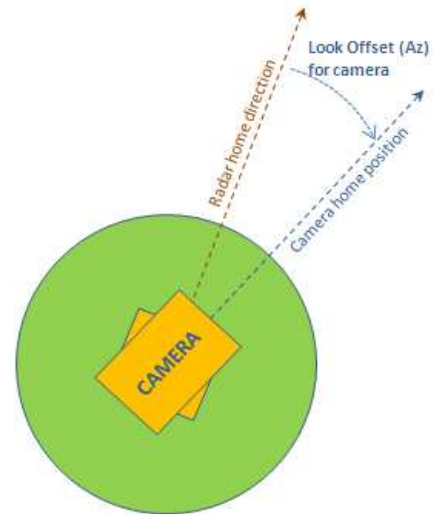
The Radar Direction is the angle in degrees between True North and the Radar home position. It is recommended that this direction be marked on the base plate so that it can be seen once the radome is replaced.



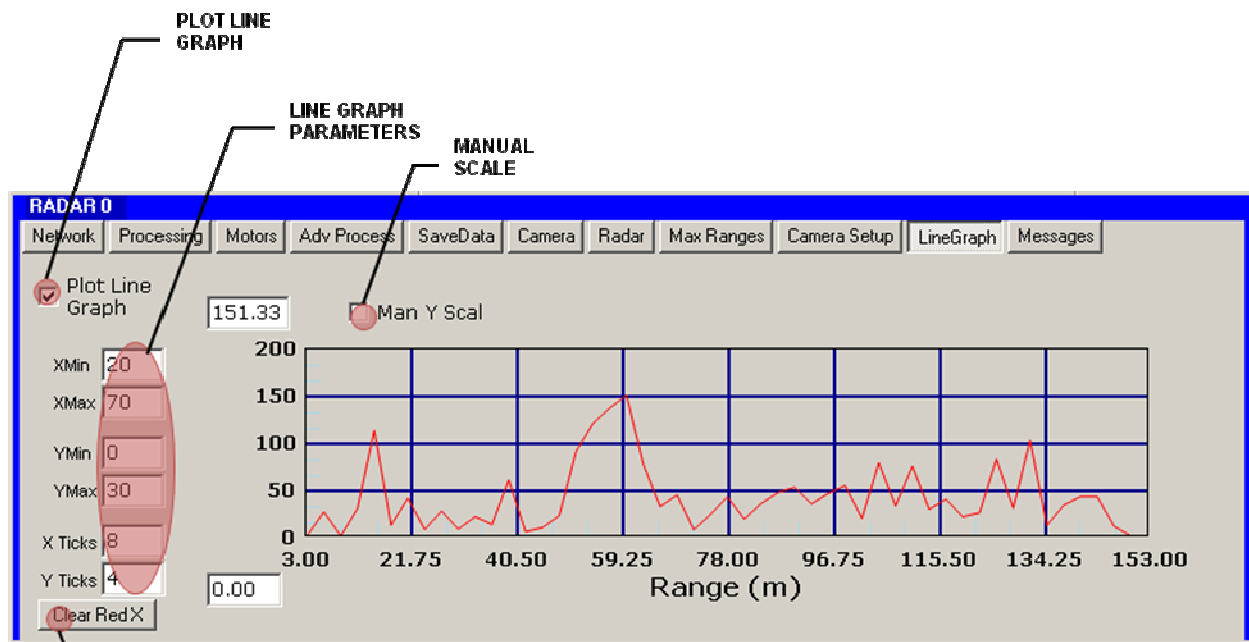
5.3.9.6 Camera Look Offsets

The figure at right illustrates the geometry for measuring the Look Offset azimuth (*LookOffAz*) for a camera mounted on top of the AIMS radome, with the Radar and the camera home positions indicated.

The Look Offset elevation (*LookOffEl*) should also be set to “0.” Note that the Radar orientation is expected to be level.



5.3.10 LineGraph



The Plot Line Graph option on the Line Graph tab plots the maximum Doppler return for each range. This is essentially a two dimensional representation of the FFT data. When selected, a line plot will be updated with each processing cycle of the AIMS Radar. The divisions on the plot can be changed by entering new values for the number of X or Y ticks. The values for the Y Axis, Ymin and Ymax can be set by selecting the Man Y Scale option. It is recommended that the Plot Line Graph option be disabled when changing the values for graphing.

