



SightLine

APPLICATIONS

EAN-Detection Modes

PN: EAN-Detection-Modes

9/8/2020

**Contact:**

Web: sightlineapplications.com

Sales: sales@sightlineapplications.com

Support: support@sightlineapplications.com

Phone: +1 (541) 716-5137

Export Controls

Exports of SightLine products are governed by the US Department of Commerce, Export Administration Regulations (EAR); classification is ECCN 4A994. The [export summary sheet](#) located on the support/documentation page of our website outlines customers responsibilities and applicable rules. SightLine Applications takes export controls seriously and works to stay compliant with all export rules.

Copyright and Use Agreement


© Copyright 2020, SightLine Applications, Inc. All Rights reserved. The SightLine Applications name and logo and all related product and service names, design marks and slogans are the trademarks, and service marks of SightLine Applications, Inc.


Before loading, downloading, installing, upgrading or using any Licensed Product of SightLine Applications, Inc., users must read and agree to the license terms and conditions outlined in the [End User License Agreement](#).


All data, specifications, and information contained in this publication are based on information that we believe is reliable at the time of printing. SightLine Applications, Inc. reserves the right to make changes without prior notice.

Alerts

The following notifications are used throughout the document to help identify important safety and setup information to the user:

 **CAUTION:** Alerts to a potential hazard that may result in personal injury, or an unsafe practice that causes damage to the equipment if not avoided.

 **IMPORTANT:** Identifies crucial information that is important to setup and configuration procedures.

 *Used to emphasize points or reminds the user of something. Supplementary information that aids in the use or understanding of the equipment or subject that is not critical to system use.*



Contents

1	Overview	1
1.1	Additional Support Documentation	1
1.2	SightLine Software Requirements.....	1
1.3	Application Bit Requirements	1
2	Detection Modes	2
3	Best Practices	5
3.1	Vehicle and Drone MTI.....	5
3.1.1	Acquisition Assist	5
3.1.2	Intelligent Assist.....	6
3.1.3	Classifier Options	6
3.2	Staring MTI	7
3.3	Aerial MTI	7
3.4	Anomaly, Radiometric, Blob, Maritime Detection.....	8
3.5	Blob Detection.....	8
3.6	Radiometric Detection	9
3.7	Gas Detection	9
3.8	Auto and Manual Sensitivity	10
4	Performance and Speed	11
4.1	Downsampling.....	11
4.2	Regions of Interest	11
4.3	Frame Step	12
5	Filtering Detections.....	12
6	Snapshots of Detections	13
7	Command and Control.....	13
7.1	Reporting Results	13
7.2	Display Related Commands.....	13
7.3	Detection Related Commands	13
8	Troubleshooting.....	13
8.1	Questions and Additional Support.....	13
	Appendix - Testing MTI	14



List of Figures

Figure 1: Automatic Target Detection Modes 5

Figure 2: Acquisition and Intelligent Assist..... 6

Figure 3: Classifier Options 6

Figure 4: Staring Settings 7

Figure 5: Stationary Camera Low Drift Setting 7

Figure 6: Aerial Settings 7

Figure 7: Anomaly, Radiometric, Maritime, Blob, Detection Settings..... 8

Figure 8: Anomaly, Radiometric, Maritime, Blob, Detection Settings..... 8

Figure 9: Radiometric Detect - Temperature Mode 9

Figure 10: Gas Detection Settings..... 9

Figure 11: Change Gas Overlay Color and Parameters..... 9

Figure 12: Auto and Manual Sensitivity 10

Figure 13: Downsampling Options..... 11

Figure 14: Regions of Interest Example 11

Figure 15: Frame Step 12

Figure 16: Filtering Settings 12

List of Tables

Table 1: Application Bits Requirement Table 1



1 Overview

This document provides information and guidelines on the parameters that primarily affect the detection modes. This document will focus on the settings that will have the most impact on detection performance, and those that will need some adjustment beyond their default settings.

