

# V-Tracking Manual



***GUIDELINES FOR PROPERLY CALIBRATING VIRTRA SIMULATORS.***  
Based on V-Tracking Version 2.28.0

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## **TRADEMARKS**

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## OVERVIEW

1. **V-Tracking™** is a custom shot tracking system designed to support various types of cameras and to be independent of camera resolution and frame rates. The current iteration is developed for the NaturalPoint OptiTrack range of motion capture cameras utilizing the NaturalPoint Camera SDK.

Instead of mapping and tracking every single screen or camera pixel, this tracking solution maps a low resolution grid of screen locations to a matching grid of camera locations.

The concept of pixel resolution is generally ignored and all locations are mapped to 32bit floating point normalized coordinates.

This mapping is being achieved by calculating the weighted average of a recognized pixel blob consisting of multiple pixels tracked with 8 bit grayscale values (256 shades of gray per pixel). Depending on the size of the blob, the resulting location data divides the pixel resolution into a much higher density grid of sub-pixels.

## FEATURES

- Utilizes a range of NaturalPoint OptiTrack cameras supporting the IR filter switcher by building on the NaturalPoint OptiTrack Camera SDK.  
<http://www.naturalpoint.com/optitrack/>
- Simplifies and speeds up the calibration process due to programmatic control of the IR filter and the ability to map the entire screen with a single rasterized image.
- True sub-pixel shot precision only limited and affected by the physical camera resolution and laser blob size and footprint.
- Highly optimized frame processing logic that is capable of rasterizing images and performing blob recognition in real time at high resolutions and framerates of 250 frames per second and beyond.
- Support for USB and Ethernet cameras without any change in configuration.
- Variable and selectable framerate within the limits of the capabilities of the attached camera.
- Two different tracking modes:

- Laser ID: Tracking of 'passive' weapons which fire a fixed laser pulse of a given length when a shot is triggered.
- Trace ID: Tracking of instrumented weapons which fire a continuous laser beam in order to track their aim in real time.

## COMPONENTS

The **V-Tracking Shot Tracking** solution consists of the following components:

### VirTra Tracking Service

A windows service running in the background that contains the actual shot tracking logic. The VirTra Tracking Service consists of a general framework for various types of shot tracking implementations as well as the V-Tracking specific implementation for shot tracking with the NaturalPoint cameras (as discussed in this document).

### V-Tracking Calibration

A windows application for calibrating the camera with the screen for correct mapping of tracked shots to the displayed screen locations.

### V-Tracking Diagnostics

A windows application to communicate with the shot tracking service and expose its settings and tracking data for diagnostics, development and troubleshooting purposes. The diagnostics tool is communicating with the shot tracking service via the Windows Communication Foundation and thus can be used locally or from a remote computer on the same network.

## INSTALLATION

### PREREQUISITES

#### Visual Studio Redistributables

The Visual Studio Redistributables 2010, 2013 and 2015 for x64 AND x86 need to be installed on the target systems:

<https://www.microsoft.com/en-us/download/details.aspx?id=14632>  
<https://www.microsoft.com/en-us/download/details.aspx?id=5555>  
<https://www.microsoft.com/en-us/download/details.aspx?id=40784>  
<https://www.microsoft.com/en-us/download/details.aspx?id=48145>

#### DirectX End-User Runtime

The DirectX End-User Runtime needs to be installed on the target systems:

<https://www.microsoft.com/en-us/download/details.aspx?displaylang=en&id=35>

#### NetTcpPortSharing Service

The shot tracking service relies on the **NetTcpPortSharing** service to run properly. This service is generally disabled on a Windows system.

The VirTraTrackingServiceInstaller enables NetTcpPortSharing automatically.

If this fails, enable the service by running the Command Prompt with administrator privileges and execute the command:  
**sc.exe config NetTcpPortSharing start= demand**

#### USB driver when utilizing a camera with USB connection

After plugging in a NaturalPoint USB camera to a new computer, the automatic attempt to install a driver for the device will fail. The driver needs to be installed manually through the device manager.

Find the entry for the driverless USB device in the Windows device manager, open the properties dialog, navigate to the driver tab and use the **Update Driver** button to browse to the folder *npusbio\_x64* provided with the installer packages for the shot tracking system.

#### Testing if the camera was properly recognized by the computer

Once either an Ethernet or USB camera has been connected to the system and its green or red control LED is lit, the NaturalPoint provided **visualtest.exe** application can be launched to verify that the camera has been recognized. If not, the program will show an error message upon start. If the camera was recognized a window with some camera information and stats will show up. The image of the window will generally be black because the IR filter is on by default.

**Prime 13:** The NaturalPoint Camera SDK has issues with certain NICs which may cause them to not see the Prime 13 camera. See the

Troubleshooting section.

## INSTALLATION OF THE VIRTRA TRACKING SERVICE

Once all the prerequisites are met, the VirTra Tracking Service can be installed by executing the installer file ***VirTraTrackingServiceInstaller.msi***

By default the tracking service will be installed to the folder ***C:\VirTra\Programs\VirtraTrackingService***

The tracking service is started automatically and will be running if no problems occurred during its startup.

## INSTALLATION OF THE TRACKING SERVICE TOOLS

The calibration tool can be installed by executing the installer file ***V-TrackingCalibrationInstaller.msi***

Its default install location is ***C:\VirTra\Programs\V-Tracking Calibration***

The calibration tool can be installed by executing the installer file ***V-TrackingDiagnosticsInstaller.msi***

Its default install location is ***C:\Virtra\Programs\V-Tracking Diagnostics***

## TRACKING SERVICE FILES

In addition to the installed components the tracking service uses the following additional data files:

### D1. Tracking Data

#### **C:\VirTra\Cameras\V-TrackingCalibration.dat**

An XML formatted file created after successful calibration that contains the camera to screen mapping coordinates for all calibrated cameras.

#### **C:\VirTra\Cameras\V-TrackingDiagnostics.dat**

An XML formatted file created by the diagnostics tool that contains the last used diagnostics tool view settings.

#### **C:\VirTra\Cameras\V-TrackingAreaOfInterest.dat**

An XML formatted file created by the calibration tool after specifying the cameras area of interest containing the exact layout of the area of interest for all cameras that have gone through that process.

#### **C:\VirTra\Cameras\V-TrackingLaserIdConfiguration.dat**

An XML formatted file created by the tracking service and modifiable with the diagnostics tool containing the frame counts for all individual LaserIDs for LaserID recognition.

#### **C:\VirTra\Cameras\V-TrackingCamera.dat**

A text file containing the desired camera name the tracking service is using when more than one camera is attached and a specific camera matches that camera name.

#### **C:\VirTra\Cameras\V-TrackingSettings.dat**

An XML formatted file created by the diagnostics tool after modifying and saving the default tracking settings. The tracking service will continue to use these settings even after a service restart or system reboot.

### D2. Verification and Debug Images

#### **C:\VirTra\Cameras\V-TrackingCalibrationImage.bmp**

The rasterized image of the last calibrated camera at the moment of completed calibration during one shot calibration mode.

#### **C:\VirTra\Cameras\V-TrackingCalibrationImageRowNN.bmp**

A number of rasterized images, one for each row, of the last calibrated camera at the moment of completed calibration of each row in the row by row calibration mode.

#### **C:\VirTra\Cameras\V-TrackingBlockingMask.bmp**

The rasterized image of the camera blocking mask based on the area of interest that was specified during the last calibration.

### D3. Log Data

#### **C:\VirTra\LOGS\VirTraTrackingServiceNN.log**

The log information continuously stored by the tracking service as events occur. It contains information about start and stop of the service, the connected cameras and any camera health issues that may have come up as well as any potential error information in case of a malfunction.

## D4.Others

### C:\VirTra\Programs\VirtraTrackingService\active.tmp

An empty file that signals that the tracking service is currently running, that a camera is attached and recognized and that it actively transmits shot data to connected shot tracking clients.

### C:\VirTra\Programs\VirtraTrackingService\error.txt

A text file containing any system exceptions which may have caused the tracking service to not launch successfully.

## CALIBRATING A SINGLE SCREEN SYSTEM WITH BASIC SETTINGS

V-100™ product running on a single computer system.

### LAUNCHING THE SOFTWARE

To begin, launch **V-Tracking Calibration™** located on the desktop.  
If everything is setup correctly, the calibration tool will open to the start screen:



Fig.01: Program icon

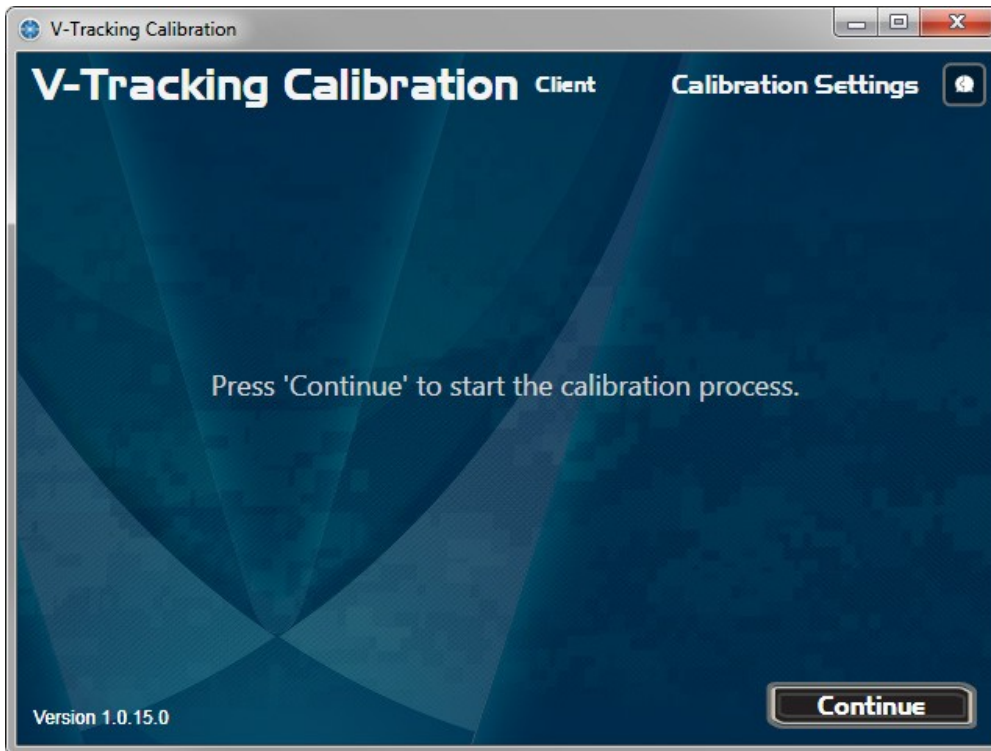


Fig.02: V-Tracking Calibration™ tool

1. Make sure the calibration tool windows is located on the screen that is to be calibrated and that will receive the laser shots. The window will use its current location to determine on which screen to present the calibration points for the process. Move it by dragging using the window's title bar.
2. On the start screen press **Continue** to go to the Calibration Focus screen.

