SightLine Applications User Guide

Release 2.16

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1 SightLine Product Export Controls

Exports of SightLine products and technical data are governed by the US Export Administration Regulations (EAR) (15 CFR parts 730-774) administered by the US Department of Commerce. Classification of SightLine products has been defined as ECCN 4A994 for documentation and hardware/firmware, and 4D994 for licensed software. Customers acknowledge re-export responsibility and certify that their sale or distribution of SightLine products (whether incorporated into another system or otherwise) may constitute a new export and as such must be in accordance with the requirements of the EAR.

2 Overview

SightLine Applications video processing systems utilize a proprietary suite of real time video processing algorithms to detect and track objects and to de-interlace, register, stabilize, and enhance video. Accepting video from EO (visible) or IR (infrared) cameras in standard formats, the system is controlled via RS232 or Ethernet using SightLine Applications' Native Communications Protocol [1]. Reporting of camera motion, target motion, and stabilization information are output at a user-configurable rate up to the video frame rate of 29.97 Hz.

SightLine Applications video processing systems are designed from the ground up to improve the usability of video in ISR (Intelligence, Surveillance, Reconnaissance) and situational awareness applications. SLA systems have been deployed for thousands of hours on multiple platforms. Registration, stabilization, tracking, and enhancement algorithms are fine-tuned to meet the challenging demands of real-world imagery and operate robustly across different lighting conditions with a minimum set of run time parameters.

This document is intended to describe how to use, configure, and integrate the SightLine Applications family of video processing units into your application.

3 General Usage Overview

A camera mounted in a moving vehicle such as an aircraft suffers from several motion-induced effects that are not present in stationary video applications. SightLine Applications systems are designed to accept video from moving cameras, and to robustly stabilize and enhance those video streams while simultaneously providing the frame-to-frame position of objects of interest.

Motion-induced effects include

- Interlacing – many standard video cameras are interlaced, which means that a single frame of video is actually exposed as two separate fields at different times (for NTSC cameras, one field is exposed every 16.7 milliseconds). Data from the two fields are "interlaced" with one another by taking alternating rows from the two fields: the top row of the video frame is taken from the top row of field 1, the second row from the top row of field 2, and so on. If the camera is moving or shaking, the fields may be of different parts of the scene and the resulting frame will appear doubled, blurry, or jittery. De-interlacing ameliorates this issue by replacing the odd rows of each frame with an estimate of their true content.
- Jitter – even after de-interlacing is applied to an interlaced video (or when using a non-interlaced video source), identifying fine details from a shaking camera can be difficult or impossible. Video stabilization operates by precisely calculating frame-to-frame registration, and then eliminating shake by suppressing the high-frequency components of the frame registration.
- Motion blur – fast camera movements, or imaging rapidly moving objects can result in the blurring of objects in an individual frame. This is particularly evident with long exposure times (or equivalently, slow shutters). Stabilization and tracking will behave properly even when motion blur is present. However, if motion blur is evident it may be advisable to decrease

camera exposure time to limit the effects.

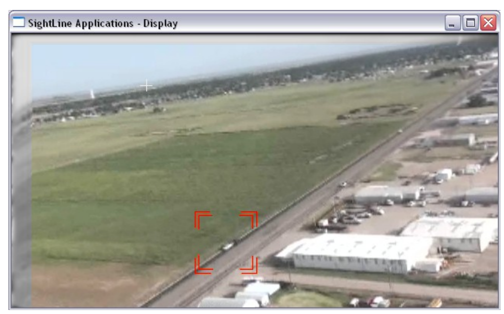
- Rolling shutter – some cameras, particularly consumer grade electronics utilize sensors with a rolling shutter (as opposed to a global shutter). These sensors expose each row of each frame at a different time. Under constant motion, objects appear stretched or skewed. Stabilization and tracking will perform properly (though with some degradation in accuracy and robustness), but the stabilized video stream will appear to vertically stretch and horizontally skew.

Sightline Applications system outputs information about stabilization and tracking through two telemetry streams described in [1]. These telemetry streams may be used to steer a turret, render stabilized video, and render track boxes over tracked targets. They must be enabled via the Set Coordinate Reporting Mode packet also defined in [1].

3.1 Using SLA-PANEL

SLA-HARDWARE object tracking utilizes template-based tracking in which the operator designates up to five targets to be tracked. Once designated, automatic tracking will determine the location of each target in each frame, along with a confidence measure; these values are output as part of the telemetry and tracking packets defined in the SLA-HARDWARE protocol. Depending on the state of the Enable Overlays parameter (see Overlays Group), the system will optionally overlay a tracking box on each target being tracked in the outbound video stream of the SLA-HARDWARE. Target overlays are enabled by default.

In the SLA-PANEL, a new track is created by a mouse click at the desired location in the tracking window (see below.) By default, this is indicated via a red tracking box. Left clicking in a new location will stop the current track, and create another track at the location of the new mouse click.

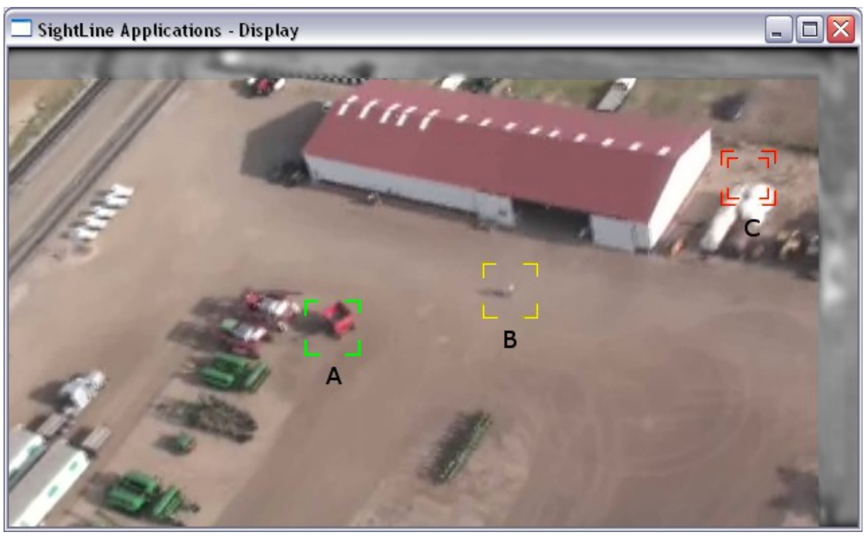


Left: SLA-PANEL tracking window which translates mouse clicks/movements into tracking messages.
Right: SLA-PANEL video output window with a solitary track, indicated by the red overlay.

To designate multiple tracks, hold down left-shift while clicking in the SLA-PANEL tracking window. Provided that the location of the mouse click is not near any tracks, this will create a new target in the location of the mouse click, without stopping the tracking of any targets already being tracked. If on the other hand, the mouse click is near a target already being tracked, the SLA-PANEL will command the system to move the target to the location of the mouse click rather than start a new track. Stopping a track is accomplished by right clicking near a track in the track window.

In order to facilitate the process of cycling through tracks, the SLA-HARDWARE designates a unique track as the "selected track". In the SLA-PANEL, pushing "tab" in the tracking window shifts the selected target to the "next" track. By default, a track is indicated as being selected by the color green. To stop tracking the selected target, push "S" in the tracking window. This is a mouse-free alternative to stopping a track. To stop tracking all targets, push "K" in the tracking window.

In addition to the notion of the "selected" track, the SLA-HARDWARE designates a unique track as the "primary target". The notion of the primary target is relevant in two ways: The first is that the primary target is the target that will be affected by the "nudge" commands. The second is that the primary target is the target whose location is streamed through the telemetry message defined in the Sightline Protocol. By default, a primary target is indicated as being primary by the color red and having a double reticle overlay. Also by default, a new user-generated track will automatically be designated as the primary track. To change the primary track, tab through the tracks until the desired track is selected and press "P" in the tracking window.



***Above**: Illustrates three simultaneous tracks. The track labeled as "A" is the "selected" track. This can be seen by the fact that it is green. The track labeled as "B" is a "secondary" track. The track labeled as "C" is the "primary" track. This can be seen by the fact that it is red and it is the track with a double-reticle.*

In addition to user-designated tracks, the SLA-HARDWARE can be commanded to generate tracks on objects in the video frames it has detected to be moving. To turn on moving target detection on, click the "Enabled" check box of the Moving Target Detection Group group in the Stabilization/Tracking tab of the SLA Panel. Aside from being shaped to fit the size of the detected moving object, moving tracks are interacted with the same as user designated tracks through the SLA Panel.

4 Best Practices for System Integration

We recommend the following best practices for integration into a more complete system:

4.1 Turret/camera steering

All telemetry reported by SightLine Applications system is in pixel units in the camera's reference frame. Therefore, the system accepting telemetry needs to scale these values by the camera's angular field of view (which changes with zoom). In aircraft applications, we have had good success using our telemetry to augment a control system in which the camera is steered via GPS and inertial data to stare at a fixed position on the earth. Proportional control, in which steering rates are augmented by scaled pixel offsets (in the camera's reference frame) has been sufficient to close the video processing loop, though more sophisticated techniques could be used as well.

When tracking is not engaged, it is recommended that the control system utilize registration offsets (scene translation fields in the Tracking Position message) to augment GPS/inertial control. Integrating these offsets over time yields stable pointing. This “scene mode” permits unattended staring at fixed points on the earth with minimal drift. When tracking is enabled, it is recommended that control is based on the position of the tracking box instead to permit automatic camera tracking of moving targets. Please note the difference in the coordinates reported in the telemetry report: registration coordinates are signed measures of frame offset, whereas tracking coordinates correspond to the position of the target within the 640 wide X 480 high video frame.

4.2 Tracking When Target is Obstructed

SightLine Applications systems use momentum estimates to recover target lock when a target is temporarily obscured. For example, when a vehicle passes through an overpass or drives behind trees, video target tracking fails, and expected position is reported, along with the target not visible flag (bit 7 of the tracking confidence byte). If the target emerges near to the expected position, as determined by frame-to-frame registration calculations, within 15 seconds then tracking will resume normally with the target not visible flag cleared.