To understand how the parameter settings impact performance, use this document during evaluating and testing.

1.1 Additional Support Documentation

Additional Engineering Application Notes (EANs) can be found on the [Documentation](#) page of the SightLine Applications website.

The [Panel Plus User Guide](#) provides a complete overview of settings and dialog windows located in the Help menu of the Panel Plus application.

The Interface Command and Control ([IDD](#)) describes the native communications protocol used by the SightLine Applications product line. The IDD is also available as a PDF download on the [Documentation](#) page under Software Support Documentation.

1.2 SightLine Software Requirements

ⓘ IMPORTANT: The Panel Plus software version should match the firmware version running on the board. Firmware and Panel Plus software versions are available on the [Software Download](#) page.

1.3 Application Bit Requirements

The functions described in this EAN require Application Bits (app bits) purchased from SightLine. App bits are enabled with a license file provided by SightLine at initial unit purchase or during a license upgrade process. License files use a hardware ID that is applicable to a specific hardware serial number. For questions and upgrade support contact [Sales](#).

Table 1: Application Bits Requirement Table

Detection Modes	Initial Software Release	Required Application Bit(s) v7 License
Base Detection modes		
Anomaly	2.22.xx	Detection - Base 0x0000 0008
Blob	2.24.xx	
Gas	2.25.xx	
Radiometric	2.23.xx	
Staring	2.22.xx	
Vehicle	2.22.xx	
Advanced Detection modes - (Base Detection is a pre-requisite for Advanced detection modes)		
Aerial	2.22.xx	Detection - Base + Advanced 0x0000 0028
Drone	2.24.xx (as part of base) 2.25.xx (moved to advanced)	
Drone w/ Classifier	2.25.xx	
Maritime (beta)	2.23.xx	



2 Detection Modes

The following six detection modes are currently supported.

Vehicle Moving Target Indication:

- Works best finding moving vehicles in a moving scene.
- Works well from a moving platform for finding objects that are typically 10 to 100 pixels long in the scene.
- Not suitable for finding very small, very large, slow, or erratically moving objects.
- Commonly used to assist in track designation. Detects up to 5 objects.



Drone Detection:

- Best for finding drones in a moving or stationary scene.
- Works well from moving or stationary platform for finding drones that are typically 10 to 100 pixels long in the scene.
- Best for tracking slow and erratically moving objects.
- Commonly used to assist in track designation. Detects up to 5 objects.
- Classification helps reduce operator workload by utilizing state of the art deep learning algorithms to reduce false positives



Staring Moving Target Indication:

- Works best from a ground camera that is either stationary or moves and then stares for an extended time at a scene.
- Detects objects that are small and move slow or fast, move at varying rates, or that temporarily stop.
- Detects up to 100 objects.





Aerial Moving Target Indication (MTI):

- Works best from a moving platform and can find small, slow moving objects.
- The only moving target mode capable of handling frame-to-frame perspective changes which makes it ideally suited for airborne applications.
- Takes the most computational resources and is likely to impact frame rate especially on the 1500-OEM.
- Detects up to 100 objects.



Anomaly Detection:

- Works from a moving or stationary platform and finds objects that are unique in the scene based on color and intensity.
- Does not require objects to be moving to be detected.
- Detects up to 100 objects.



Radiometric Detection:

- Works from a moving or stationary platform and finds objects within a specified temperature range.
- Does not require objects to be moving to be detected.
- Detects up to 100 objects.



**Maritime Detection:**

- Works from a moving or stationary platform and finds objects in a maritime environment such as ships or life jackets.
- Does not require objects to be moving to be detected.
- Detects up to 100 objects.

**Blob Detection:**

- Works from a moving or stationary platform and finds objects that are light, or dark compared to their surroundings.
- Does not require objects to be moving to be detected.
- Detects up to 100 objects.

**Gas Detection:**

- Works from a moving or stationary platform.
- Reduces operator workload.
- Enhances and colorizes gasses that are visible with specialized cameras sensitive in the methane absorption band.