## A1.Error Message during launch

The tool will bring up an error message dialog if either of the following conditions are not met:

- Tracking Service is not running
- No camera is connected.

In this case go to **Section VII: Troubleshooting**.

## CALIBRATION FOCUS SCREEN

This section explains how we adjust the focus on the calibration screen. See Fig. 03 below.

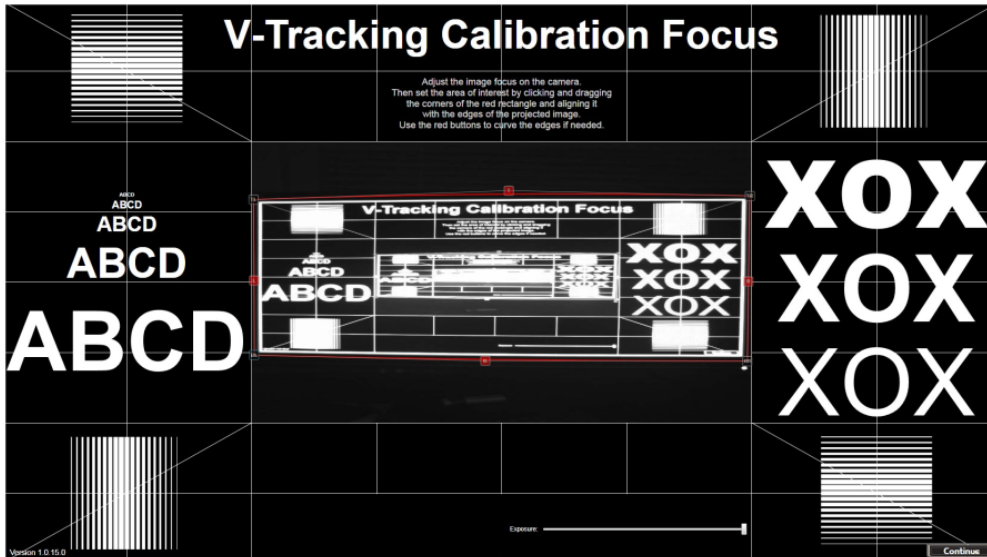


Fig.03: V-Tracking Calibration Focus screen

### Exposure:

1. Use the **exposure slider** at the bottom to select an exposure level that makes the details on the recorded camera image in the center clearly visible.



Fig.04: Exposure slider

### Camera Location:

2. Move the camera to a location where the focus image can be seen in its entirety on the recorded image. Make sure the image is not angled and uses up as much of the recorded area as possible.
3. It is ok to mount the camera at any 90 degree angle, including upside down or at the back off the screen creating a mirrored image. However the edges **should be parallel** to the recorded image frame as much as possible.

### Focus:

4. Adjust to the optimal image focus by rotating the lens on the camera.

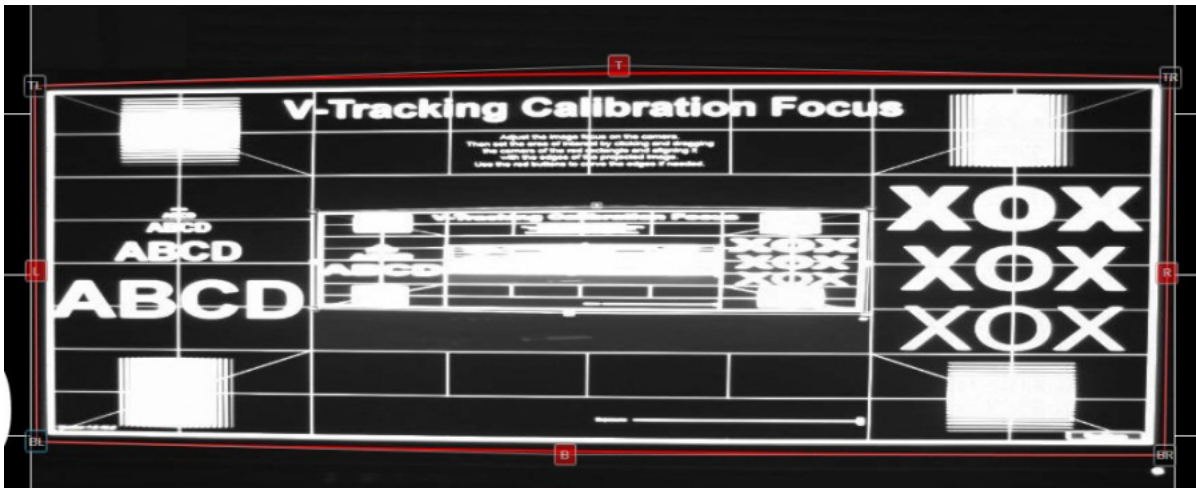
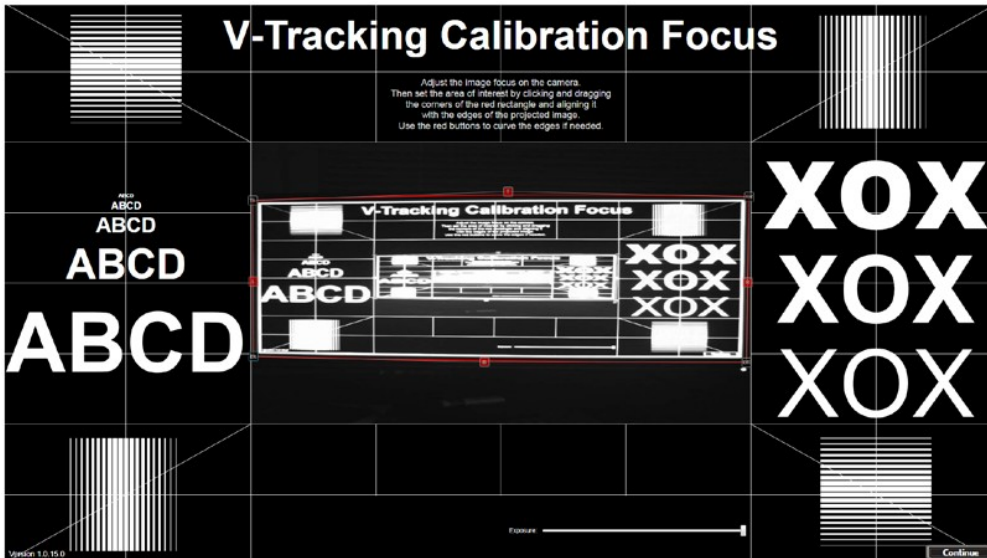


Fig.05: Adjusting Area of Interest

### Area Of Interest:

5. Click on and drag the four corner buttons labeled **TL**, **TR**, **BL** and **BR** of the area of interest outlined in red so that it contains the entire projected image including the thick white border as seen on the screenshot. See Fig 05 above.
6. Make sure any potential light source or reflections visible in the recorded image are **outside** the red boundary.
7. In situations where multiple screens border each other or unwanted IR sources can come very close to the screen it is **ok** to move the red outline on top of the thick white image frame.
8. If a camera lens is being used that shows a wide angle, distorted image the four red buttons labeled **T**, **B**, **L** and **R** can be used to curve the edges to match the outline with the potentially curved edges of the recorded image.

## LAUNCH CALIBRATION

1. Click '**Continue**' to launch the calibration process.

The system will go through a number of black screens which are blank or show white dots. The amount of time for this process to complete depends on the lighting situation in the room and can take up to a minute.



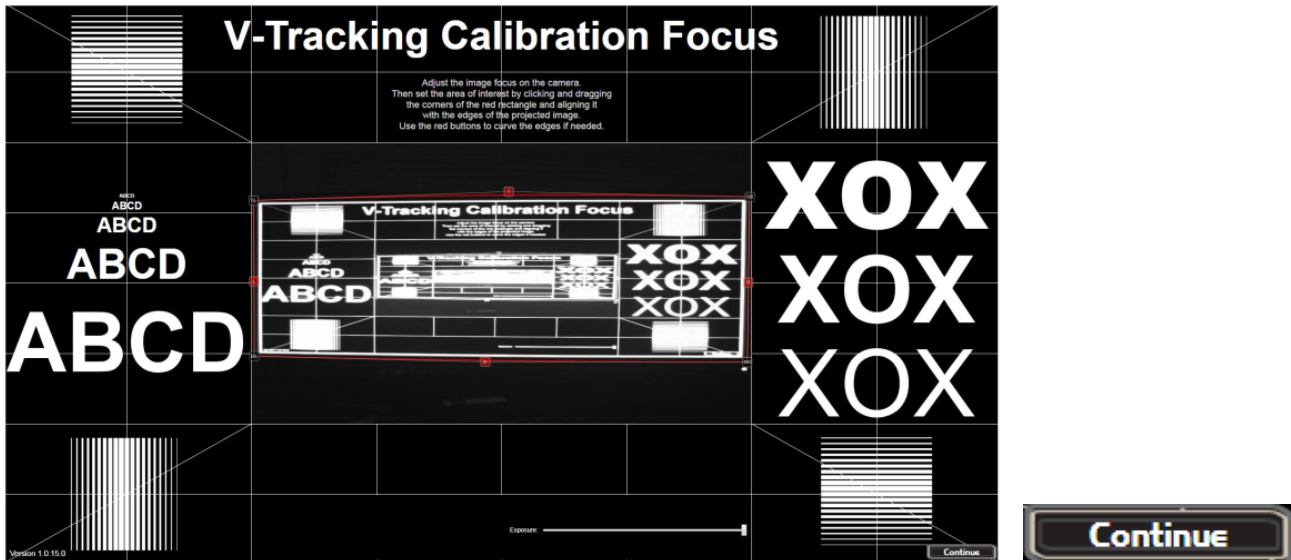


Fig.06: Launch Calibration stage

## CALIBRATION RESULTS

1. If the calibration concludes with an **error message dialog box**, repeat the calibration process and make the appropriate adjustments.
2. On success, the calibration process concludes with a dialog giving the option whether to **accept** or **reject** the calibration data.