Targets may also be temporarily lost from view due if the camera is “bumped” away from the target. This could occur because of mechanical or steering rate limits, or because of a sudden external event such as a gust of wind. The behavior of the target not visible flag is identical in this situation, and tracking will resume when the target re-enters the field of view of the camera.

4.3 Digital Zoom and Zoom to Track

The use of SightLine Applications' digital zoom feature offers robustness advantages to achieving the same field of view using the digital zoom feature built into many cameras. When using a digital zoom feature built into a camera, a cropped frame is produced by the camera resulting in a reduced angular field of view to use for tracking. This reduced field of view makes the overall system more susceptible to disturbances. However, when using SightLine Applications' digital zoom, the entire camera frame is delivered to the processing board, and the larger field of view is used for frame-to-frame registration and target tracking with no increase in susceptibility. Digital zoom is a post-processing operation that occurs after registration and tracking.

This opens up the use of the Zoom to Track mode. In this mode, digital zoom is applied to each frame centered on the position of the tracked target, rather than on the center of the frame. This mode provides a perfectly centered view of the tracked target and has the side effect of reducing the impact of the borders created by video stabilization.

4.4 Use Bias When Commanding Steering Rates

When commanding known steering rates to a turret, use horizontal and vertical bias terms to prevent video stabilization from fighting the steering command. Bias levels feed into the stabilization filter exactly as pixel rates: command values proportional to angular steering rate and inversely proportional to angular field of view. Using this approach, it is possible to completely eliminate stabilization borders and the corresponding steering lag that would otherwise be present when steering.

4.5 Handling Rapid Turret Retasking

When a turret needs to be rapidly re-tasked, it is useful to temporarily disable video stabilization. This will prevent image lag and eliminate distracting stabilization artifacts as non-overlapping frames are mistakenly registered. During this period, feedback from both tracking and scene registration should be ignored by the control system.

4.6 Command Track Position in Display Coordinates

When initiating tracking, target position is provided to the system in display (stabilized) coordinates. The system will automatically convert the display position to camera coordinates for tracking, using the screen offsets of the currently stabilized frame. Since stabilized coordinates are more consistent than camera coordinates (which vary with camera shake), this approach improves target designation accuracy and provides as much tolerance as possible to video and command latency. Different from the coordinates used for designation, tracking is reported in camera coordinates to simplify computation of steering feedback.

4.7 How to Render Tracking Position

Track position may be calculated and rendered on a remote terminal rather than on the SightLine Applications board. This has the advantage of not disturbing the output video with graphical overlays. However, any latency in the telemetry communications channel will result in a rendered tracking position that lags the true position. To calculate the position at which to render the tracking box use the following equations:

$$x = (x_t + x_d) * \cos(A/128) + (y_t + y_d) * \sin(A/128)$$
$$y = (x_t + x_d) * -\sin(A/128) + (y_t + y_d) * \cos(A/128)$$

Where (x_t, y_t) are the coordinates of the track, (x_d, y_d) are the display offsets and A is the display rotation. These numbers are reported in the telemetry feed.

4.8 System Latency

Telemetry is reported immediately following registration and tracking (and before performing processing required for video enhancement and digital zoom). Since the registration and tracking algorithms are nearly constant time, the telemetry packet will be sent approximately 15ms following complete receipt of a video frame, or approximately 48ms following the start of transfer of each frame.

Due to unsynchronized input and output clocks, video latency through SightLine applications system is somewhat more variable, and changes from 2 to 3 frames of latency as the phases of the input and output clocks shift relative to one another.

5 Sample User Interface – SLA-PANEL

SightLine provides an example user interface that allows a user to test the functionality of the SLA-HARDWARE. The user interface provides buttons and edit controls that wrap our Video Protocol[1]. Once the user becomes comfortable with the system numerous C/C++ sample code programs are available to help expedite integration into the autopilot or turret controller.

```

#include "sltypes.h"
#include "slfip.h"
#include "slfipport.h"
#include "sldiscover.h"
#include "slsock.h"
#include "slfiputil.h"

  //Send out a discover message over the network to see list of available boa
  //List will be printed to command line
  SLDiscover(&g_sysList, 0);

  //connect to the 0th device.
  SLStatus rv = g_sockPort.Initialize(g_sysList.info[devIdx].ipaddr, SLFIP_TC

  // Get Image Size
  dataLen = SLFIPGetImageSize(buffer);
  if(g_port->Write(buffer, dataLen) != dataLen) {
    SLTrace("Error SLFIPGetImageSize %d\n", SLSockError());
  }
```

Illustration 1: Example of sample code and protocol functions

5.1 Stabilization/Tracking Tab

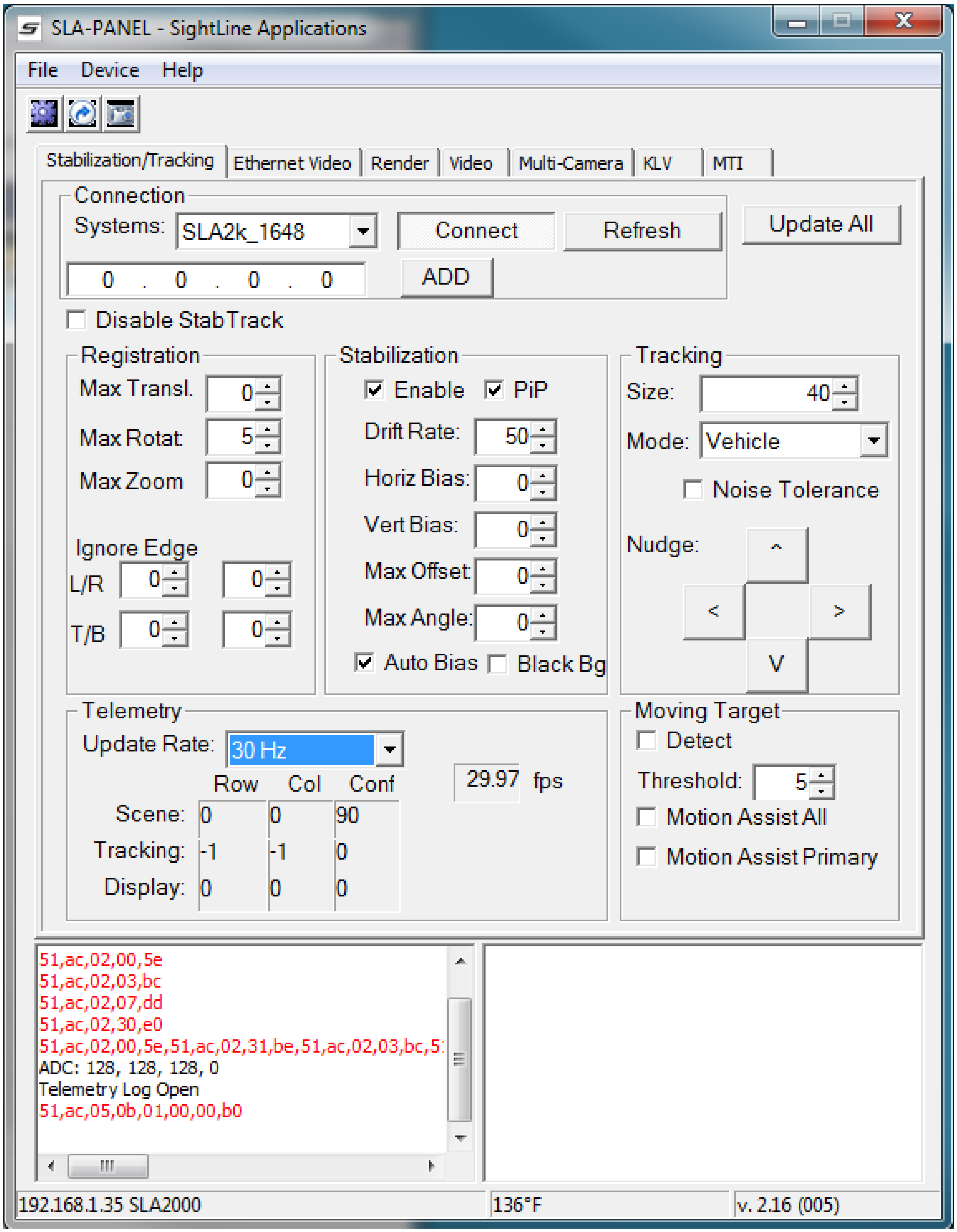
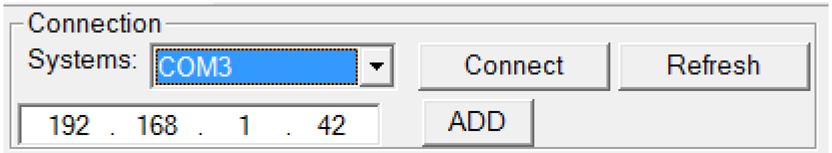


Illustration 2: Stabilization/Tracking Tab

5.1.1 Connection Group

On start-up the System pull-down list is populated with available PC COM ports and SightLine Applications devices found on the local network. To connect to a system, select the appropriate system name in the pull-down list, and click on the Connect button.

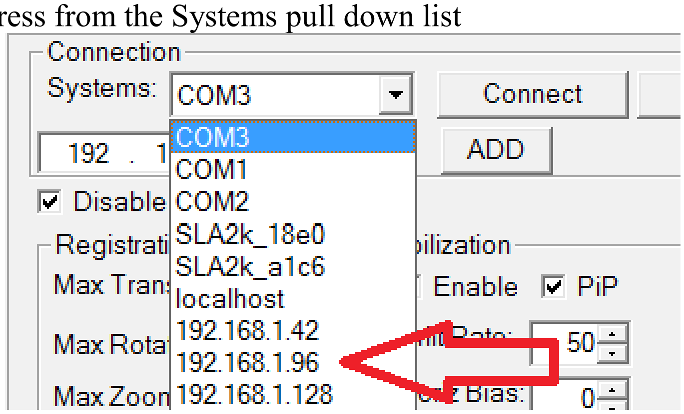


Systems	List of available PC COM ports and SightLine Applications hardware on the network.
Connect	Connects to the selected System.
Refresh	Re-query for network devices.
ADD	Manually add the IP address of a known unit

5.1.1.1 Manually Add IP Address

To manually add the IP address of a known unit:

1. Enter the IP address into the fields provided
2. Click the ADD button
   - The IP Address is then added to the the Systems pull down list
3. Repeat steps 1 & 2 as needed
4. Select the IP Address from the Systems pull down list



5. Click the Connect button
   - SLA-PANEL should establish a connection to the unit given the IP Address
   - You can verify this by looking at the IP Address and Firmware version in the status bar at the bottom of the screen

Other Notes:

- It saves the IP address to a text file (*ipaddress.txt*) local to the application
- When SLA-PANEL starts, it will read any strings from this file and add them to the Systems

combo-box (pull down list)
- If you need to remove an IP address, you can edit the text file directly.