3 Best Practices

The best place to start is to use the *Detect* default parameters in Panel Plus » *Tracking* tab » *Detect* tab (Figure 1). Adjust the sensitivity and notice how that changes the number of detections (both true and false detects).

Advanced detection settings can be found by clicking the Advanced button in the Detect tab.

The following sections will not describe every parameter in depth but will attempt to explain parameters that may need adjusted depending on the hardware setup and use case.

Processing at a constant frame rate is also important for detection performance. The display processing load can be reduced by setting a display frame step, turning off enhancement, choosing a faster encoder (MPEG4 for 1500-OEM), and using a smaller output frame size.

The Performance graphs in Panel Plus shows the time used by the processing steps. From the main menu go to View » Show Performance Graphs.

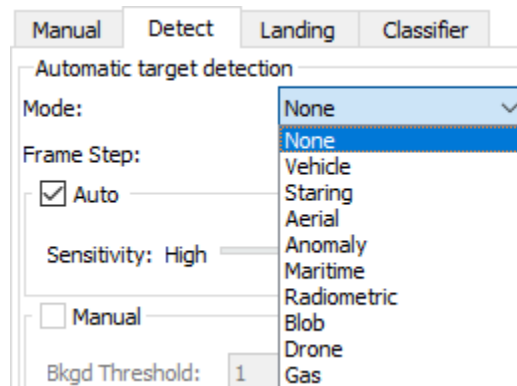


Figure 1: Automatic Target Detection Modes

3.1 Vehicle and Drone MTI

The primary parameter setting for *Vehicle* and *Drone* detection MTI is *Sensitivity*. Use the default value as a starting point for easy adjustments. Other key settings are *Regions of Interest* and *Downsample* covered in the [Performance and Speed](#) section.

3.1.1 Acquisition Assist

In the **Set Tracking Parameters (0x0C)** message, the *Acquisition Assist* (Figure 2) setting has an impact on Vehicle and Drone MTI. It uses an algorithm, with hints of detection data, to make an optimal axis aligned bounding box for the target. If it is not enabled, only the detection data is used. It also works well if the scene is not cluttered. If the scene becomes too cluttered, it should be disabled.



3.1.2 Intelligent Assist

Enabling *Intelligent Assist* is useful in *Drone* mode. Intelligent assist allows the track box to be resized as needed.

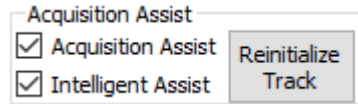


Figure 2: Acquisition and Intelligent Assist

3.1.3 Classifier Options

The *Use Classifier* setting is only available on the 3000-OEM and 4000-OEM using the *Drone* detection mode. This enables a deep learning algorithm that continuously runs on the detections.

In 3.0.xx software the Classifier can now be used to filter out detections that are not classified as a drone and/or add a classification label.

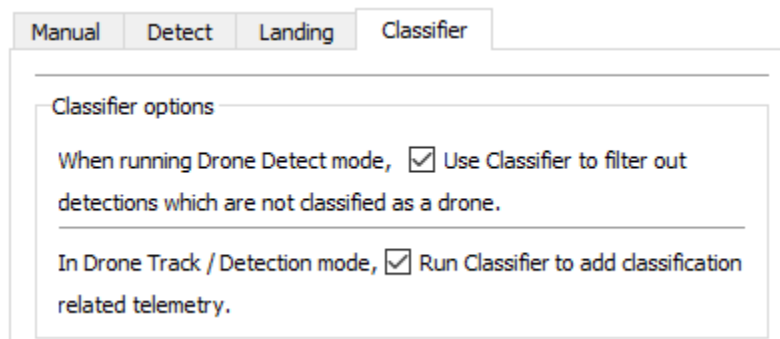


Figure 3: Classifier Options

3.1.3.1 Filter Detections

The classifier can be used to reduce the number of false positives. When an object is detected in the scene the classifier will evaluate that object. If the object has been labeled a drone a track is started, otherwise the detection is ignored.