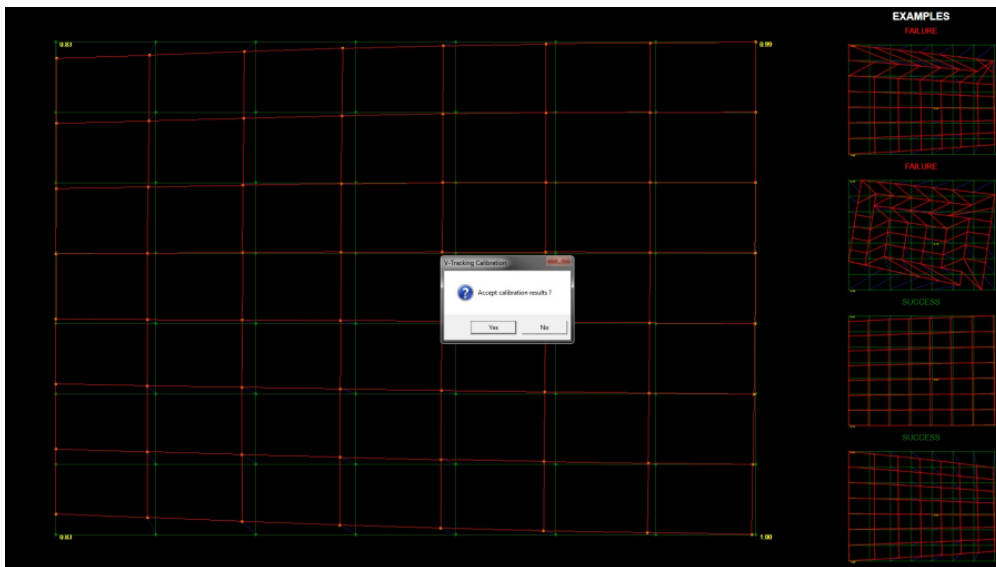


Fig.07: Calibration results

## EXAMPLES OF SUCCESSFUL AND FAILED CALIBRATION RESULTS

### Successful Calibration Result

It will present a green and red grid to verify the success of the calibration process. The green grid represents the projected grid and the red grid represents the grid the camera was able to read. The red grid might be slightly distorted based on the camera angle in relation to the screen. See Fig. 08 below..



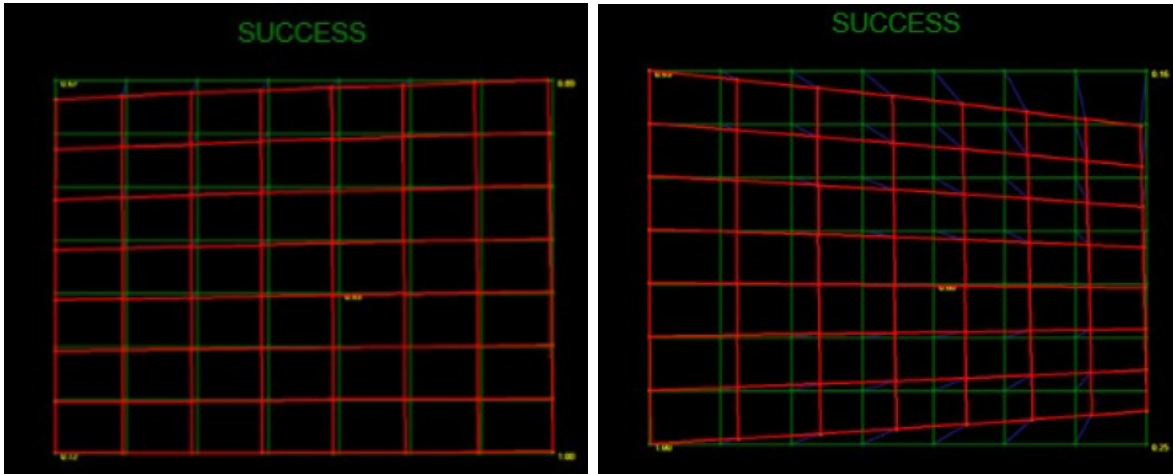


Fig.08: Examples of successful calibration results

### Unsuccessful Calibration Result

The calibration is only successful if the red grid represents a uniform grid that may be somewhat skewed. If individual points are missing or if they appear to not be in the expected location, the calibration needs to be repeated. See Fig. 09 below.

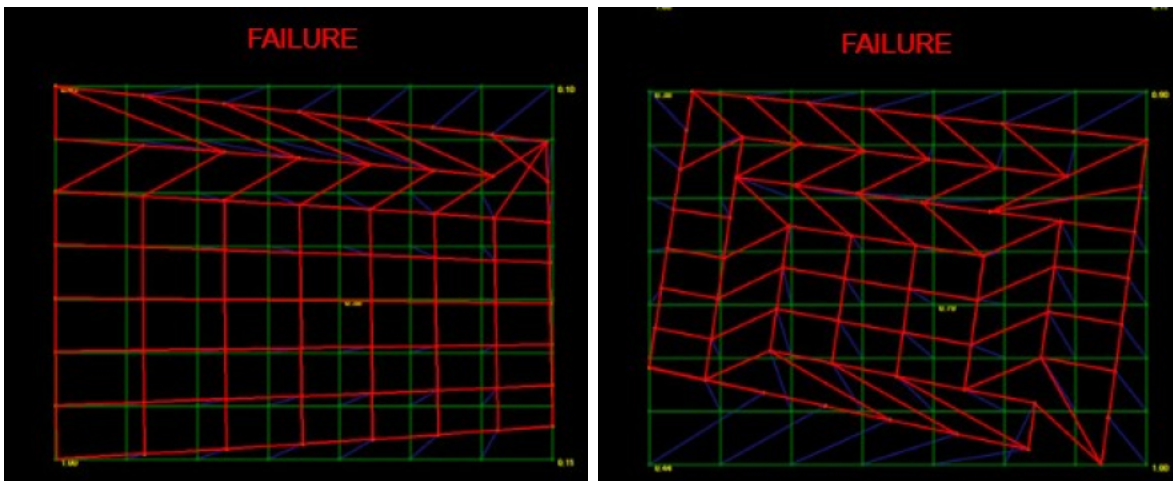


Fig.09: Examples of unsuccessful calibration results

## CALIBRATING A SINGLE SCREEN SYSTEM WITH ADVANCED SETTINGS

### CALIBRATION SETTINGS

For particular situations a number of additional calibration options are available. In order to access these options the calibration tool must be started in advanced mode.

To do so, hold down the **shift key** while double clicking the **V-Tracking Calibration** desktop icon. See Fig. 10 to the right.

The options are:



**SHIFT +**

Fig.10: Shift + Double click to access the advanced settings

#### 1. Projector Adjustment View

Projects a full screen image showing boxes with the desired real world measurements based on the screen layout information specified in the **C:\VirTra\CONFIGS\Config.xml** file. This view can be used to modify the projector settings until the size of the projected boxes and screen is exactly of the desired size.

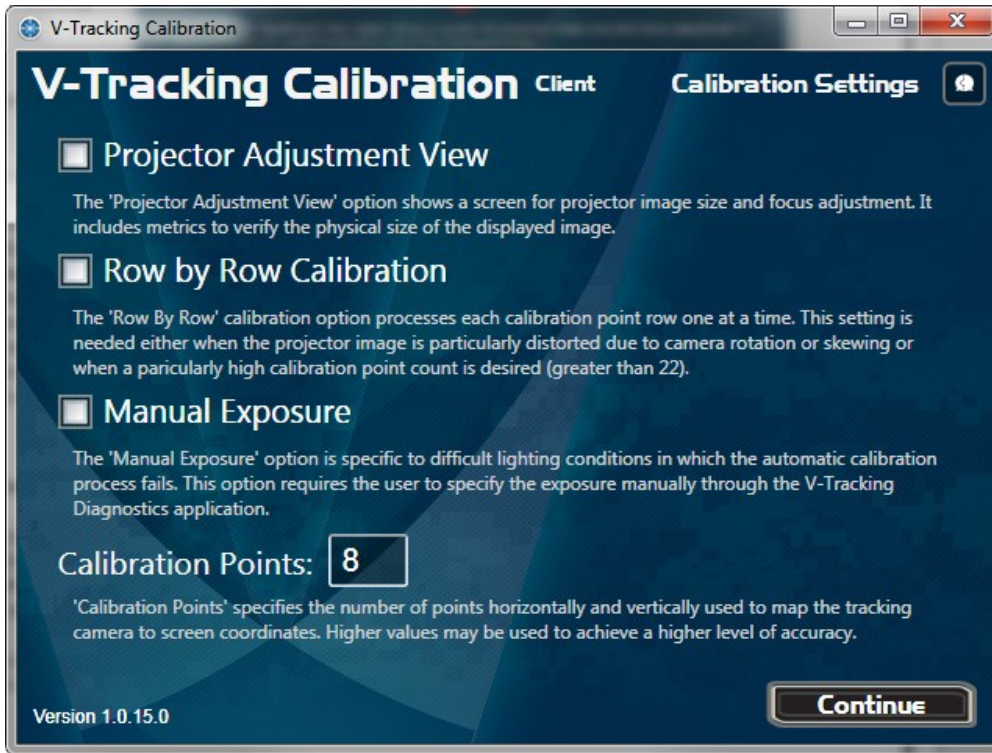


Fig.11: Tracking Calibration Client interface

## 2. Row by Row Calibration

This can be used if the camera had to be mounted at a particularly awkward angle that makes it difficult for the calibration system to recognize the location of the calibration points with a single image. In this case the calibration points are determined row by row which slows down the calibration process but allows for successful calibration with rotated or skewed camera angles.

In addition, this process is required when more than 22x22 calibration points are desired. That is because the OptiTrack SDK provides a maximum of 500 objects at a time so calibrating 23x23 objects at once is not possible.

## 3. Manual Exposure

This is needed when the lighting situation is such that the automatic calibration process fails and the camera settings need to be tweaked manually for the calibration program to correctly recognize the calibration points. This is explained after the Automatic Calibration section below.

## ADDITIONAL FOCUS OPTIONS

1. Use the **Rotate Image** button for a correct view if the camera is mounted at 90 or 180 degrees. This feature does not affect calibration and it is not required to rotate the image appropriately.

2. **FOR USB CAMERA APPLICATIONS ONLY**, use the **Show and Clear** buttons to preview or clear the actual area of camera pixels the camera will ignore. Since the area of interest resolution for this camera is lower than the actual camera resolution it might be important to see which exact pixels are being ignored.