5.1.2 Disable StabTrack

Checking this box disables registration, and reduces processor load considerably. With registration disabled, stabilization, tracking, moving target detection, video enhancement, and video display manipulations (rotation, false colors, etc) are also disabled. However, ethernet video options remain available.

5.1.3 Registration Group

Registration is the measurement of view changes from the previous frame to the current frame. Registration is performed in translation and rotation. Frame to frame changes are accumulated and reported in the telemetry output. SightLine Applications proprietary video registration algorithms are designed with real-time operation in mind: robust, accurate results are computed in constant time to provide telemetry with consistent delay most appropriate for integration into a control system.

Max Transl	Maximum frame to frame translation (offset) in pixels (0...255). Setting this value to a number less than 255 pixels may improve registration robustness and speed if the translation is always less than this amount. The default value of 0 results in a maximum translation of ¼ the minimum image dimension or 120 pixels in the case of a 640x480 image.
Max Rotat	Maximum frame to frame rotation in degrees. If frame to frame rotation is present (for example, in video taken from an airborne platform orbiting a fixed point of view on the ground), setting maximum rotation to 5 degrees/frame will increase the robustness of the registration solution. If it is known in advance that frame-to-frame rotation will be minimal, setting maximum rotation to 0 may improve the overall registration estimates.
Max Zoom	Maximum frame to frame zoom in percentage. If the image zoom is changing frame to frame such as in the case where camera zoom is changed or the camera is moving towards the scene, setting this to a 1% to 5% may improve registration robustness and allow tracking to handle gradual changes in zoom. For zoom caused only by camera motion, a value of 1% is recommended. When zoom changes are minimal, leaving this value at 0% will reduce processor load and improve registration robustness.

5.1.4 Stabilization Group

Stabilization takes the registration history and the current frame as input, and renders the current frame to minimize video jitter. Several parameters affect the smoothness of the resulting video stream. These include:

Enable	Stabilization can be enabled and disabled independently of tracking and enhancement.

Pip	Enable (checked) or disable (unchecked) stabilization of the Picture-In-Picture image.
Drift Rate	Stabilization drift rate 0...255. The re-centering rate of the stabilization filter. Large values lead to rapid re-centering, and eliminate only the highest frequencies. Small values lead to slow re-centering, keeping the scene nearly still. The re-centering factor is this number divided by 1000, so a value of 50 is a 0.05 re-centering factor or about 5% drift back to center each frame.
Horiz Bias	Horizontal and vertical stabilization bias in pixels per frame. Commanding the bias terms is used to compensate for commanded turret motions. With the bias terms set to 0, the stabilization will "fight" commanded turret motions – the high-frequency portion of the turret motion will be eliminated creating the impression of sluggish turret response along with gray bands on the edges of the video. To counter this effect (and to eliminate the gray bands on the edges of the video stream), set bias to simultaneously with commanding turret motion. The bias value used should be proportional to the angular rate of motion and inversely to the angular field of view of the camera.
Vert Bias	
Max Offset	Maximum stabilization offset (translation) in pixels. Limiting offset (translation) is useful in conjunction with adjusting the drift rate for particular applications, especially where camera steering based on video telemetry is not used. For example, on a fixed front-mounted camera on a ground vehicle it may be preferable to limit stabilization translation to prevent stabilization lag as the vehicle negotiates turns. Note that limiting stabilization translation does not have an effect on frame-to-frame registration.
Max Angle	Maximum stabilization angle in degrees. If maximum registration rotation is enabled, stabilization in rotation may be performed as well. This option has the greatest effect when there is a substantial amount of camera roll: for example on front-mounted cameras on aircraft or on ground vehicles negotiating bumpy terrain.
Auto Bias	Automatically adapt stabilization to continuous pan and/or tilt so that the stabilization does not try to force the resulting image to be largely off screen. Enable for stand-alone stabilizer mode, disable when feed forward pan and tilt are used in an integrated system (Horiz Bias and Vert Bias).
Black Bg	Disabled: background of a stabilized image is the previous image with color turned off and blurring added. This mode is generally more visually appealing. Enabled: background of a stabilized image is black.

5.1.5 Tracking Group

SightLine Applications object tracking utilizes template-based tracking in which the operator designates up to five targets (see user-interface recommendations, below). From that point on automatic tracking will determine the location of each target in each frame, along with a confidence measure; these values are output as part of the telemetry and tracking packets. See [1] for more information about these packets.

Tracking is highly resistant to target drift, and implements a combination of adaptive parameter updating and target momentum estimation to achieve hands-free tracking of targets for minutes at a time. Even if the target is temporarily obscured (partially or completely) or if the camera is momentarily “bumped” off the target, target lock can automatically re-establish when the target becomes visible. Tracking telemetry reflects the “visible” vs “estimated” state of the target with the most significant bit of the tracking confidence field. A 1 in the most significant bit means that the target is in an “estimated” state, 0 means that it is “visible”.

Tracking parameters apply to the next target that will be designated by the user.

Size	Target size in pixels. Precise setting of this parameter is not important, but tracking robustness is optimal when the tracking box is just larger than the size of the target to track or when the number of foreground (target) and background (non-target) pixels are roughly balanced. For example if tracking a car from an airborne system, setting the box to just longer than the length of the car is best (the square box will overlap the car along its shorter dimension). For long targets such as a long semi truck and trailer, sizing the box to approximately the size of the truck's cab works well. This useful range of this value is 20 to about 120 with typical values of 40 to 60.	
Mode	Tracking mode may be one of:	
	Stationary	To be used when tracking a stationary object such as a building
	Vehicle	To be used when tracking a moving object
	Scene	To be used when tracking a stationary object using the full frame to frame registration information only. Scene mode may be preferable to stationary tracking when tracking a low contrast feature such as the desert floor.
Noise Tolerance	In very noisy video streams, such as low light imaging with a visible camera, or with some infrared cameras operating with high gain, tracking robustness may be improved by selecting this option. The option implements a small amount of image smoothing to help eliminate pixel noise, and helps prevent target dithering. Enabling this feature in low-noise video streams may slightly decrease target accuracy.	
Nudge	Enables small adjustments to the position of the primary target's tracking box relative to the position of the primary target in the video. When initially designating a target, it may be difficult for an operator to accurately “click” on a target, especially in high-latency situations when command uplink is slow and/or downlink video exhibits significant lag. Box position may be adjusted via nudge commands.	

5.1.6 Telemetry Group

The telemetry group shows a continuously updating view of the connected system's telemetry output. By default, no telemetry is output. Set the Update Rate parameter to 10Hz, 15Hz or 30Hz to enable telemetry output at the specified rate.

Scene	Reports frame to frame registration offsets in pixels and confidence 0..100. Positive

	offsets indicate that the camera view has moved down and to the right.
Tracking	Position in 640 wide by 480 high input frame where primary target is found. Confidence shows tracking confidence 0..100. If confidence is >127, track position is based on momentum due to an obscured or off-screen target.
Display	Display offset in pixels and angle in degrees applied to camera frame to produce display frame. This is necessary for applications that choose to render their own tracking overlays in a remote terminal, rather than having the SightLine system render overlays.

5.1.7 Moving Target Detection Group

Automatic detection of moving targets reduces operator work load and compensates for the difficulty in designating fast moving targets in systems with display latency.

Detect	Automatically find moving targets.
Threshold	Sensitivity level to finding moving targets. 1 = most sensitive, 10 = least sensitive.
Motion Assist All	Use the moving target detection information to continuously re-center all existing tracks on moving targets.
Motion Assist Primary	Use the moving target detection information to continuously re-center only the primary track on a moving target.

When moving target detection is enabled, targets will automatically be generated for objects the system determines are moving. These targets will initially appear as blinking targets in the SLA-PANEL. After an object has been monitored for some time to ensure that it is indeed moving, it will be upgraded to an “active” state which means that the system will treat it as a designated target. This will be indicated in the SLA-PANEL when the target no longer blinks.