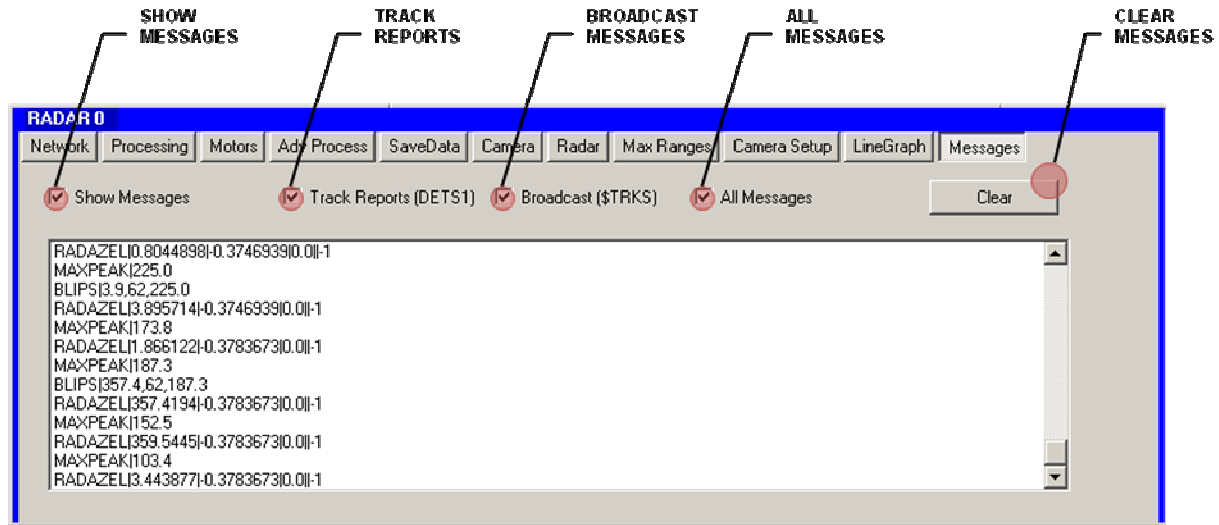
The Line Graph parameters include;

- *YMin*. When Man Y Scale is enabled for Line Graph, this parameter sets the minimum Y-axis value.
- *YMax*. When Man Y Scale is enabled for Line Graph, this parameter sets the maximum Y-axis value.
- *YTicks*. When plotting Line Graph, this parameter sets the number of Y-axis gradient lines.
- *XTicks*. When plotting Line Graph, this parameter sets the number of X-axis gradient lines.

When displaying a lot of graphics in real-time the Windows environment will sometimes get hung up and fail to properly refresh, showing a red X in the graphic window. The Clear Red X button clears those resources and allows the graphic display to recover.

5.3.11 Messages

This tab is used to visually monitor the reported traffic between the Radar Server and Client software.



The user may elect to see the Track Reports, Broadcast Messages, All Messages or none. The Clear Messages button is used to erase any previous messages from the screen display.

5.3.11.1 Processing Parameters

The Go and Stop buttons are used to start and stop the radar. Clicking the Go button sets a flag and puts the radar into the OperateLoop. Once entered the loop is continuous. Pressing the Stop button sets another flag that prevents the Operate subroutine from being called. The Operate loop is where the digitized data is processed.

Several check box options are available

- *Print to GUI.* The detection data is printed in the box on the Detection Tab.
- *Replay Data/Folder.* Prompts the user to select files for plotting. This is a diagnostic mode and should only be selected when the radar is stopped. To change the list of selected files the check box should be cleared and then checked again. To replay all files in a folder, check the folder checkbox.
- *Scripted Mode.* Checking this box results in values for the min and max ranges and the elevation angle being read from a file. The values stored are indexed by the azimuth angle and are intended to allow the radar to follow an outline created for an area of interest (configurable only through the Client interface).