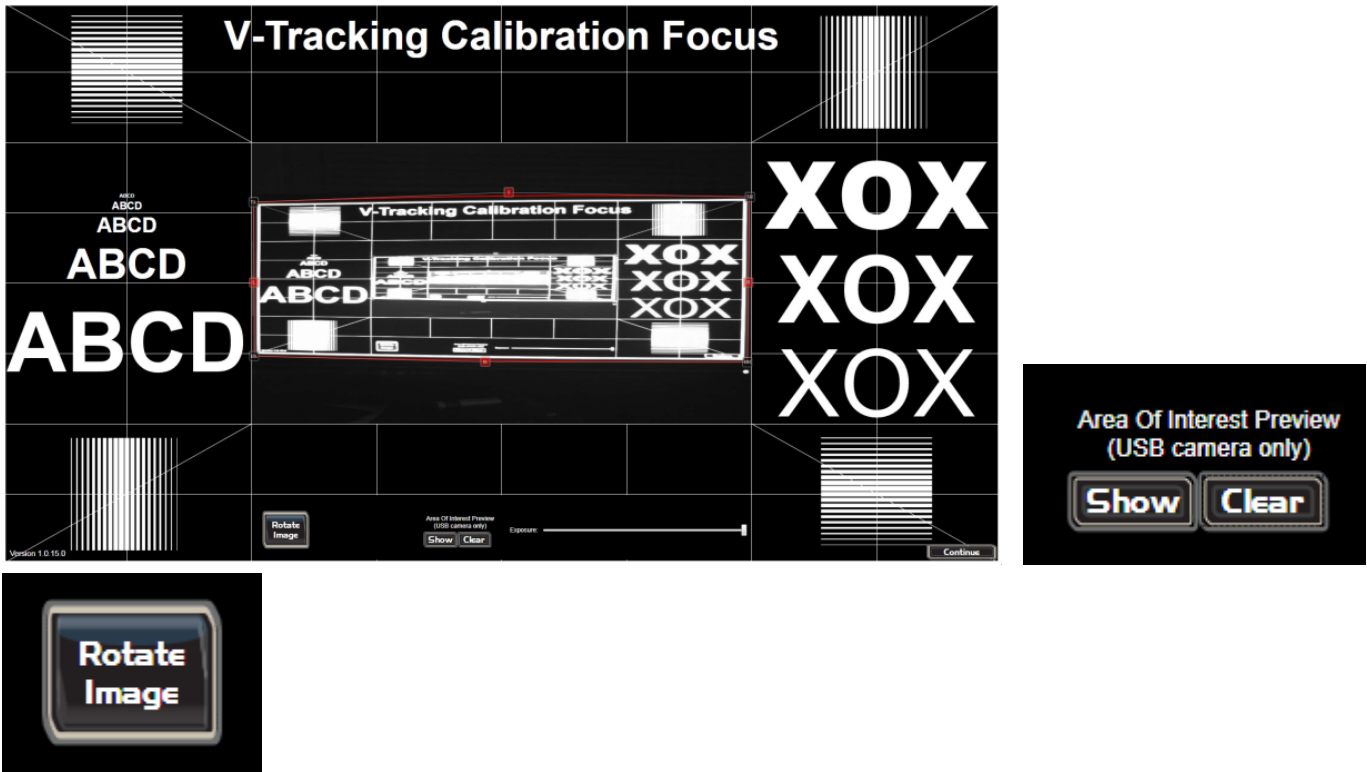


Fig. 12: Tracking Calibration Client interface

## MANUAL CALIBRATION PROCESS AND THE DIAGNOSTICS TOOL

When the automatic calibration process fails because of difficult lighting conditions or due to a dim projector or other reasons, it is possible to attempt calibration by manually adjusting the exposure and threshold values.

For the manual process select **Manual Exposure** in the calibration settings and continue the calibration process through the focus view as before. After continuing from the focus view 5 circles will be continuously projected onto the display until the camera settings have been adjusted in a way for the camera to clearly distinguish them.

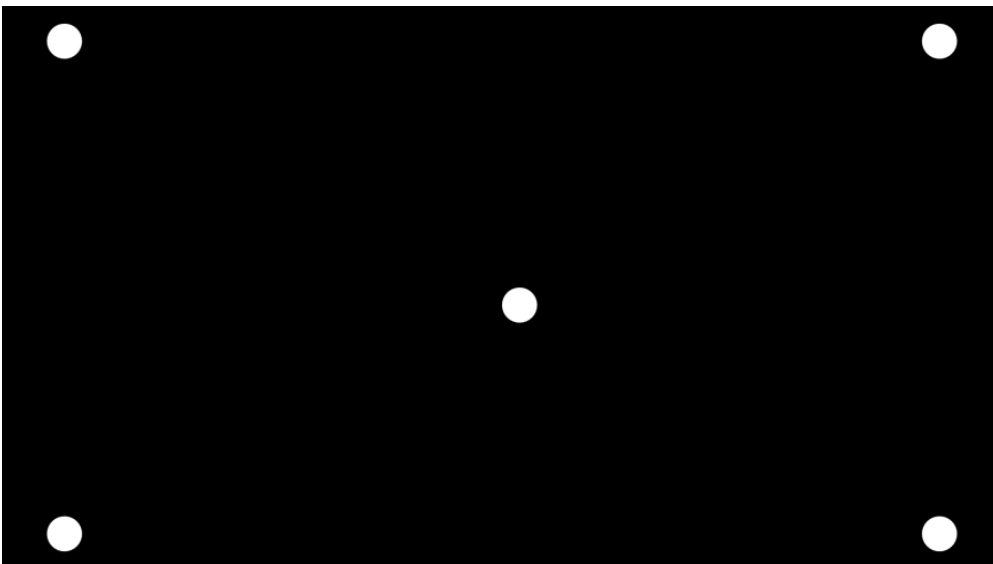


Fig. 13: Tracking Calibration Client interface

This is done by running the **V-Tracking Diagnostics** application on a second monitor or on a networked computer. For a full explanation of the diagnostics tool refer to **Section VI. V-TRACKING DIAGNOSTICS TOOL REFERENCE**.

1. Run the diagnostic tool by launching with the **V-Tracking Diagnostics** desktop shortcut or directly with **V-TrackingDiagnostics.exe** in the folder **C:\VirTra\Programs\V-Tracking Diagnostics**.
2. Switch the tool into **Advanced Mode** by either launching it while holding the **Shift** key or selecting **Advanced UI** in the **Tools** menu.



SHIFT +

3. If the diagnostics tool runs on the same system, the default **localhost** setting is correct and it will immediately connect to the tracking service and showing **Connected** and listing the name of the attached camera.

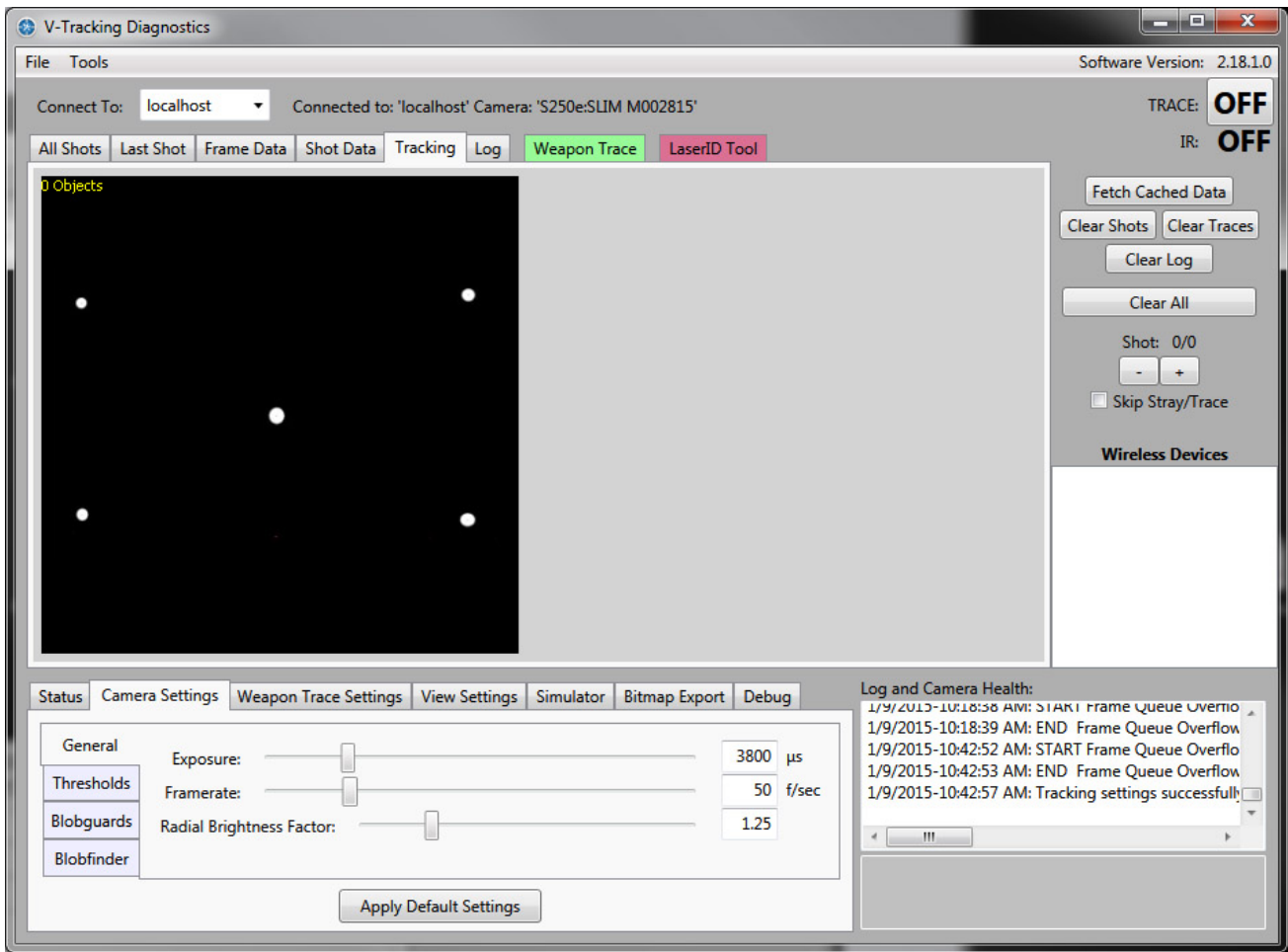


Fig. 15 V-Tracking Diagnostic interface: Adjusting Exposure, Camera Threshold, and Area Threshold

4. If the diagnostics tool runs on a remote system, select the **IP** or network name of the computer running the tracking service from the '**Connect To**' drop down menu. If the name is not listed enter the **IP** or the network name directly into the same box and hit tab or click elsewhere in the window. The diagnostics tool will then try to connect to the tracking service and indicate success with **Connected** and the name of the attached camera.

5. Select the **Tracking** tab.

6. The window will show a real time representation of the calibration objects the camera is recognizing. The top left area will show the number of objects it is seeing.