The classifier is intermittently run on all tracks. If a track no longer classifies as a drone the track is dropped. The label and confidence the classifier assigned to a detection can be included in telemetry using the **Track Positions Extended (0xA0)** message. To enable this mode, use the **Set Detection Parameters (0x2D)** message.

3.1.3.2 Label Detections

The classifier can also be run without filtering out false positives. Doing this allows the user to make the decisions based on classification labels and confidence values included in the **Track Positions Extended (0xA0)** message. To enable this mode, use the **Set Tracking Parameters (0x0C)** message.

If this is enabled at the same time as the filter detections option, the classifier will also run on user designated tracks or detections that are made primary.



3.2 Staring MTI

Parameters for this feature can be found by clicking the *Advanced* button in the *Detect* tab. The parameter settings for *Staring* and *Aerial MTI* are nearly identical. In most cases, the default values are sufficient. *Staring MTI* uses two additional parameters.

Average Time Constant: The approximate amount of time to fully replace the background model.

Edge Penalty: Applied to edges in the background model, minimizing small differences to reduce the number of false detects. The higher the value, the larger the penalty. Lowering the value allows smaller slower moving objects to be detected but may have more false detections.

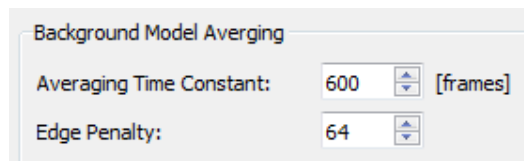


Figure 4: Staring Settings

Staring MTI requires the *Stationary Camera Low Drift* setting in the Stabilization and Registration dialog window (Panel Plus main menu » *Configure* » *Stabilization*). This corresponds to setting the *Update Rate* in the **Registration Parameters (0x9E)** message to 10.

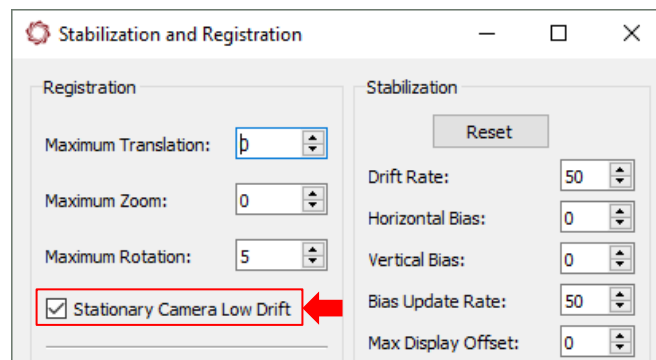


Figure 5: Stationary Camera Low Drift Setting

3.3 Aerial MTI

Parameters for this feature can be found by clicking the *Advanced* button in the *Detect* tab.

The *NframesBack* setting determines how far back in time to search.

Reductions in frame rates will need to be changed under certain circumstances. For example, if every other input frame is being skipped, the number may need to be lowered. The number should also be lowered for fast moving objects (between 6 and 15).

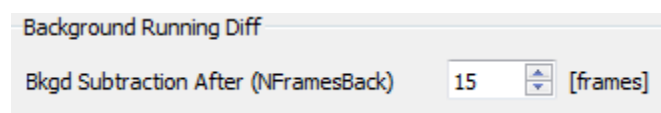


Figure 6: Aerial Settings



3.4 Anomaly, Radiometric, Blob, Maritime Detection

Parameters for this feature can be found by clicking the Advanced button in the Detect tab.

Use Registration: Anomaly, Radiometric, Blob, and Maritime detection modes use this parameter. It is used to control whether detections are tracked from frame to frame.

When looking for detections on each frame independent of other frames, i.e., when scanning a large area, disable this setting.

When slowly scanning or staring, use the registration results along with a higher number of watch frames to reduce the number of false detects.