5.3.11.2 Auto Scan Control

Auto Scan is a learning algorithm that tries to set the optimum motor speed dynamically to insure the desired overlap in azimuth beam positions. It evaluates the min and max ranges for each angle and the processing speed to determine the best speed setting. It works best for very wide sector scans and 360° rotation. The Auto Scan control parameters include;

- Enable/disable Auto Scan Speed
- Required Coverage% (1-100%)
- Speed Steps

Also displayed in this area are;

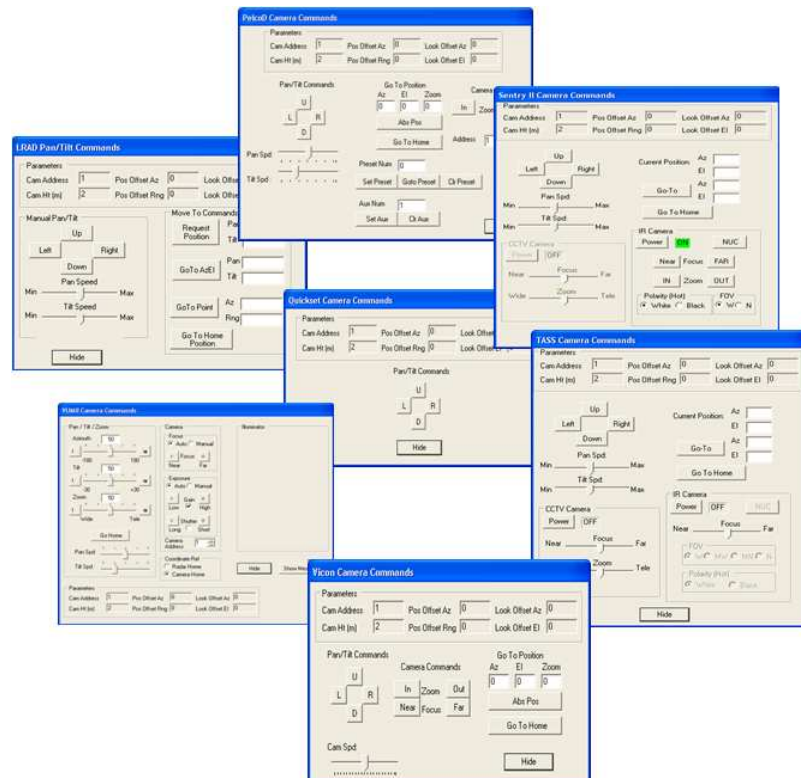
- Actual Coverage %
- Current Scan Rate (deg/sec).

5.3.11.3 Camera Parameters

For both Camera 1 and 2, the camera tracking settings include;

- *Track to Alarm.* Checking this box will enable slew-to-cue tracking of the camera to alarm detections.
- *Zone 1.* If Track to Alarm has been checked, the checking of this box restricts the tracking to alarms detected within *Zone 1* only.
- *Camera FOV Settings.* The minimum and maximum field of view (FOV) settings are used to limit camera tracking to range of coverage for each camera (after entering new values in text boxes click SetAngs to load values in system).

If a camera had been setup there would also appear another button *Show Cmds* immediately to the right of the *Zone1* checkbox. Selecting this feature brings up a new window containing camera management tools uniquely setup for each camera *Type* (see Camera Setup tab). Some example camera management screens appear below.



5.3.11.4 System Status

Selecting this button engages a built-in test function that verifies communications with the serial communication ports 1, 2 and 3, interrogates both the azimuth and elevation motors and verifies no other errors have been reported.

5.3.11.5 Restore Factory Settings

Used when all other efforts have failed to restore the operational state of the equipment! Before the equipment has left the DMT factory, during the final testing process, a factory settings file is created (“FactorySettings.txt”). Like the Saved Settings file (“SrvrSetMR.txt”), the Factory Settings file is used to restore the equipment to a known operational state. Please do not alter this file.

6 Troubleshooting

6.1 No Connection to the AIMS Server.

If the AIMS client is not connected follow the instructions listed in **Error! Reference source not found..** Be sure that the correct IP address and Port number are entered on the Network tab. If all settings are correct and no connection can be established;

1. Open a command window and use ping to check the communication link to the AIMS Server, enter 'Ping' followed by a space and the IP address for the server.
2. Check the IP configuration of the client computer by typing "ipconfig" in the command window. The client (or local) machine running the AIMS Client software should have an IP address similar to AIMS Server.
3. If the local machine and radar can be pinged, use Remote Desktop to connect to the Radar. Be sure that the AIMS Server application is running. Start the application if it is not.
4. If no communication to the Radar is possible, but local PC appears to be functioning normally, you may need to cycle the power to the Radar (a last resort).