7. Now modify the **Exposure**, **Camera Threshold** and **Area Threshold** until the **Health** indicator to the right of the value sliders lists no camera errors, the number of objects recognized shows exactly **5** and the image represents the layout of the **5 calibration points**. The calibration process will continue automatically and finish the process on its own when this is accomplished. See Fig.16 below.

- a. **Exposure** is the camera exposure and the main control to adjust for this process.
- b. **Camera Threshold** (under the Thresholds Tab) can be used if modifying Exposure alone fails to generate a result. Threshold should be modified carefully in small increments. Dropping it too low or too high will generate camera errors which will show up under Health.
- c. **Area Threshold** (under the Thresholds Tab) is a special feature needed when the camera exposure drops so low that the camer



a picks up thermal noise and generates objects that do not exist. They show up as red dots and are generally so small that moving the **Area Threshold** to around 1.0 usually fixes the problem.

8. Continue and repeat the calibration process until a successful calibration has been accomplished. If unable to calibrate consider the options in the troubleshooting list under **'What modifications might help to calibrate when automatic and manual processes fail'**.

## CALIBRATING A MULTI-SCREEN SYSTEM

Calibration of a multi-screen system is being performed by controlling a separate calibration tool instance on each image generator remotely through a calibration tool running in host mode on the multi-screen system's host computer. In essence the calibration process for each individual screen is exactly the same as for the single screen system except that all user input is handled through the host calibration tool.

## RUNNING THE CALIBRATION TOOL IN HOST MODE

To run the calibration tool in host mode start it on the host computer system with the **Calibration HOST** desktop shortcut or directly with **V-Tracki ngCalibration.exe -Host** in **C:\VirTra\Programs\V-Tracking Calibration**.



Fig. 17: Calibration HOST icon

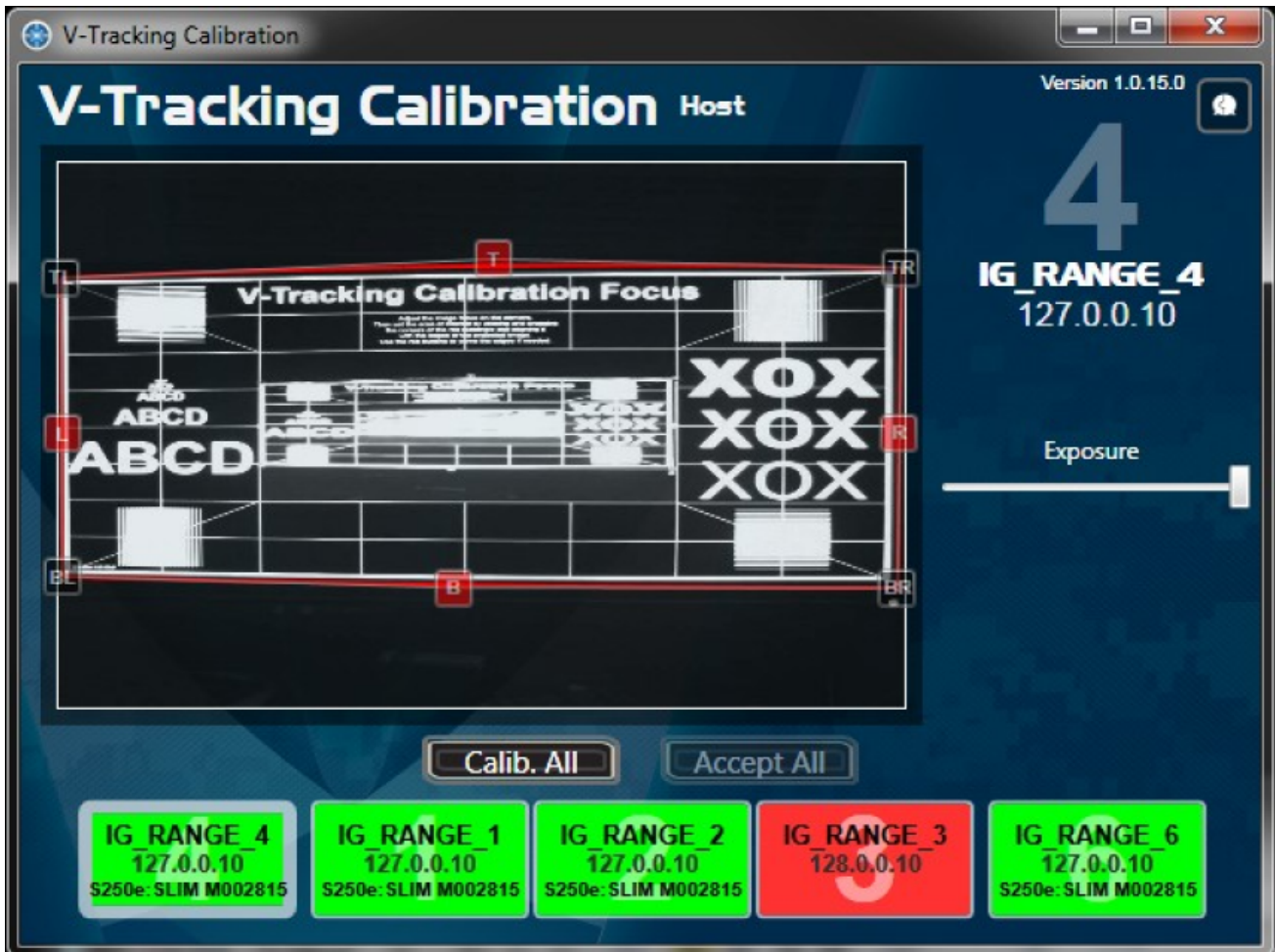


Fig. 18: V-Tracking Calibration - Host

When running in host mode the calibration tool shows an alternate user interface that allows for individual control of each connected image

generator system. The systems being controlled are defined by the cluster nodes listed in the general **VirTra system.xml** file in **C:\VirTra**.

The host calibration tool continuously tries to communicate with the selected clusters and shows the status of each in the bottom button row.

- A **RED** button means that either the client cannot be found on the network or the client could be found but does not run the Tracking Service.
- A **YELLOW** button means that the client is connected and the host can communicate with its Tracking Service, but no camera is actively being processed by it.
- A **GREEN** button means that the client is connected, its Tracking Service running and a camera is active. The camera name will be displayed in the button.

Once a client is connected and its button is turning green, the host tries to remotely launch the calibration tool on that system using the **VirTra System Control**. If the calibration tool is not launching, make sure the client has the calibration tool installed and **VirTra System Control** is configured correctly.

## CONTROLLING THE CLIENT CALIBRATION SETTINGS

Click on the desired client button in the bottom row to select a specific client. The video screen will show a video feed and area of interest indicator from the selected client.

Use the **area of interest** controls and the **exposure control** to the right of the video screen to control the clients settings exactly like when calibrating for a single screen system.

After making all the desired adjustments on some or all clients, use the button row below the video screen and above the client buttons to control the calibration process on an individual or all clients.

- **Calib. All** launches the calibration process on all connected clients.
- **Accept All** accepts the calibration result on all connected clients and closes their calibration tool instances.

For potential issues with the tracking service or the remote calibration tool on any of the remote system, two context menu options are available when right clicking on any of the individual remote client buttons:

- **Restart Remote VirtraTrackingService:** Completely stops and restarts the tracking service running on the selected client. The client button color will change accordingly during this process.
- **Restart Remote Calibration Tool:** Restarts the remote calibration tool on the selected client.

After acceptance the remote systems will confirm successful saving of the new calibration data with a dialog.

The dialogs can be responded to by simply closing the calibration host which will close the remote calibration tools and the system calibration is complete.

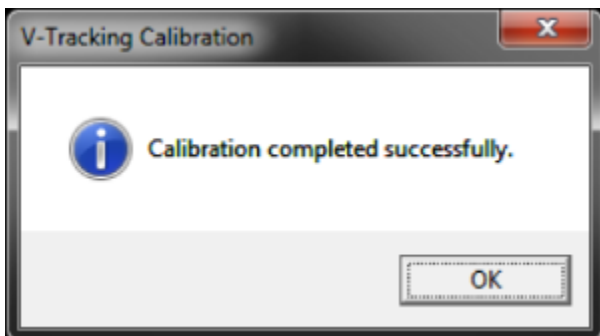


Fig. 19: Confirm successful calibration

## ADVANCED OPTIONS FOR THE CALIBRATION TOOL IN HOST MODE

Just like in single screen mode, a number of additional calibration options are available for particular situations. In order to access these options the calibration tool must be started in advanced mode. To do so, **hold down the shift key** while double clicking the **Calibration HOST** desktop icon.