5.1.8 Update All Button

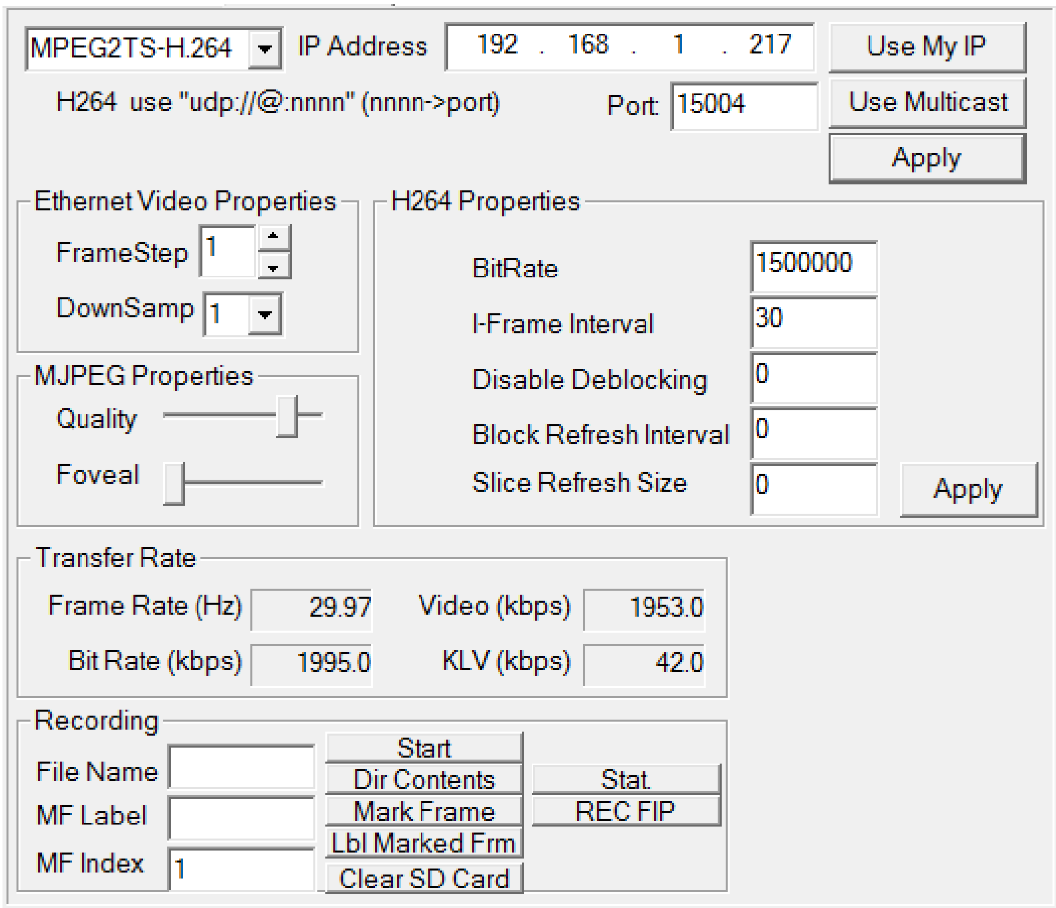
Update All	Updates all parameters shown in SLA-PANEL for the currently connected system. The state of SLA-PANEL can go out of date relative to a connected system if the system is power cycled.

5.2 Status Bar

Connection Status	Indicates the IP address of the remote device or Serial port used to connect.
Temperature	Reports the current temperature as detected by the SLA-HARDWARE-OEM
Version	Hardware and software version numbers are reported following client

	connection to a system.

5.3 Ethernet Video Tab



NOTE: In order to stream video, the **Video Mode → Display Destination must be set to Network**. See below for more information on how to set the video output mode.

RTP-MJPEG	SightLine Applications provides the option to output video via Motion JPEG (M-JPEG) encoded RTP streams over Ethernet. An RTP M-JPEG stream can be viewed by an open source program such as JM-Studio (see http://www.oracle.com/technetwork/java/javase/download-142937.html). In addition, the SLA-PANEL has a viewer which allows a user to view at most one RTP M-JPEG stream at a time.
MPEG2TS-H.264	Enables H.264 encoding encapsulated in an MPEG2 transport stream, optionally with an embedded KLV metadata stream. Video compression, encapsulation, and metadata is in accordance with MISB standards 0601, 0604, and RP 0603. Video may be viewed with numerous 3rd-party viewers including VLC (http://www.videolan.org/vlc/) See instructions below.

IP Address	The network address to stream the video to. Destination addresses in the range 224.0.0.0 through 239.255.255.255 imply multicast data, and other addresses imply unicast (point-to-point) data. Note that some addresses are generally associated with specific protocols (see http://en.wikipedia.org/wiki/Multicast_address)
Port	The base port to stream video to. The first video stream will be sent to the port field. Each additional stream will increment the destination port by two.
Use My IP	Sets IP Address to be the address of the computer running SLA-PANEL.
Use Multicast	Set IP Address to the multicast address 224.10.10.10.
Apply	Updates the connected system with specified address/port parameters. Enables streaming of video over Ethernet.

5.3.1 Ethernet Video Properties Group

FrameStep	1: send every frame, 2: send every other fame, etc. (1 to 120). Useful to achieve low bit rate with high quality images at reduced frame rate.
DownSamp	Whole integer value that image will be down sampled by. 1 – no downsample, 2 – 2x2 downsample, 4 – 4x4 downsample. Useful to achieve low bit rate with reduced quality at high frame rate.

5.3.2 MJPEG Properties Group

Quality	Controls the quality of the Motion JPEG encoding. Higher quality requires more bandwith to stream the video.
Foveal	Controls how the quality decreases from the center of the image outward. High foveal values correspond to high variation of quality from the center of the image outward. Low values correspond to low variation of quality from the center of the image outward.

5.3.3 H.264 Properties Group

BitRate	Sets the constant bit rate generated by the H.264 Baseline Profile encoder. The H.264 engine will adjust the quality of the video frames in order to maintain a constant bit rate.
I-Frame Interval	Controls the frequency at which I-frames are inserted into the video stream, made up of P-frames and I-frames. The I-Frame will be sent every *Nth* frame as specified by this value. The smaller the value the more I-Frames will be sent. I-frames are larger and are derived from a single frame of video. P-frames are based on predictions

	(differences) from earlier I-frames and P-frames, and are much smaller than I-frames because they encode only the differences between frames. Since P-frames require a reference to an earlier I-frame this interval is also referred to as the refresh rate. **NOTE: Set I-Frame Interval to 0 in order to use Block/Slice Refresh.**
Disable Deblocking	Set to 1 to disable the H.264 deblocking filter. Deblocking is a smoothing filter. Disabling the filter can result in video that looks worse.
Block Refresh Interval	An H.264 frame is divided up into a large number of small rectangular blocks which may be independently refreshed. The **Block Refresh Interval** sets the frequency (in frames) at which each block will be updated. Like **Slice Refresh Size**, this has the effect of smoothing out bandwidth usage and improving error resilience, but is not correctly decoded by all viewers.
Slice Refresh Size	An H.264 frame is divided into one or more video-width slices of the specified height (size). Setting this parameter to a positive value causes an I-slice to be sent with every frame (instead of refreshing with the I-frame interval). Like **Block Refresh Interval**, this has the effect of smoothing out bandwidth usage and improving error resilience, but is not correctly decoded by all viewers.
Apply	Send specified H.264 parameters to SLA-HARDWARE

5.3.4 Transfer Rate Group

Frame Rate	Displays the frame rate of the digital video being output in frames per second.
Bit Rate	Displays the data rate in kilobits per second. This rate is includes the overhead of the entire packet (e.g. MPEG2-TS, H.264 video and KLV).
Video	Displays the video only data rate in kilobits per second.
KLV	Displays the data rate of the KLV data being sent in kilobits per second.

5.3.5 Recording Group

The SLA-2000-OEM works with the following class 10 SDHC Micro SD card.

`Wintec 32GB Micro SDHC FileMate Mobile Professional SDHC`

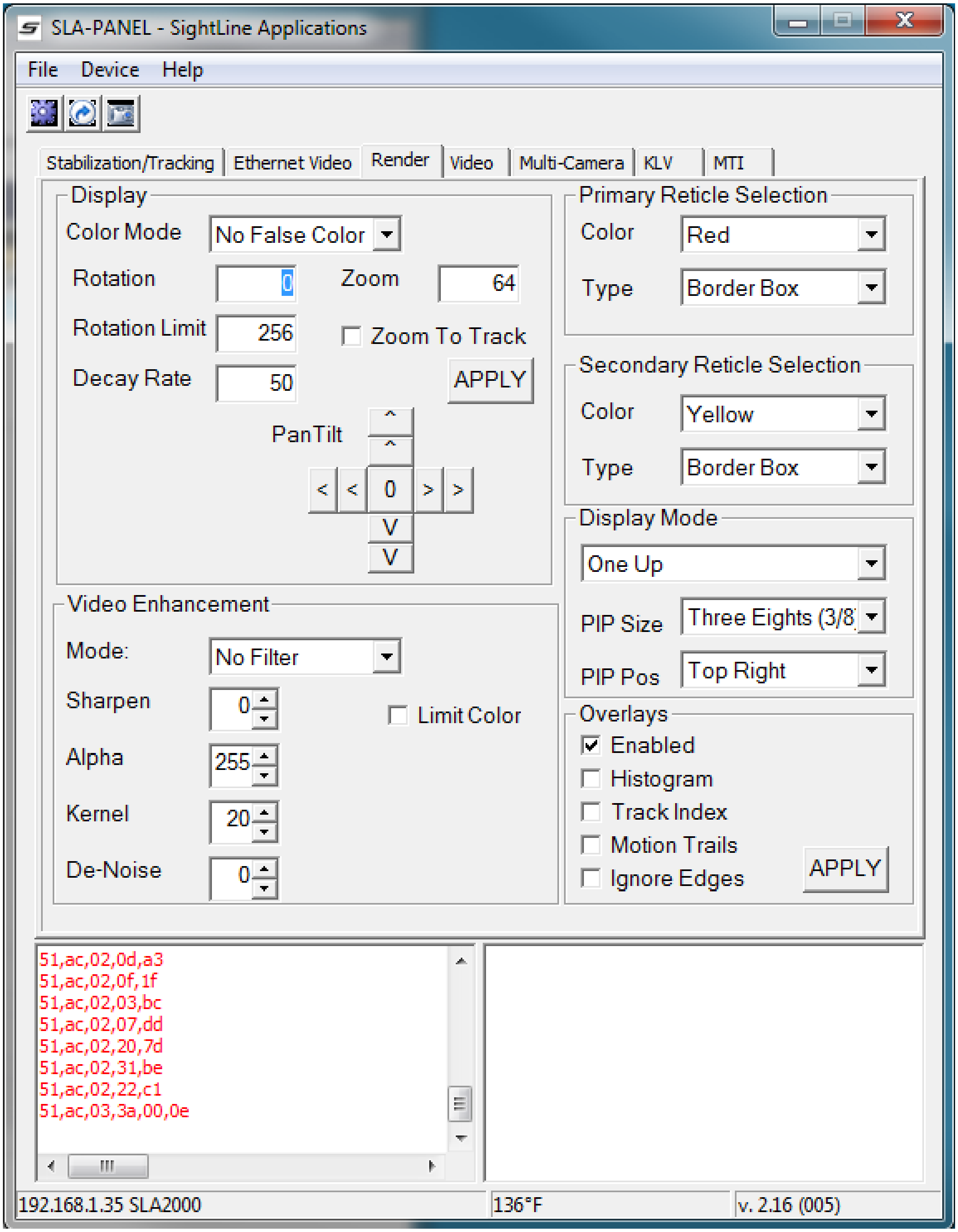
`Model 3FMUSD32GBC10-R`

NOTE: The SLA-2000-OEM Micro SD interface has limited bandwidth and is is only capable of recording at around 2-3 frames per second in MJPEG mode and less than about 250Kbps in h.264 mode.