6.2 The AIMS Server crashes.

This may happen if the AIMS Server application was restarted and there are erroneous values in the default parameter set file.

1. Connect to the AIMS Server using Remote Desktop.
2. Delete the SrvrSet.txt file located in the DMTLLC folder in the root directory (normally c:\DMTLLC\SrvrSet.txt)
3. Restart the application.

6.3 I'm getting too many False Alarms

This happens when one or more parameters have been set incorrectly, if the environment has changed significantly since installing the system, or if a man-made or object in nature begins to suddenly move dramatically.

There are several ways to control False Alarms:

- Set Range properly (**use** Scripted Mode when possible)
- Set Gain properly (Default set at installation)
- Set Sensitivity (Default set at installation)
- Set Clutter Cancellation (Clutter X):
 - Used to create a clutter notch (eliminates frequencies around 0 hertz)

- Default = 1, most commonly used values = 0, 1 or 2. Severe clutter values = 3 or higher.
- Set Null Cells (discussed in user manuals), Ramps or Steps
- Use Null Doppler Slices

The above mentioned items have been discussed in previous sections of this paper. Figure shows what these controls look like.

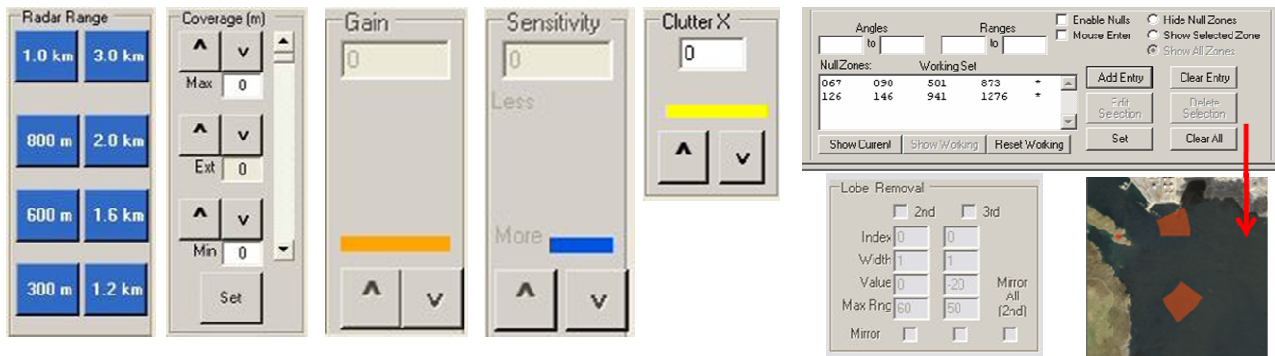


Figure 13. False Alarm Reduction Controls

6.4 I am not detecting as far as I would like.

For most occasions, the inability of the radar to detect an intruder is due to one or more settings of the radar. For instance, the intruder may be visible in a camera but is not detected because the maximum range setting is shorter than the current range of the intruder. The intruder may be inside a zone of no interest (a null zone, for instance). Remember that range is set using the Radar Range buttons found on the Radar Tab or through the Scripted Mode (described in earlier modes).

Detection range performance for a given intruder is a function of:

- **RCS** (radar cross section)
- **Output Power** of the radar
- **Antenna Gain**
- **Environmental Losses or obstruction.**

RCS is out of the control of the user. It is the “size” of the object as viewed by the radar. The wavelength of the radar, the reflectivity of that object, shape of the object, orientation and the size of the object affect its RCS. Units are given in square meters (sm) or dBsm. A walking human is taken to be 1 square meter or 0 dbsm by DMT.

The AIMS radar systems are ordered for a given detection range for humans. A 1.5 km AIMS radar means it should be able to detect the average walking human up to about 1.5 km. Output power and antenna gain are set by the factory for these ranges. So if you have purchased a 1.5 km system, the power amplifiers used to generate the pulsed energy and the antenna size and shape have been specified to give you this performance. ***So if you have purchased a 1.5 km radar, you will not see a person at 3 kms – even if you have selected 3 km on the user interface.*** In addition, if the person is crawling or if the intruder is smaller than a human, the

detection range will be less than the maximum rated performance. So for our example, a crawling human will be detected at ranges less than 1.5 km for a 1.5 km radar.