V-Tracking  
Calibration

SHIFT +

Fig.20: Shift + Double click to access the advanced mode of the calibration tool

### C1.Advanced Mode Interface

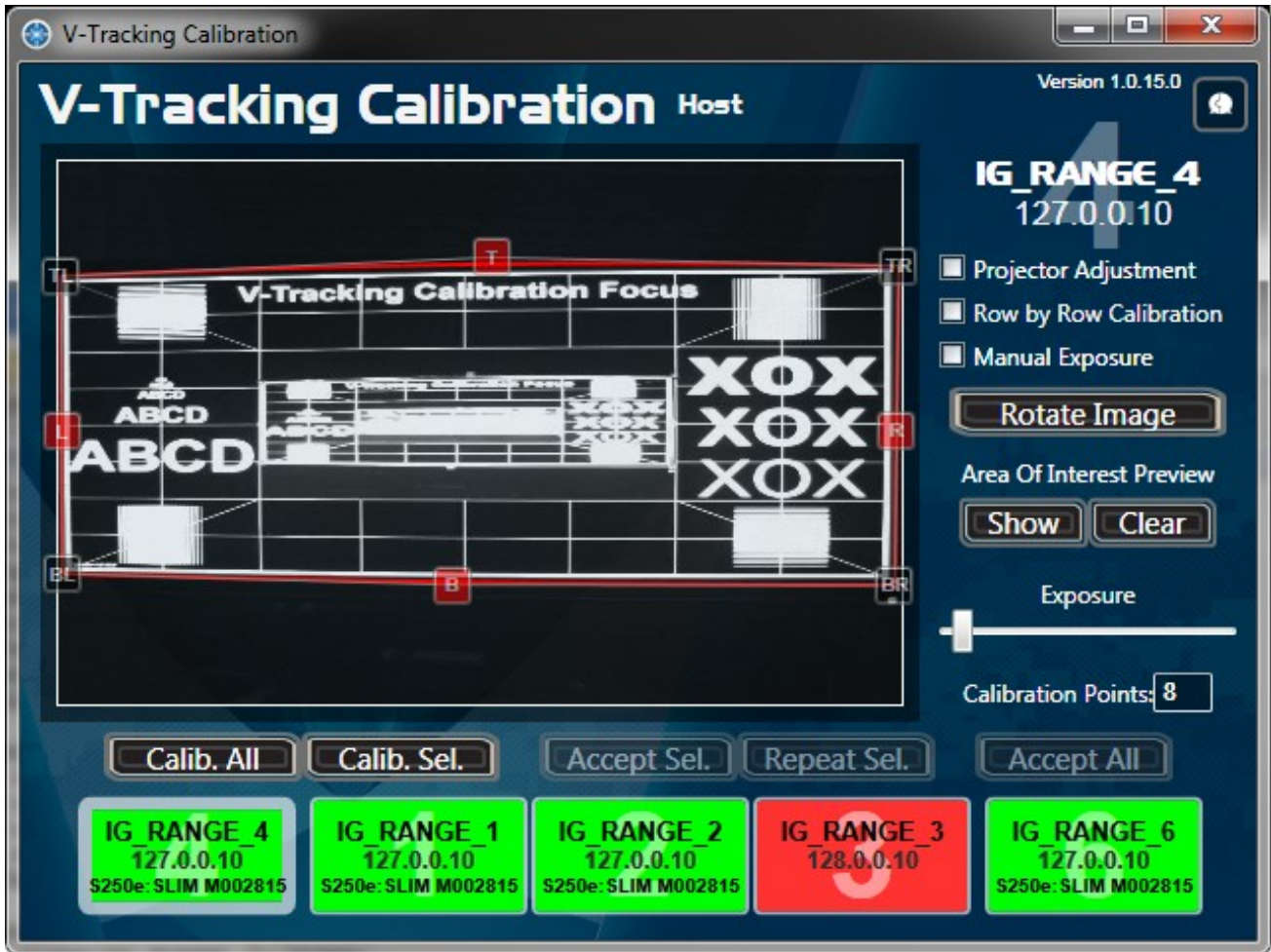


Fig.21: Advanced Mode Interface

1. To the right of the video screen, a list of options identical to the ones in single screen mode appears. All functions, including the manual exposure settings, are available.

2. The **Projector Adjustment** checkbox toggles the client back and forth, in and out of the projector adjustment view.

Additional buttons to allow for individual calibration of screens become available:

3. **Calib. All** launches the calibration process on all connected clients.

4. **Calib. Selected** launches the calibration process on the selected client only.

5. **Accept Sel.** accepts the calibration result on the selected client only and closes the client's calibration tool instance.

6. **Repeat Sel.** allows for repeating the calibration process after a failure on the selected client.

7. **Accept All** accepts the calibration result on all connected clients and closes their calibration tool instances.

## V-TRACKING DIAGNOSTICS TOOL REFERENCE



## LAUNCHING V-TRACKING DIAGNOSTIC

Launch **V-Tracking Diagnostic** with the desktop shortcut.

**Hold** the **Shift** button while clicking the icon to launch in advanced mode.

The **V-Tracking Diagnostics** tool exposes processing data and control settings from the shot tracking service. The tool can run on the same machine as the shot tracking service or on a networked remote system.



Fig.22: Shift + Double click to access the advanced mode of the diagnostic tool

### A1.Connecting to the local or remote shot tracking service client:

1. The system automatically tries to connect to the tracking service on the local system due to the default entry of localhost in the "**Connect To:**" connection box.
2. To connect to another system either select an **IP** or **computer name** from the drop down box or type an **IP** or **computer name** into the box and hit tab or click anywhere outside the box.
3. The current connection status will be shown next to the connection box.

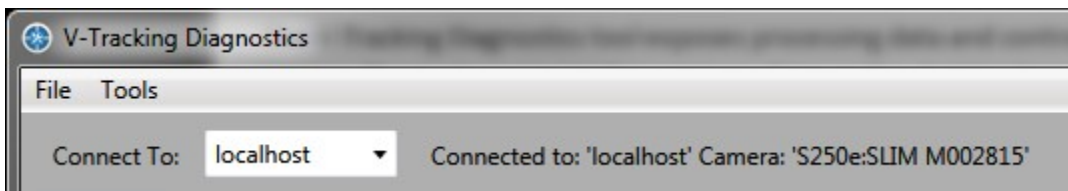


Fig.23: Connecting to Tracking Service Client

## V-TRACKING DIAGNOSTIC INTERFACE

### 1. Menu Options

### 2. Status and Navigation Options

### 3. Shot Tracking Settings Tabs

### 4. The Diagnostic Tool Tabs

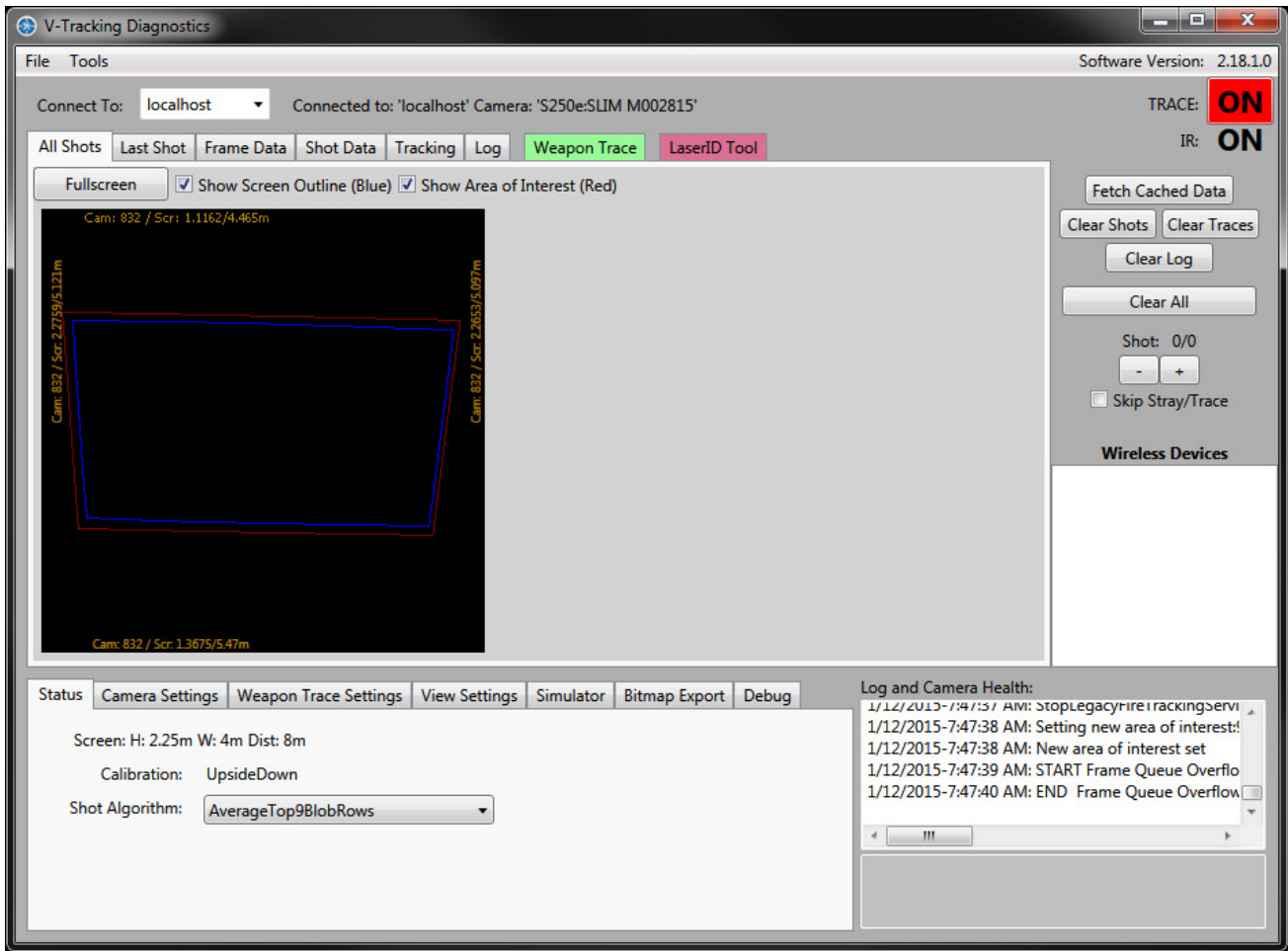


Fig.24: V-Tracking Diagnostic advance mode

## B1.Menu Options

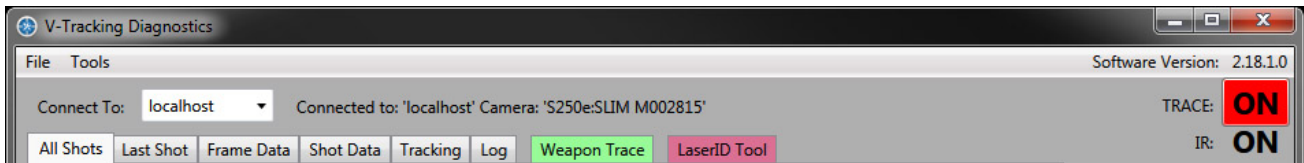


Fig.25: Menu Options, connection settings and Trace mode toggle

## 1. File Menu:

### Load Shot Data

Loads a shot data .dat file into the diagnostics tool. That way it is possible to load and analyze shot data created in another session or on another computer with a system that cannot connect to the shot tracking service.

### Save Shot Data

Saves the current shot data information to a .dat file for loading at a later date or on another system

### Export Shot Data

Exports a subset of the current shot data information to a .csv comma delimited text file or .xlsx Excel file for analysis in Excel or another software

### Export Calibration Data

Exports the currently used calibration data to a .csv comma delimited text file for analysis in Excel or another software

## Exit

Closes the diagnostics tool

## 2. Tools Menu:

### Check Cameras (advanced UI only)

Check the status of the local and remote tracking service and camera access and displays the results in a dialog box.

### Clear Shot Data

Clears the currently loaded shots from the diagnostics tool

### Toggle IR Filter (advanced UI only)

Turns the IR Filter on the camera used by the connected tracking service on and off

### Rasterize Frame to File (advanced UI only)

Saves the most recent camera frame of the connected tracking service to a .bmp file under **C:\VirTraLOGS** and displays it in the default Windows photo viewer program

### Local Tracking Service Status

Check the status of the connected tracking service on the local system. This is specific to the local system, the 'Connect To:' setting is ignored. The resulting dialog box allows for stopping and restarting the local tracking service.

### Restart Remote Tracking Service

Restarts the tracking service running on whichever client the diagnostics tool is currently connected to.