File Name	Name of the recording file. Can also be a path for use with Dir. Contents or Clear SD Card.

MF Label	Mark frame label string which corresponds to MF Index.
MF Index	Mark frame index number.
Start	Start recording to the file File Name.
Dir Contents	Opens dialog showing the contents of the SD card.
Mark Frame	Creates a Marked Frame with index MF Index.
Lbl Marked Frame	Labels the Marked frame with index MF Index with the label string in MF Label.
Clear SD Card	Delete the contents of the SD card. If a path is specified all files in that path will be deleted If a specific file name is specified then that single file will be deleted.
Stat	Recording status – opens dialog which shows the current status.
REC FIP	Start/Stop recording of protocol commands and responses.

5.4 Render Tab



5.4.1 Display Group

Several settings are available that affect display output, but have no impact on registration, tracking, or stabilization.

<table>
<tr><td>Color Mode</td><td>Applies false color lookup table to input frame. This option is useful when using gray scale cameras (such as infrared cameras) to assist in interpreting imagery.</td></tr>
<tr><td colspan="2">Display rotation is possible by specifying a target rotation angle, a proportional decay rate, and a rate limit. At each frame interval, the current angle is set to the decay-weighted average of the current angle and the commanded angle according to:
$\text{Angle}_{new} = (256\text{-decay})*\text{Angle}_{old} + \text{decay}*\text{Angle}_{commanded}$
Angular changes of greater than the Rotation Limit are clipped to the Rotation Limit.</td></tr>
<tr><td>Rotation</td><td>Rotate video to commanded angle (in degrees).</td></tr>
<tr><td>Rotation Limit</td><td>Rate limit to angle changes in degrees per frame (frame rate is 29.97 Hz)</td></tr>
<tr><td>Decay Rate</td><td>Linear decay rate of screen angle update.</td></tr>
<tr><td>Zoom</td><td>Renders camera input frame scaled up by a factor of 1.0 to 255/64. Input values of less than 64 are interpreted as 1.0X zoom. Zoom is around image center, unless zoom to track option is enabled.</td></tr>
<tr><td>Zoom To Track</td><td>Renders output stabilized video with the primary target in the center of the display screen.</td></tr>
<tr><td>Apply</td><td>Sends a single message to command new rotation, limit, and rate.</td></tr>
<tr><td>Pan Tilt</td><td>Electronically pan and tilt the display center. Inner arrows take small steps. Outer arrows take large steps. Inner button resets to the default center.</td></tr>
</table>

5.4.2 Video Enhancement Group

Video enhancement can provide improvement to low contrast, high noise, under-exposed and over-exposed imagery. For example, an object barely visible in shadow can be rendered more visible without adversely affecting other objects in the scene.

Illustration 3: Without Enhancement (Left), With Enhancement (Right)

Mode	Two different contrast enhancement algorithms are provided, Contrast Limited Adaptive Histogram Enhancement (CLAHE) and Local Area Processing (LAP). Both of these boost contrast in low-contrast regions of the video. CLAHE can also work well to enhance objects partially obscured by smoke or fog.
Sharpen	Boosts the impact of small edges in the image, resulting in a sharper output image. Larger values lead to more sharpening.
Alpha	Alpha blending term used to mix the input frame with the enhancement processed frame. 0 is equivalent to disabling enhancement, 128 yields a 50/50 blend, and 255 is only the enhanced output.
Kernel	Kernel size parameter for contrast enhancement algorithms. The typical value is 20. A larger value results in more enhancement, a smaller enhances less.
De-Noise	De-noising is performed by computing the running average of registered frames. This can have the effect of greatly reducing video noise, and because the averaging is applied to registered frames, behaves well even when the camera is moving. De-noising may be selected in conjunction with other enhancement methods. In this case, de-noising is applied before the other operations. Presently denoising only operates correctly when frame-to-frame rotation is small and is automatically disabled in other situations.
Limit Color	Apply a color limiting filter near high contrast edges. This can reduce so called “dot crawl” effects introduced in the decoding of composite analog video.

5.4.3 Primary and Secondary Reticle Selection Groups

Reticles are overlay graphics drawn on the output display to indicate the position of tracked targets.

Two sets of two parameters affect how the graphics are drawn on tracks. One set controls how the primary track is rendered, the other set controls how the remaining tracks are rendered. For more information about primary versus secondary target distinctions, see the Using SLA-PANEL section.

Color Mode	May be off, white, black, auto, rainbow, red, orange, yellow, green, blue, or violet. Auto selects either black or white, whichever results in the higher contrast with the background video frame.
Reticle Type	May be one of border box (the default), cross, circle, duplex crosshair, modern rangefinder, target dot.

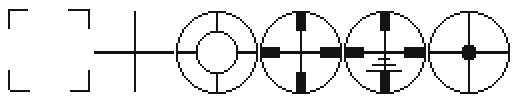


Illustration 4: Reticle Types

5.4.4 Display Mode Group

Display Mode	One of the following:	
	One Up	Single camera view.
	Picture-In-Picture	Renders a down-sampled version of the second logical camera over the first logical camera. This mode uses the subscreen size and position selections to control the position and size of the overlayed image.
	Two Up	Two cameras displayed side by side. Video from first logical camera on left, second on right.
	Quad Screen	Four cameras displayed in a 2 by 2 matrix. Video from first logical camera is in upper left, second in upper right, third in lower left, fourth in lower right. See Video Mode Group to control logical camera order.
	Blend	Render a blended EO/IR image. See Blend Group for more information.
	Stitched	Render a panoramic stitched image of the first and second logical cameras side by side (first on left, second on right). See Stitch Group for more information. Note that the system must be configured for digital output for this mode to work since it renders a 1280x480 video stream.
	None	No video output is rendered. Telemetry and communications remain active.
PIP Size	Size of the sub-picture for picture-in-picture display.	

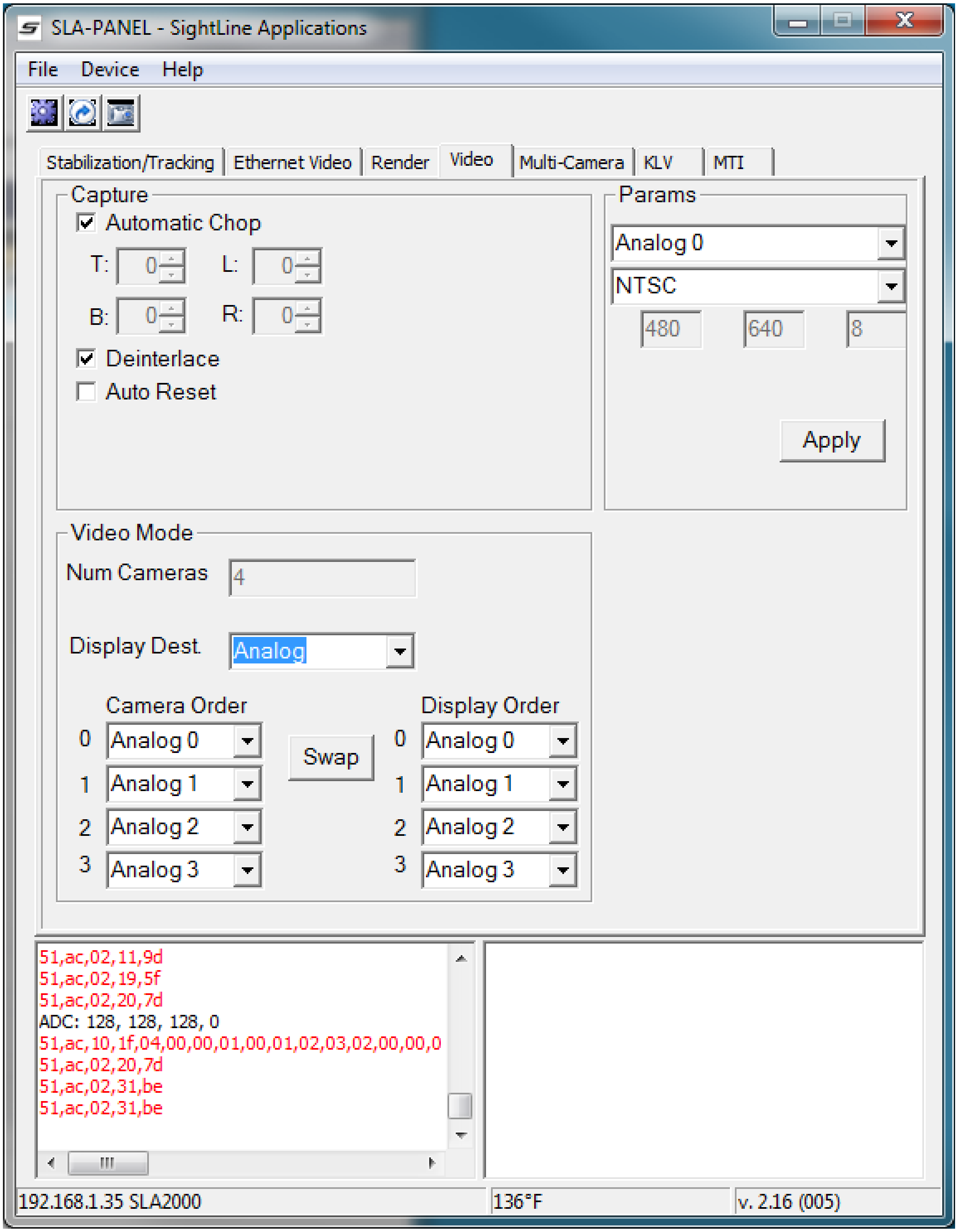
PIP Pos	Position of the sub-picture for picture-in-picture display.
Apply	Apply the Display Mode settings.

Depictions of the different render modes. From left to right: one up, picture-in-picture, two up, quad screen, stitch, and blend.