Update Rate: Anomaly and Maritime use this parameter. It controls how fast the detection model is updated. Larger values put more emphasis on the current frame. Typical values are in the 8 to 64 range. For example, when running *Maritime* detection mode in high seas, lowering this number helps reduce the number of false detects. When running in calm seas where registration may be less accurate, increasing this value can be beneficial.

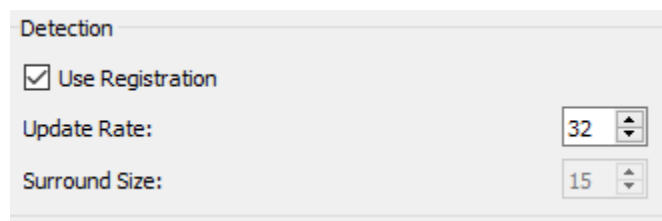


Figure 7: Anomaly, Radiometric, Maritime, Blob, Detection Settings

3.5 Blob Detection

Parameters for this feature can be found by clicking the Advanced button in the Detect tab.

Use Registration: Anomaly, Radiometric, Blob, and Maritime detection modes use this parameter. It is used to control whether detections are tracked from frame to frame.

Surround Size: Determines how large an area around each pixel to consider in the blob detection algorithm. This number should be larger than the size of the object that is being detected. If detections appear only on one side of the object or only the outline of the object in the debug image, the number should be increased.

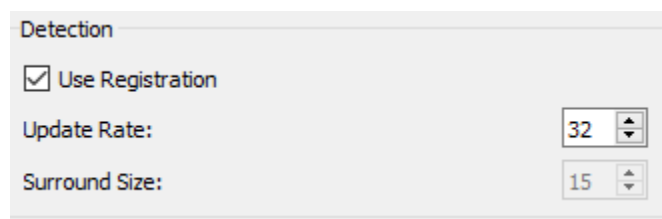


Figure 8: Anomaly, Radiometric, Maritime, Blob, Detection Settings



3.6 Radiometric Detection

Radiometric Detection looks for pixels that fall within a specified range of gray values. This algorithm can operate on 8-, 14-, or 16-bit data.

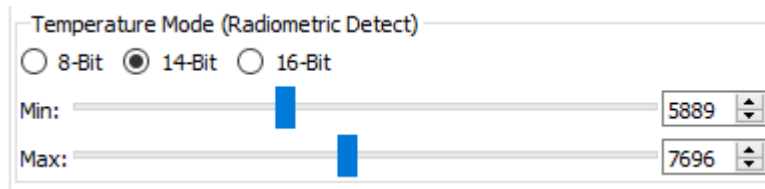


Figure 9: Radiometric Detect - Temperature Mode

16-bit mode operation available in 3.2.x.

3.7 Gas Detection

Parameters for this feature can be found by clicking the Advanced button in the Detect tab.

Use the settings in *Background Model Averaging* to control the discrimination of gas features from the background.

Averaging Time Constant: The approximate amount of time in frames to fully replace the background model. For Gas, a small value between about 5 and 20 is recommended. Larger values can make the measurement more sensitive, but only for stationary cameras. Smaller values work better for cameras with some shake or small movements.

Edge Penalty: Applied to edges in the background model, minimizing small differences to reduce the number of false detects. The higher the value, the larger the penalty. A value of 64 is recommended for Gas Detection.

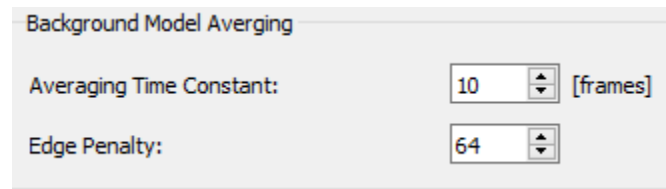


Figure 10: Gas Detection Settings

Use the settings in *Gas Enhance* to control the displayed enhancement of gas.

Color: Select the color of the enhanced gas. White for no color.