### Enable VirTra Device Services

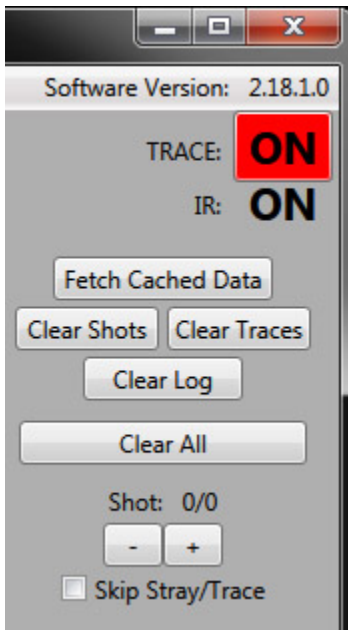
Enables the VirTra Device Services which communicates with instrumented weapons connected to the system. If any Weapons are connected a box for each appears in the **Wireless Devices** list box on the left showing some of the weapons data settings

### Advanced UI

Toggles the user interface between basic and advanced settings.

## B2. Status and Navigation Options

The top right window area is reserved for the status navigation options:



- **Software Version** indicates the currently installed version of V-Tracking.
- The large toggle button on the top right marked with **TRACE** switches the tracking system between regular laser ID and trace weapon mode. It is colored red when trace mode is **ON**.

When **OFF**, the system only recognizes non-instrumented weapons shooting single pulses when a shot is triggered. The varying lengths of the shot identifies the shot by a specific Laser ID as specified in the LaserID Tool.

When **ON**, the system recognizes pulsing instrumented trace weapon lasers for real time tracking of weapon aim. In this mode the system is also able to recognize Laser Id shots as long as they are longer than 20 frames which, with default Laser Id settings, are Laser Ids 3 and up. Note that this mode only functions with cameras supporting 250FPS.

- **IR:** indicates the current status of the camera's IR filter. The IR filter must be engaged during tracking and is only off during the calibration process.
- **Fetch Cached Data** retrieves a certain amount of tracking and shot data stored in the VirTra Tracking Service before diagnostics tool was launched.
- **Clear Shots** clears the shot data currently displayed in the diagnostics tool
- **Clear Traces** clears the trace data currently displayed in the diagnostics tool
- **Clear Log** clears the log data currently displayed in the Log window
- **Clear All** clears all displayed shot, trace and log data
- **Shot** shows the shot number which is displayed in the **Last Shot** or **Shot Data** tab and the currently stored shot count
- The + and - buttons select the next or previous shot to be displayed in the **Last Shot** or **Shot Data** tab
  - Hold the SHIFT button while clicking to jump 10 shots per click
  - Hold the CTRL button while clicking to jump 100 shots per click
  - Hold the SHIFT and CTRL button while clicking to jump 1000 shots per click
- When the **Skip Stray/Trace** button is enabled the + and - navigation buttons skip past any non-valid shots and only display shots which have been communicated to the tracking clients

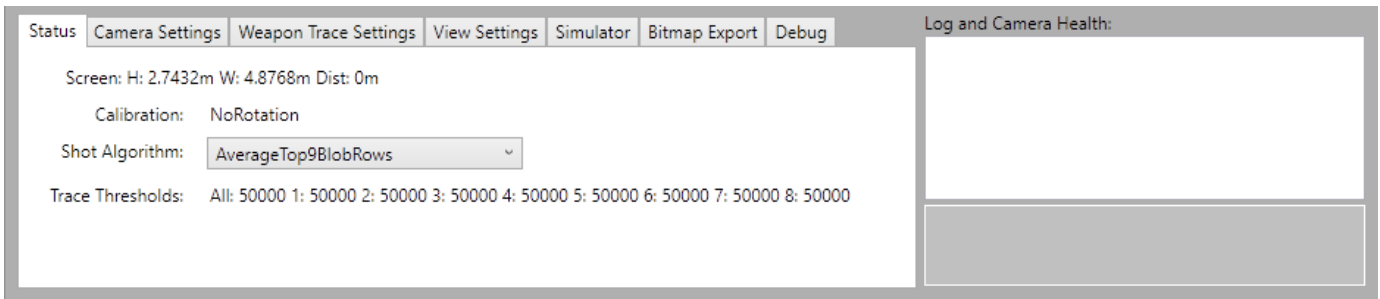
### B3.Shot Tracking Settings Tabs

Located below the main view in a tabbed interface, visible in **ADVANCED UI MODE ONLY**.

All tracking related settings modified in this section are automatically saved by the system, no manual saving as in previous version is necessary.

The **Apply Default Settings** button can be used to return all tracking related settings to the original default values which are optimized to produce the best tracking results in most circumstances.

### Status Tab



#### Screen:

Shows the configured screen width, height and distance from the firing line as defined in the SYSTEM.XML file.

#### Calibration:

Shows the camera orientation determined during the calibration process.

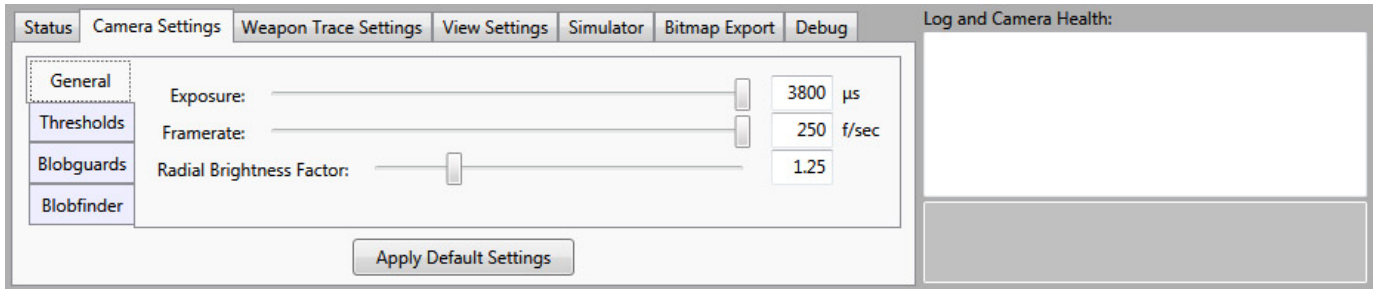
#### Shot Algorithm:

The algorithm that determines the actual hit location of a shot created from a collection of blobs caused by a recoiled weapon. The default value is "**AverageTop9BlobRows**".

#### Trace Thresholds:

Diagnostics power thresholds of all and individual trace id signals recognized during tracking of traced weapons.

## Camera Settings Tab



### General Sub-Tab

#### Exposure:

Shows and controls the current camera exposure setting. For Ethernet cameras the value is in **s** (micro- seconds). For USB cameras each point of exposure is equivalent to a **single** scanline.

#### Framerate:

The current requested camera frame rate in frames per second. Note that this is the **requested camera framerate**. The USB camera rounds the framerate to 30 increments. The actual framerate being used can be verified in the Shot Data tab after a shot has been processed.

#### Radial Brightness Factor:

A factor used to multiply the brightness of an individual blob depending on its distance from screen center. This factor helps to compensate for the falloff of light energy from the center towards the edge of the screen.

### Threshold Sub-Tab

#### Area Threshold:

A filter that forces the shot tracking service to ignore any blob object smaller than the designated value. This feature is used if thermal noise on the camera is an issue.

#### Stray Threshold:

A filter that designates incoming shots as stray shots when their brightness value is below the stray threshold percentage value. These shots will show up in the diagnostics tool but not send to the tracking service user application.

#### Camera Threshold:

The threshold value used by the camera hardware to filter out low intensity objects, allowing the camera to discard faint objects as noise before the software can process them.

#### Trace Thresholds:

Shows the current trace threshold values used to determine between pulsing and shooting for traced weapons. These values are determined by the system on a constant basis as trace weapons are being recognized.

### Blobguards Sub-Tab

#### Shot Detector:

The maximum allowed distance of frame subsequent blobs used to create an individual Laser ID shot. If the blob distance is greater, a new separate shot is created.

#### Edge Shot Combiner:

The maximum distance range used to combine blob streaks of shots that strayed off screen during the recoil. Set this higher if a weapon that is recoiling off screen produces double shots.

#### Segment Builder:

The maximum distance allowed for blobs assigned to a trace segment for tracing weapons. A higher value allows for recognizing faster weapon movements but results in less accuracy in tracking overlapping traces. A lower value improves tracking of overlapping traces but reduces the ability to track fast weapon sweeps.

**Trace Recoil Bridge:**

The distance range used to assign shots which are not part of a trace to neighboring traces. Improves the ability to properly track trace weapons with very high recoil speed as the recoil can result in interrupted traces.

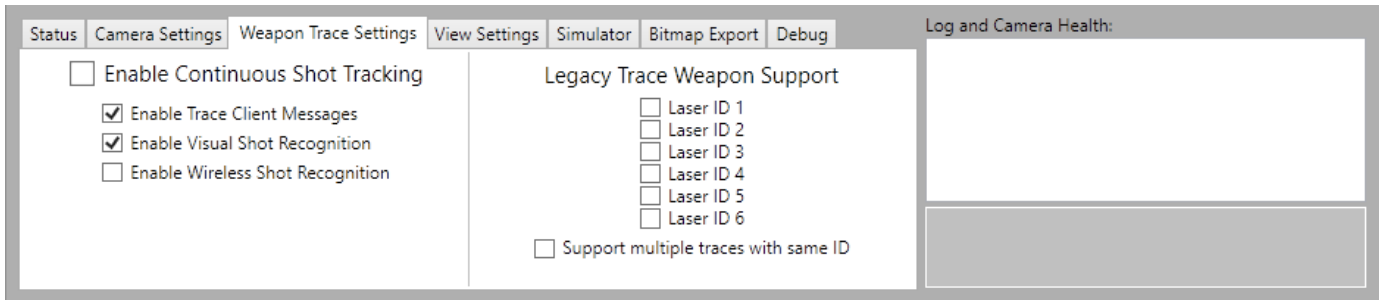
**Trace Split Streak:**

Merges multiple blobs of a single frame into a single blob if they are within this distance range and weapon tracing is enabled. High recoiling weapons can produce interrupted streaks in a single frame causing the software to falsely assume multiple weapons are being used. This feature alleviates this problem.

**Blobfinder Sub-Tab**

This tab contains settings affecting the logic that separates a single blob into multiples if they appear to originate from separate weapons, indicated by multiple separated bright areas in a single blob.

**Weapon Trace Settings Tab**



**Enable Continuous Shot Tracking**

The main switch toggling between recognition of Laser ID pulse weapons and instrumented trace weapons. This toggle is a duplicate of the large TRACE: ON/OFF toggle in the main window.