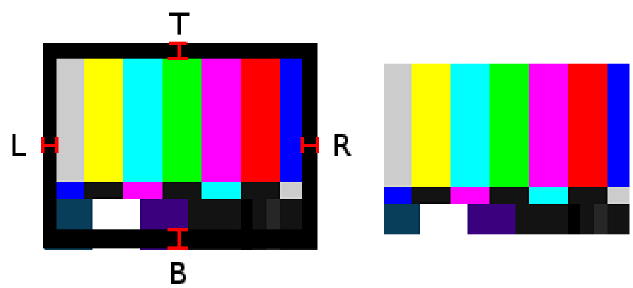
5.4.5 Overlays Group

Enabled	Enables or disables the rendering of all overlays such as tracking boxes over the top of the outputted video. See Primary and Secondary Reticle Selection Groups for more information about tracking box rendering.
Histogram	Enables or disables the overlay of the histogram of the input image.
Track Index	Show the track index number for moving targets in the image.
Motion Trails	Show the past trajectory of moving targets.
Ignore Edges	Show lines indicating the extent of the edges which are ignored in registration. See the Registration Group for control of the ignore edges feature.
Apply	Apply the Overlays settings.

5.5 Video Tab


SLA-PANEL - SightLine Applications
File Device Help
Stabilization/Tracking
Ethernet Video
Render
Video
Multi-Camera
KLV
MTI
Capture
Automatic Chop
T: 0 L: 0
B: 0 R: 0
Deinterlace
Auto Reset
Params
Analog 0
NTSC
480 640 8
Apply
Video Mode
Num Cameras 4
Display Dest. Analog
Camera Order
Display Order
0 Analog 0
1 Analog 1
2 Analog 2
3 Analog 3
Swap
51,ac,02,11,9d
51,ac,02,19,5f
51,ac,02,20,7d
ADC: 128, 128, 128, 0
51,ac,10,1f,04,00,00,01,00,01,02,03,02,00,00,0
51,ac,02,20,7d
51,ac,02,31,be
51,ac,02,31,be
192.168.1.35 SLA2000
136°F
v. 2.16 (005)

5.5.1 Video Group

Automatic Chop	Depending on the source, the input image may be surrounded with a frame of black pixels that are not valid video data. A frame of invalid data surrounding the normal image data will degrade the quality of the stabilization and tracking algorithms and therefore its removal is desirable prior to processing. Automatic chop attempts to determine the dimensions of a frame of invalid data, if there is one, and remove it automatically.
Manual Chop T/B/L/R	Allows for the manual specification of amounts to chop off the top, bottom, left and right portions of the image in pixels. See below for diagram.
	
Deinterlace	Controls whether or not the image is deinterlaced before processing. If the image is interlaced, then this should be enabled or the quality of stabilization and tracking will compromised.
Auto Reset	Check to automatically detect color reversal ("smurf mode") in the video decoder and reset the video decoder if detected.

Q: What are the real limits when specifying chop on the SLA-HARDWARE?
A: 64 pixels top & bottom. 128 left & right. And really wants a multiple of 4 vertically (top& bottom) or 8 horizontally (left & right). Each direction can be independent {top, bottom, left, right}. Center is still (240,320).

Q: What happens if you designate a track in a chopped area?
A: Track is ignored.

Q: What happens when a track goes into a chopped area?
A: System continues to track, but treats it as if target went off the screen. Track result confidence will report a 128 (0x80) to indicate that it is "off the screen".

5.5.2 Video Mode Group

Num Cameras	Displays the number of cameras available to the system.

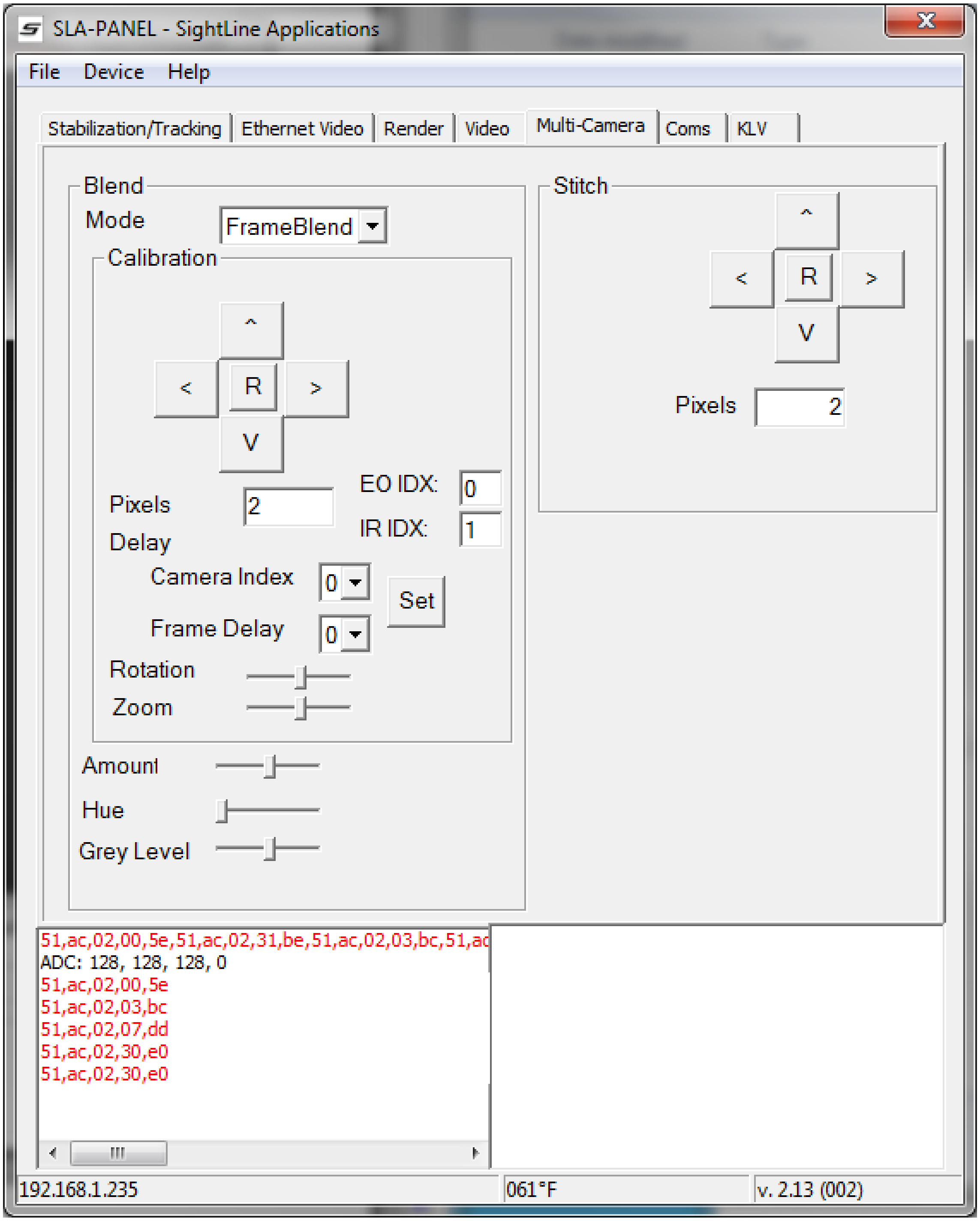
Display Dest.	Destination for display.	
	Analog	Analog video output (NTSC or PAL).
	Network video	output via M-JPEG/H.264. See Ethernet Video Tab section for more options pertaining to digital video output.
	Analog & Net	Both analog video output and network video output.
	HD-SDI 720p	SLA-2100-OEM only
	HD-SDI 1080p	SLA-2100-OEM only
	HD-SDI 1080i	SLA-2100-OEM only
Camera Order	Logical order of the analog video inputs. The video streams are processed in the specified order with Camera 0 being the primary camera. See Display Mode Group fore more information about these render modes.	
Display Order	Order in which the cameras are displayed.	
Swap	Swap the top two of both the camera order and display order.	

5.5.3 Params Group

Used to configure digital cameras or switch between NTSC and PAL analog video input.

- Select “Digital” from the first drop-down.
- Select the type of camera connected to the digital video port from the next drop-down. Digital camera options are available using the SLA-20000-CL CameraLink adapter, the SLA-2100-OEM HD-SDI board or the parallel digital interface to a custom adapter.
- Click “Update” to apply this change.
- Restart the SLA-2000-OEM (Device->Reset->Board).

5.6 Multi-Camera Tab



5.6.1 Blend Group

Blend controls allow user selectable blending of image information from two cameras. In addition to selecting the type of algorithm used to control video mixing, one video may be translated, rotated, and delayed relative to the other to compensate for misalignment and latency differences between sensors.