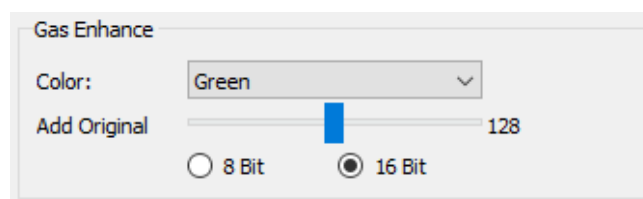


Figure 11: Change Gas Overlay Color and Parameters



Add Original: Controls the fraction of the original image that is shown with the gas differences. 0 will only show gas differences. 128 will show 50% of the original image intensity plus the gas differences. 255 will show 100% of the original image plus the gas differences.

8/16 Bit: Choose 16 Bit to allow the algorithm to run on the original 16-bit image (before auto gain) if it is available. Choose 8 Bit to always execute on the image after it has gone through auto gain. 16-bit allows the detection to remain sensitive even in regions that get saturated by auto gain.

16-bit is only available in None Downsample mode.

3.8 Auto and Manual Sensitivity

For *Aerial*, *Starring*, *Anomaly*, *Maritime*, *Blob*, *Gas*, and *Radiometric* detection modes, the sensitivity can be controlled in one of two ways using the **SetDetectionParameters (0x2D)** message.

Auto sensitivity: Easiest to use. The sensitivity directly controls other parameters. A higher sensitivity will result in a greater likelihood of detecting a target but has a greater likelihood of false detections.

Manual sensitivity: Allows the user to directly control the background threshold, watch frames, and suspicious score. The sensitivity setting does not apply.

The screenshot shows a control panel for 'Automatic target detection'. At the top, there is a 'Mode' dropdown menu set to 'Aerial' and a 'Show Debug' checkbox. Below this is a 'Frame Step' input field with the value '1' and a 'Reset' button. The 'Auto' section is active, indicated by a checked checkbox, and features a 'Sensitivity' slider ranging from 'High' to 'Low', with the slider handle positioned approximately in the middle. The 'Manual' section is inactive, indicated by an unchecked checkbox, and contains three input fields: 'Bkgd Threshold' set to 12, 'Susp Score' set to 2, and 'Watch Frames' set to 5.

Figure 12: Auto and Manual Sensitivity

The background threshold defines how different an object needs to be from the background model to be detected. In the example shown below, a low background threshold number will generate more detections.

Watch Frames: Defines how long a target should be watched before reporting it to the user. A lower number of watch frames will result in shorter detection times and can result in more false positives.

Suspicious Score: Defines a level at which the algorithm will consider a track to be unstable based on a history of the track detections. For example, a leaf that blows in the wind moves erratically and would require a high suspicious score to show up as a detection. A car driving in a straight line would require a much lower suspicious score to show up as a detection.

The suspicious score does not apply to the Anomaly, Radiometric, Blob, Gas, or Maritime detection modes. The background threshold parameter does not apply to the Radiometric detection mode.



4 Performance and Speed

This section reviews the tradeoffs between performance (how well the algorithm does at detecting objects) and speed (how long the algorithm takes to run). Settings are in Panel Plus » *Tracking tab* » *Detect tab* » *Advanced*.

4.1 Downsampling

Parameters for this feature can be found by clicking the *Advanced* button in the *Detect tab*.

In *Auto* mode, the downsampling rate is automatically set and is based on the image size and algorithm. Increasing the downsampling time allows bigger and faster targets to be detected (faster processing time). Lowering the downsampling time allows for slower and smaller moving targets to be (slower processing time).

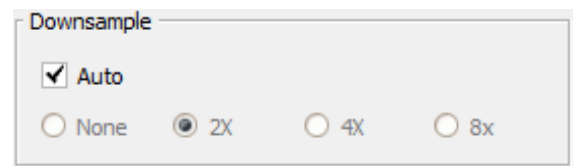


Figure 13: Downsampling Options

Downsampling can also be adjusted to detect slower and smaller targets with HD inputs. This may reduce the output frame rate or require the user to make changes to other parameters such as the *Region of Interest* to maintain full frame rate. Downsample does not apply to anomaly detection.