If the person is walking behind a building or wall, the radar will not detect that object. In addition, a person partially obstructed will have a lower RCS and will also be detected at shorter ranges than a walking human. An example of this is thick vegetation. If a person walks in thick brush up to his/her waist, then the maximum detection range for this person is likely to be reduced to 75 to 80% of the range of a fully illuminated person.

There are 4 methods, however, for increasing the detection range of the radar:

- Increasing the GAIN setting of the radar;
- Decreasing the SENSITIVITY setting of the radar;
- Increasing the DOP RESOLUTION setting of the radar;
- Slowing the spin rate of the radar.

With the exception of the spin rate, these controls are all found on the Radar Tab.

Increasing *Gain* actually increases the transmitted pulsewidth of the radar. The greater the pulsewidth, the greater the average power output of the radar. This, in turn, will increase the detection range against all intruders.

Decreasing the *Sensitivity* setting actually lowers the threshold of the radar. Lowering the threshold of the radar will permit the weaker signals from distance objects to be detected at further ranges. However, lowering the Sensitivity control too low will cause more false alarms from near-in objects.

Increasing the *Dop Resolution* control value actually increases the number of pulses integrated by the radar. The more integrated pulses, the greater the effective signal strength for coherent objects (like people and cars). The greater the effective signal strength, the longer the detection range. Unfortunately, the price is paid by longer processing times. This often translates to slower spin rates.

Slowing the spin rate of the radar enables more energy to return to the radar receiver from the “sweet spot” of the antenna. The “sweet spot” (or inner 1-dB of the antenna’s main lobe) supplies the greatest amount of available power on the object of interest. There is a point of diminishing returns. Spinning the radar too slow will provide no additional performance boosts and can cause the radar to miss seeing an intruder due to the low revisit rate. Currently, the spin rate can only be set on the radar server code.

6.5 How do I use Sensitivity and Gain?

The Sensitivity control on the Radar Tab is a measure of the required signal strength needed to declare an alarm. The AIMS radar calculates the average signal strength using the outer cell slices of the Doppler Spectrum for every range bin. This value plus the Sensitivity setting value is compared to the peak Doppler response for every range bin. This procedure reduces false alarms by ensuring that the threshold is applied consistently above the average signal for every range bin. Figure illustrates the point. The red curve is the average Doppler spectra level versus range. The blue curve adds the threshold (Sensitivity) value to the red curve. It is this blue

curve level that must be crossed before a detection is declared. Of course this is the first of many steps used in validating the detection is a real target.

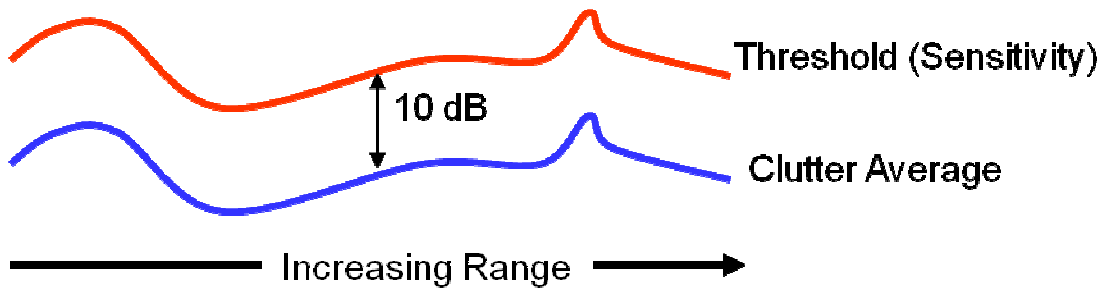


Figure 14. Threshold Setting

Gain is used to increase the average power of the radar. The value displayed in the textbox is the actual pulse width in nanoseconds (10^{-9} seconds). Typical values of gain are normally set to between 100 and 300 nanoseconds. When Gain increments, the values are the valid pulses currently wired in the radar's waveform generator board. Many more values are available, but must be specified upon request. DMT does not include all of the possible pulse widths settings because it is not particularly useful. A 101 nanosecond pulse, for instance, does not really provide measurable performance gain over a 100 nanosecond pulse. So DMT has provided only significant jumps in performance in the Gain control.