Mode	Controls the method used to blend the EO/IR images. It is assumed that EO camera is logical camera 0 and IR camera is logical camera 1.	
	FrameBlend	Pure frame “alpha” blend. Use the amount parameter below to control blend amount. 0 corresponds to all EO, 100 corresponds to all IR.
	ThermalBlend	Blend of EO/IR luminance with false coloring derived from IR. Red corresponds to fully saturated IR and blue corresponds to no IR.
	NightBlend	Meant for night use. IR luminance blended with portions of the EO image that contain visible data.
	Calibrate	Toggles display back and forth between EO and IR every second. Meant for use during alignment of the images.
Calibration Arrows	Moves the IR image up, down, left, or right by the number of pixels in the pixels field relative to the EO image.	
R	Resets any image alignment calibration to defaults. This affects the calibration, zoom, and rotation parameters.	
Pixels	Number of pixels to move the IR image each click of one of the calibration arrows.	
Camera Index	Logical camera index of camera to set delay frame delay.	
Frame Delay	Number of frames to delay camera whose index is in the Camera Index field below by. Delay is between 0 and 3 frames.	
Set	Sets the delay of the camera with the logical index in the Camera Index field to a frame delay in the Frame Delay field. This will restart the system if the delay has changed.	
Rotation	Rotates the IR image relative to the EO image clockwise from -5 (slider to the left) to 5 (sldier to the right) degrees.	
Zoom	Scales the IR image relative to the EO image with a scale factor between .9 (slider to the left) and 1.1 (slider to the right).	
Amount	Parameter is used in both FrameBlend and ThermalBlend modes. In FrameBlend mode, this amount controls the amount of EO image to blend with the IR image. 0 (slider to the left) corresponds to all EO and 1 (slider to the right) corresponds to all IR. In ThermalBlend mode, this amount controls the amount of the IR image to include into the luminance of the blended image. 0 (slider to the left) corresponds to no IR in the	

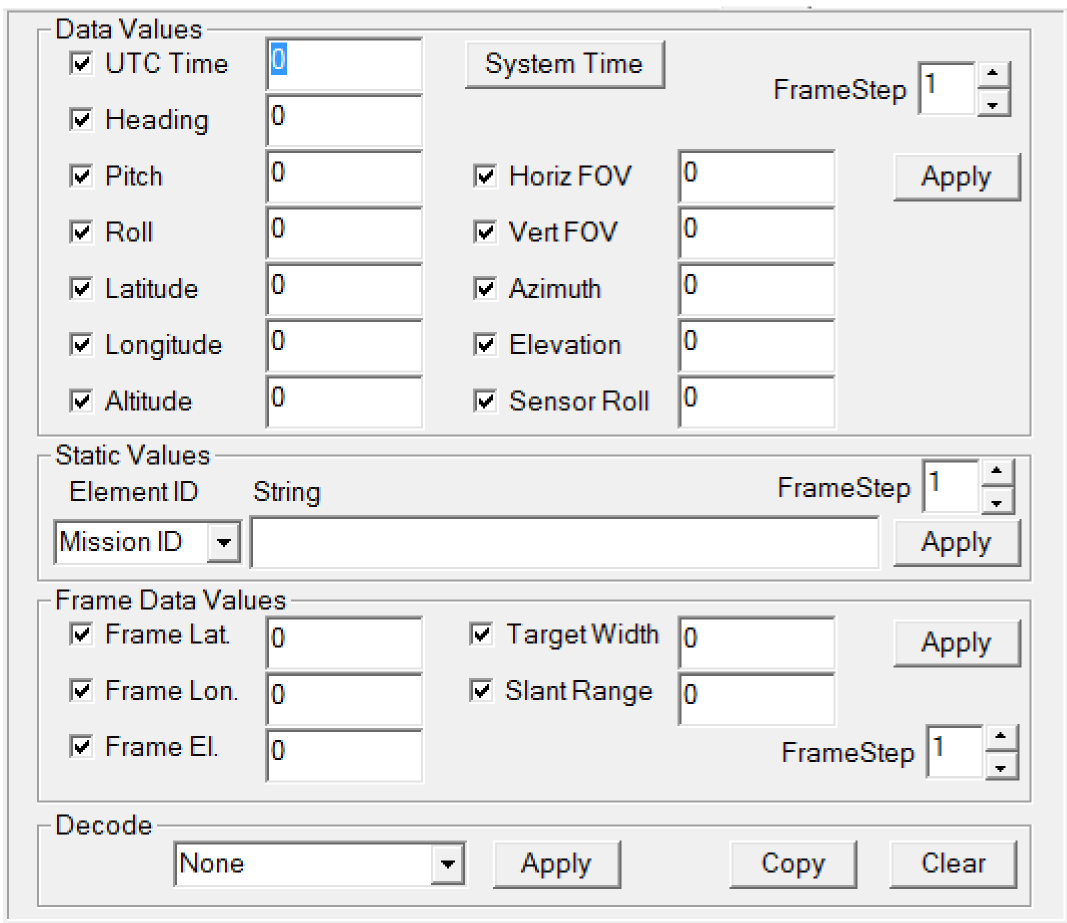
	luminance of the blended image. 1 (slider to the right) corresponds to full IR in the luminance of the blended image.
Hue	Parameter is used in ThermalBlend mode only. It is a hue stretch factor and controls the color contrast of the false coloring given by the IR image.
Grey Level	This parameter is used in ThermalBlend mode only. It is used to set the grey level of the IR image so that the “background” of the IR image, if present, does not show up in the blended result.

5.6.2 Stitch Group

To use stitch, ensure that logical camera zero corresponds to the left camera and logical camera one corresponds to the right camera.

Arrows	Moves logical camera one's image up, down, left, or right by the number of pixels in the pixels field relative to logical camera zero.
R	Resets the relative offset of camera one to camera zero.
Pixels	Number of pixels to move camera one's image each click of one of the calibration arrows.

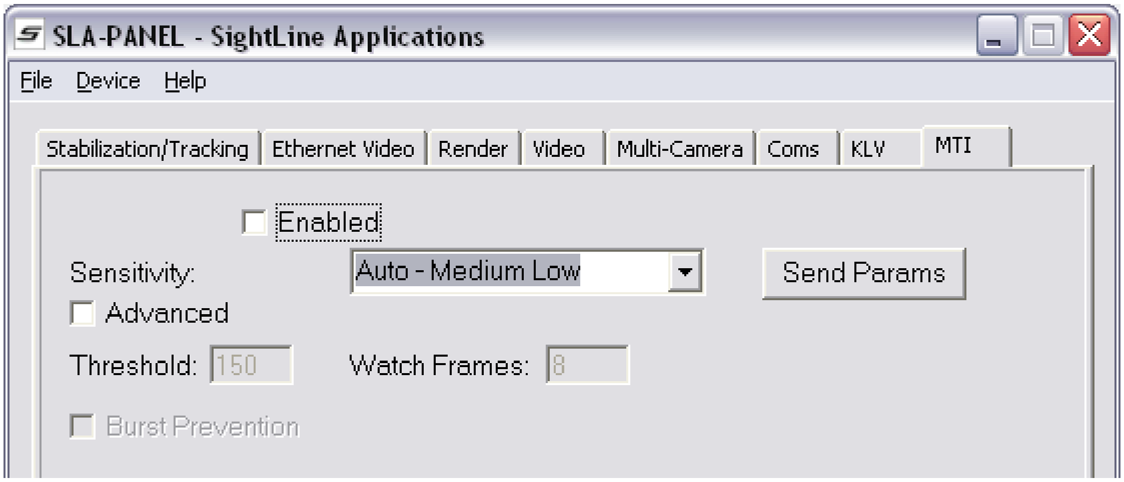
5.7 KLV Tab



Check Boxes	Check the box next to each item to be sent.
Edit Boxes	Data values to be sent (if checked).
Frame Step	How often to send the KLV data. 1: every frame, 2: every other frame, etc.
Apply	Send the checked data and frame step within a group.
System Time	Click to fill in the current system time into UTC Time.
Decode	Controls which KLV data is decoded and shown in the lower right corner of SLA-PANEL.
	TimeStamp – only show the time stamp
	Selected – only show the checked data
	All – show everything
	None – show nothing

Copy	Copy the decoded KLV data to the clipboard
Clear	Clear the decoded KLV window.

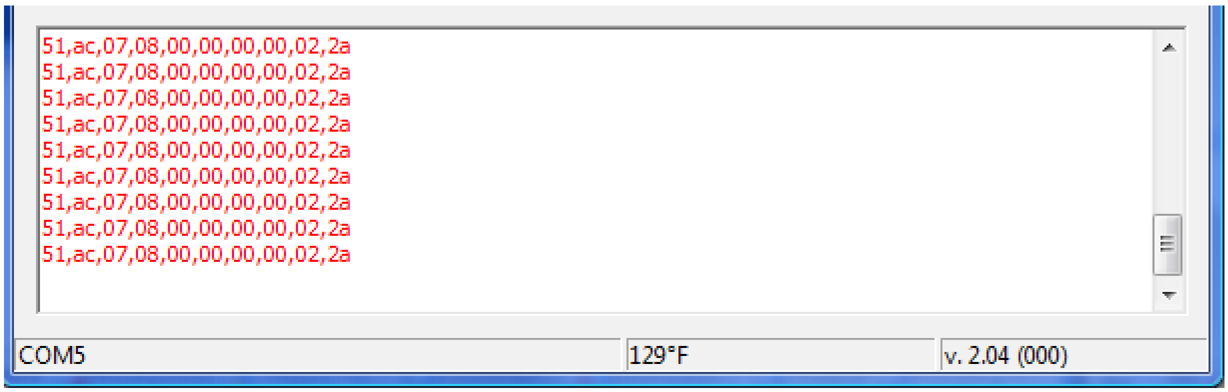
5.8 MTI Tab



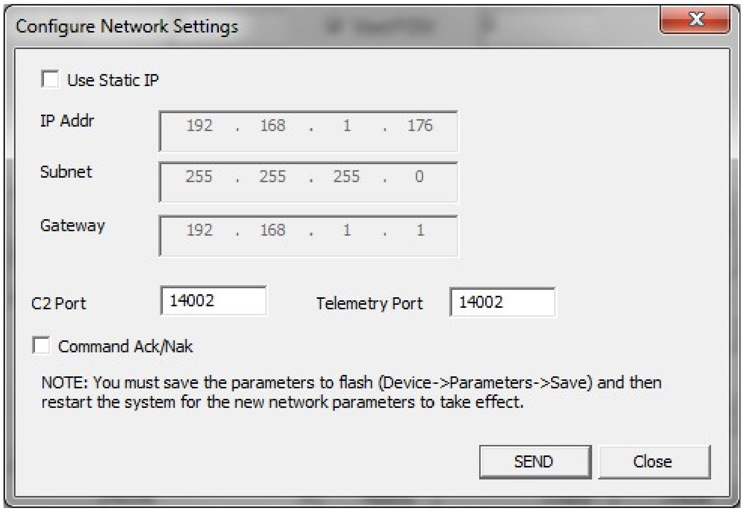
Enabled	Enable motion detection.
Sensitivity	Controls the sensitivity of the MTI algorithm to moving targets in the video it is analyzing. There is a tradeoff between sensitivity and false positives: Low sensitivity translates into a low false positive rate at the expense of missed detections and high sensitivity translates into less missed detections at the expense of a higher false positive rate.
Send Params	Sends the MTI command packet to the SLA-2000.
Advanced	Enable or disable advanced parameters. Note that when advanced parameters are enabled, the sensitivity parameter is ignored and vice versa.
Threshold	This is an advanced parameter. It controls the threshold for finding potential moving targets. When advanced mode is disabled, it is automatically set by the moving target detection algorithm based on the sensitivity parameter and scene content. Sometimes better detection results are obtained by manually setting the threshold to a lower setting. A reasonable range of thresholds is 135-180.
Watch Frames	This is an advanced parameter. First the MTI system generates potential moving targets. (This is controlled by the threshold parameter above.) After a potential moving target is generated, it is watched by the system for a number of frames to verify that it is indeed moving. Lower watch frames results in more sensitivity, and higher watch frames results in less false positives. Experimenting with combinations of low threshold, high watch frame count, low threshold, low watch frame count can yield better results than using the non-advanced sensitivity parameter.
Burst	Occasionally, if there is a mis-registration (during a fast pan for example), the MTI

Prevention	system may generate a “burst” of false positives. This parameter enables a burst prevention system that attempts to stop this from happening.