4.2 Regions of Interest

Regions of Interest can be used to control the speed and performance of the various detection algorithms. In the example below the search area is defined in blue based on the settings shown. This region directly impacts the speed of the algorithm since this is the region that will be processed. The detection area is defined in red and based on the settings shown. Detection will be reported in this area. To detect objects as soon as they enter the detect region, make the search region slightly larger. When using the *Set Mouse* option from Panel Plus, the detection and search areas are set to the same size.

Both areas can be the same size, but the detection area cannot be larger than the search area.

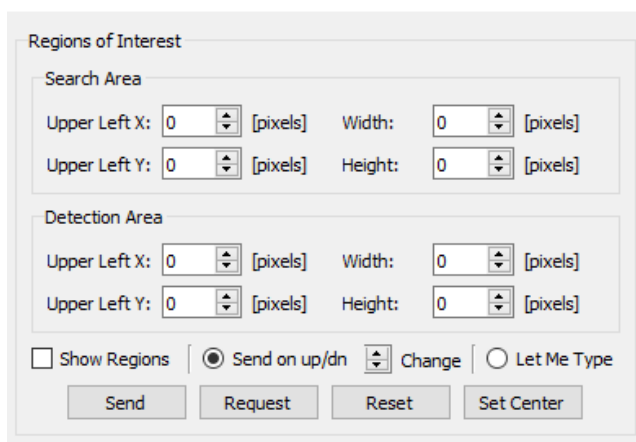


Figure 14: Regions of Interest Example



4.3 Frame Step

Frame Step is under the *Automatic target detection* section in the *Detect* tab. It can be used to reduce the processing load by only running the algorithm every other or every third frame. It can also be used to increase the amount of motion between frames, allowing detection of slower moving objects.

Keep a consistent frame rate through the system. Frame stepping an individual algorithm should only be used as a last resort.

Frame Step does not apply to Vehicle, Drone, or Gas detection.

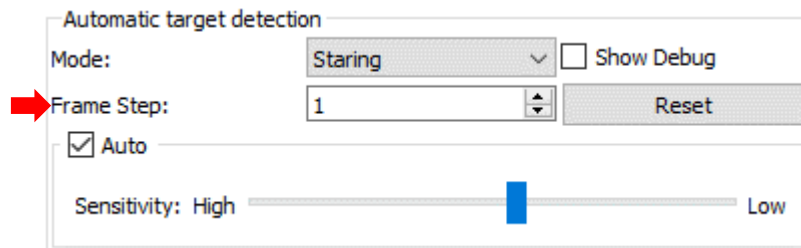


Figure 15: Frame Step

5 Filtering Detections

Use these settings to help setup filtering parameters. Settings are in Panel Plus » *Tracking tab* » *Detect tab* » *Advanced*.

Detections can be filtered based on many different parameters including size, velocity, and in some cases acceleration. Setting these parameters correctly can be difficult, but when done correctly it can help filter out false detections.

Filtering does not apply to Vehicle, Drone, or Gas detection.