5.9 Menu → File → Log Commands



5.10 Menu → Device → Network



Use Static IP	By default, the SLA-HARDWARE-OEM assumes it will gain an IP address from a DHCP server on the network. Checked indicates that you will assign a static IP address to the SLA-HARDWARE. Unchecked indicated that the SLA-HARDWARE will receive an IP address from the DHCP server.
IP Addr	The static IPv4 address that the SLA-HARDWARE will use.
Subnet	The subnet mask for your network.
Gateway	The IP address of the Gateway (router).
C2 Port	UDP Port number to send command and control responses to. Default: 14002
Telemetry Port	UDP port number to send telemetry responses to. Default: 14002
SEND	Sends the current Network Parameters to the system
Close	Closes the dialog

NOTE: If DHCP fails, system will use a 192.168.1.ddd, where ddd is internally determined using its MAC address. Its subnet mask will be 255.255.255.0 and gateway will be 192.168.1.1

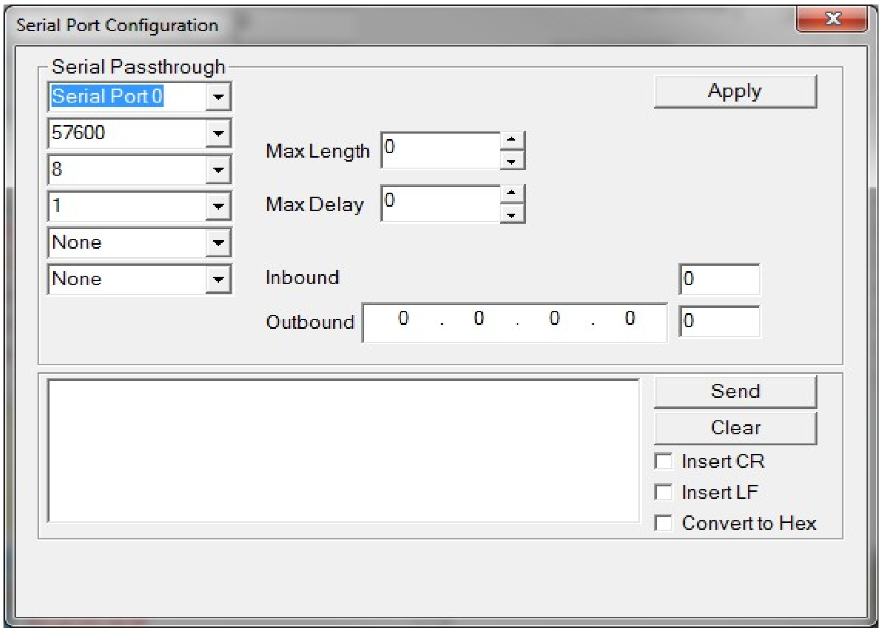
5.11 Menu → Device → Parameters

Save	Stores current configuration in flash. When system restarts, parameters are loaded from flash and applied.
Reset	Resets all active parameters to default values. Parameters saved to flash are not effected.
Get All	Not Yet Implemented
Send All	Not Yet Implemented

5.12 Menu → Device → Reset

Video	Performs a soft reset the capture and display hardware components.
Board	Performs a soft reset of the entire board.
Application	Restarts the hardware application.

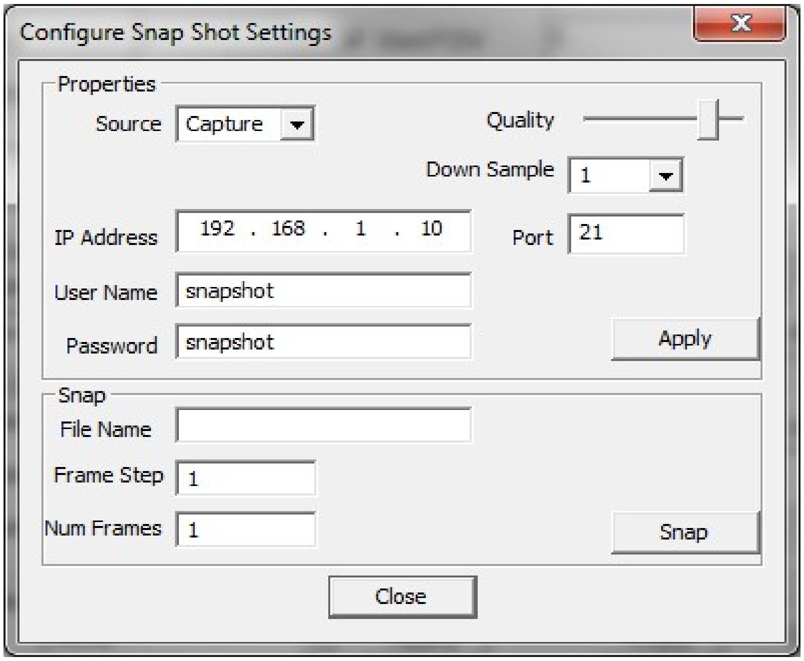
5.13 Menu → Device → Serial Port



Configure serial port and UDP port for pass through operation.

Port	Serial port number
Baud Rate	Default 57600
Data Bits	Default 8
Stop Bits	Default 1
Parity	Default None
Protocol	None: No pass through Alticam & SLA: Pass through Alticam and SLA protocol Tau: Pass through FLIR Tau protocol
Max Length	Maximum packet length.
Max Delay	Maximum delay in ms.
Inbound	Incoming UDP port to pass through from.
Outbound	Outgoing UDP address and port through to.

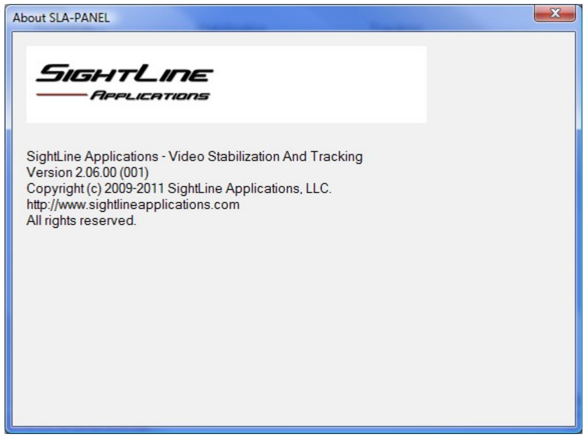
5.14 Menu → Device → Snap Shot



Configure image snap shot to ftp server setup.

Source	Capture – unprocessed input image Display – processed output image
Quality	JPEG image quality (0 to 100), default 80.
Down Sample	1: full image, 2: downsampled 2x2, 4: downsampled 4x4
IP Address	Address of the FTP server
Port	FTP server port (default 21)
User Name	FTP server user name
Password	FTP server password
Apply (Properties)	Set up the FTP output configuration.
File Name	Base name to use on the FTP server. The system will append "_0.jpg" to the first snap, "_1.jpg" to the next, etc.
Frame Step	Step between frames sent (1: every frame, 2: every other frame, etc)
Num Frames	Number of frames to send
Snap	Send Num Frames snapshots to the FTP server.

5.15 Menu → Help → About



6 H.264 & VLC

Describes how to configure the hardware to send H.264 data from an SLA-HARDWARE to your PC and how to configure VLC Media Player to display the data.

Configure SLA-HARDWARE to Send:

1. SLA-PANEL → **Stabilization/Tracking** tab
2. Select the **System** from the pull down list
3. Click **Connect**
4. Select **Ethernet Video** tab
5. Select **MPEG2TS-H.264** from the pull down list
6. Click **Use My IP**
7. Change the port to **4321**
8. Click **Send**

- **Note the IP address and Port. They will be used to create the URL for VLC**

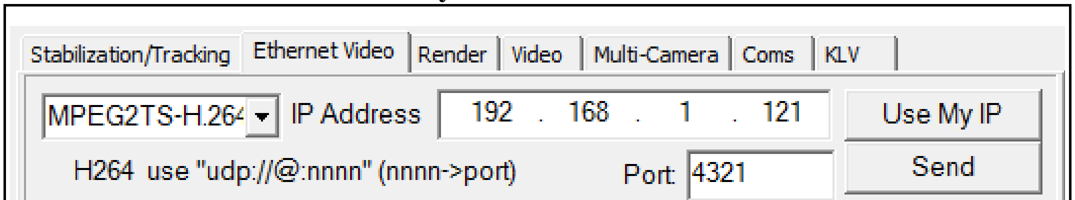


Illustration 5: For example: udp://@:4321

9. Select **Video** tab
10. Set # **Net Display** to **1**
11. Set **Display Dest.** To **Network**

Configure VLC to Receive:

12. Open **VLC**
13. Menu → Media → **Open Network Stream**
14. Enter the network **URL** from above
15. Click **Play**

Configure VLS to Record:

16. **Menu → Media → Open Network Stream...**
17. Pull down → Stream (ALT+S)
18. Destinations
19. New Destinations = File

20. Click Add

    "This module writes the transcoded stream to a file."

21. Filename = C:\temp\VLCRecord\SightLineVid.ts

22.

7 References

[1] SightLine Applications Native Communications Protocol
[2] SightLine Applications SLA-HARDWARE Quick Start Guide
[3] VLC Media Player 1.1.11 The Luggage (http://www.videolan.org)

8 CONTACTS

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