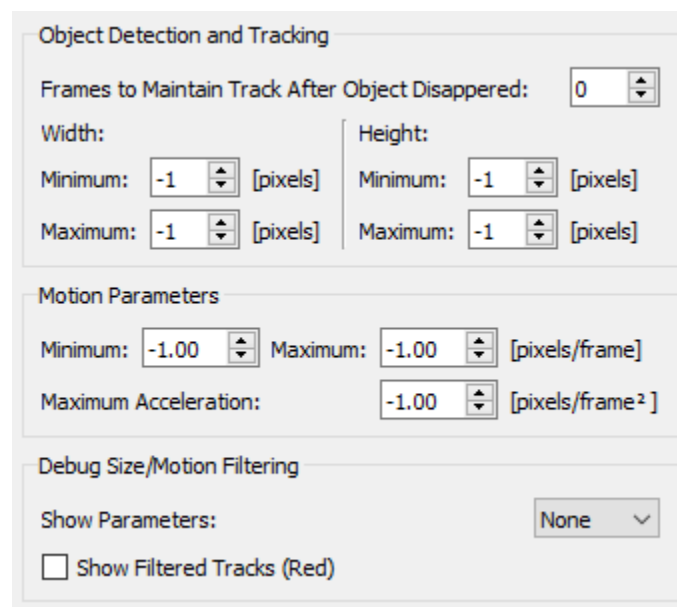


Figure 16: Filtering Settings



6 Snapshots of Detections

New in 3.2.x software. Snapshots of detections can be used for a number of reasons depending on the application. For example, to reduce the amount of data sent over a network or to collect data for training a classifier. See the Configure Detection Snapshots section in the [EAN-File-Recording](#) for more information on this feature.

7 Command and Control.

The following packets are used to set up and control the detection algorithms. Details on these can be found in the [Interface Command and Control \(IDD\)](#).

7.1 Reporting Results

Tracking Position (0x43)

Tracking Positions (0x51)

Tracking Positions Extended (0xA0)

Set Coordinate Reporting Mode (0x0B)

Set Telemetry Destination (0x64)

7.2 Display Related Commands

Set Overlay Mode (0x06)

Set Display Parameters (0x16)

Do Detect Snapshot (0xAB)

7.3 Detection Related Commands

Set Detection Parameters (0x2D)

Set Advanced Detection Parameters (0x76)

Set Detection Region of Interest (0x7C)

Set Tracking Parameters (0x0C)

8 Troubleshooting

Expected detections are not shown: Enable the debug window. This shows what the algorithm is actually seeing.

Additional troubleshooting: Turn off all detection modes, overlays, and stabilization. Record 1 to 2 minutes of video and send it to SightLine. SightLine will post process it and provide an analysis of performance and make parameter recommendations.

8.1 Questions and Additional Support

For questions and additional support, please contact [Technical Support](#). Additional support documentation and Engineering Application Notes (EANs) can be found on the [Documentation](#) page of the SightLine Applications website.

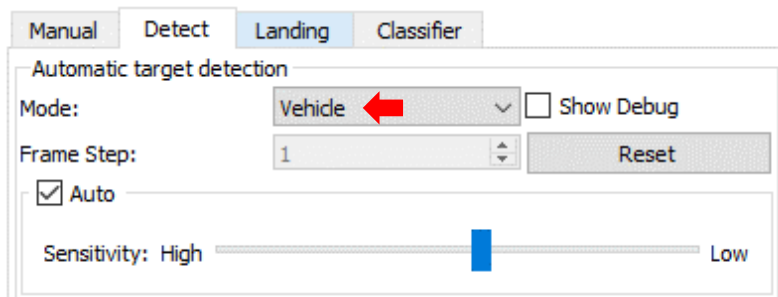


Appendix - Testing MTI


1. From the main menu in Panel Plus, go to *Configure » Acquisition Settings*.
2. Under the Camera Type drop down menu, select *TestPattern Car* or *TestPattern Multi Car*.
3. The *Apply* button will turn red indicating input field changes have been detected. Click *Apply*.



4. From the main menu, go to *Parameters » Save to board*. Cycle the system power or go to *Reset » Board*.
5. After the board resets, the test pattern video should be displayed in Panel Plus. Go to *Tracking tab » Detect* tab. In the *Mode* dropdown menu select *Vehicle*.



6. The system should detect the car and place a detection box around it.

 *The mouse can be used to designate other targets.*



7. To exit the test pattern, from the main menu in Panel Plus, go to *Configure » Acquisition Settings*.
8. Under the Camera Type drop down menu, select a previous camera setting or select *None*.
9. Click *Apply*.
10. From the main menu, go to *Parameters » Save to board*. Cycle the system power or go to *Reset » Board*.