**Enable Trace Client Messages**

If enabled causes the tracking service to send trace location messages to its clients. If disabled only shots are being sent to clients.

**Enable Visual Shot Recognition**

Enables the logic that recognizes shots visually in weapon traces based on their pulsing pattern or lack thereof.

**Enable Wireless Shot Recognition**

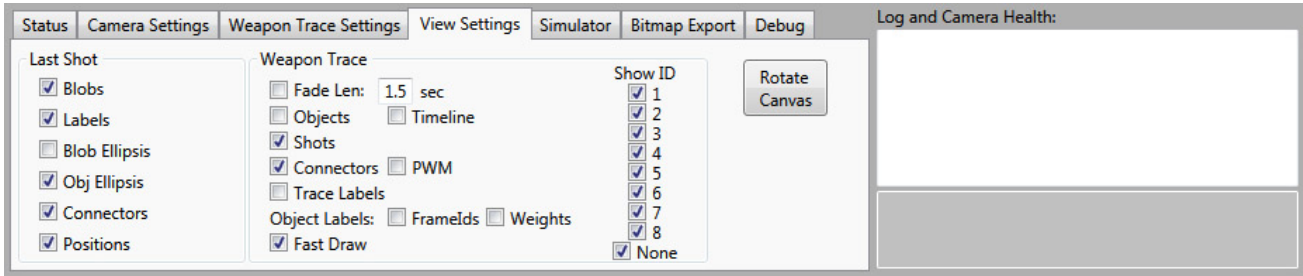
Enables the logic that recognizes shots based on events sent from instrumented weapons. This feature only works when the **VirTra Device Services** are enabled (see the **Menu** section of this manual). **VirTra Device Services** are disabled by default.

**Legacy Trace Weapon Support**

Enables tracing logic based on pulsing laser ids. The selected Laser IDs will no longer be interpreted as laser shots but as trace locations for traced weapon input.

The 'Support multiple traces with same ID' switch enables the separation of multiple traces being projected simultaneously with the same Laser ID.

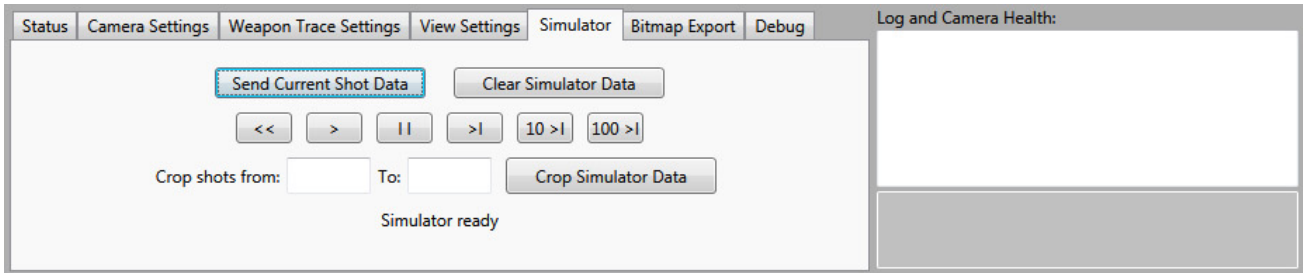
**View Settings Tab**



This tab contains **Toggle Buttons** to enable and disable drawing of individual shot data elements:

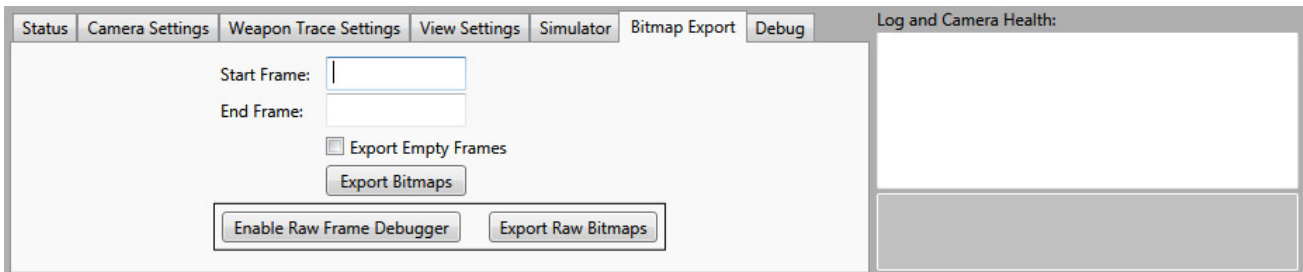
- Affecting the **Last Shot** viewer tab:
  - **Blobs** – The actual pixel blobs of an individual shot object
  - **Labels** – The text labels on the shot data
  - **Blob Ellipsis** – The general blob shape and size determined by the shot tracking service
  - **Obj Ellipsis** - The blob shape as reported by the Camera SDK
  - **Connectors** – The connector lines showing the relationship and order of object blobs in a shot
  - **Positions** - The shot position as reported to the client
- Affecting the **Weapon Trace** viewer tab:
  - **Fade Len and time** - When enabled fades the traces after the specified time. When disabled the trace remains until replaced by a new one.
  - **Objects** - Trace object location. Objects above trace power threshold are drawn larger as the ones below threshold.
  - **Timeline** - Draws a contiguous line through all objects for easier recognition in which order blobs where being recognized by the system.
  - **Shots** - Highlights individual shots embedded in trace data
  - **Connectors** - Draws connector lines between segment object points
  - **Trace Labels** - Labels each trace segment with trace segment related data
  - **Object Labels**
    - **FrameIDs** - Shows the frame ID of each segment object
    - **Weights** - Shows the weight value of each segment object
  - **Fast Draw** - Improves drawing speed of complex traces by reducing precision
  - **Show ID** - Enables and disabled drawing of specific trace segments based on their ID. None stands for trace segments which could not be identified.
- **Rotate Canvas** button - Rotates the contents of the canvas displays by 90 degrees on each button push

## Simulator Tab



The simulator tab contains a tool for re-running previously captured shot data for software development purposes.

## Bitmap Export Tab

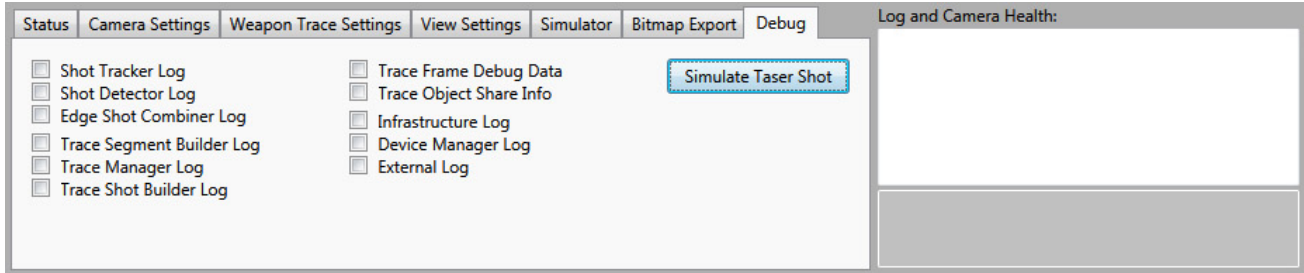




The **Bitmap Export** tab allows for exporting camera frame images for software development purposes. A set of frames with frame IDs between the specified **start** and **end** frame is being exported by pressing the **Export Bitmaps** button. This exported data represents the blob information that has bubbled up through the processing pipeline and may not contain all data that has been recognized.

For the complete, unprocessed set of data to be exported, use **Enable Raw Frame Debugger** to enable this feature and the **Export Raw Bitmaps** button to export the images. Due to memory constraints only the last 2000 frames containing data are available for export.

## Debug Tab



The **Log** switches enable output of log data strings to the log window and log file for a particular tracking service process as indicated in the name.

**Trace Frame Debug Data** stores trace segment blobs so they can be viewed in the Frame Data viewer tab. When off only shot blobs can be viewed.

**Trace Object Share Info** adds information about which blobs are shared between which trace segments. This option is very slow and will cause camera frame read stalls.

The **Simulate Taser Shot** button produces a simulated Taser shot consisting of 2 separate but time synchronized laser shots for software development purposes.

## B4.Diagnostic Tool Tabs

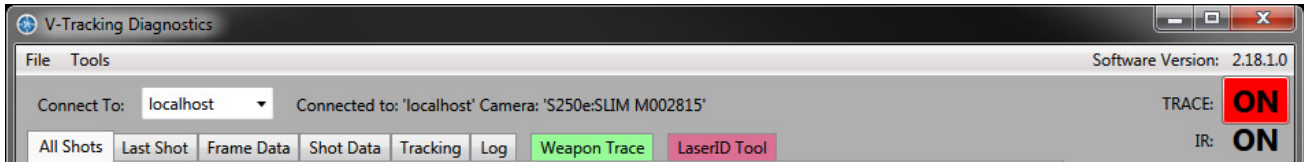


Fig.28: Diagnostic Tool Tabs

### All Shots

**All Shots** tab shows the shot location of all tracked shots since the diagnostics tools is running.

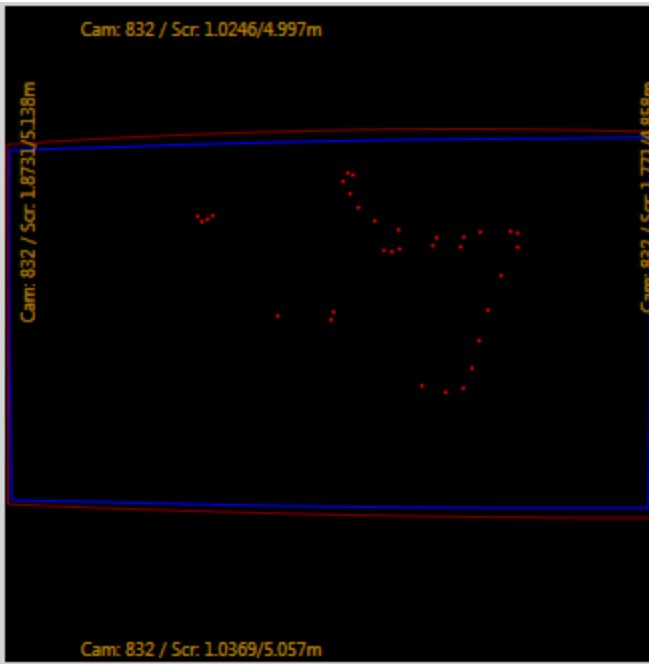


Fig.29: Tracked Shots in camera space

Figure 29 shows the tracked shots in camera space. The black area of the view is the entire area the camera can see. The shots are colored according to their LaserID. The color values represent the following LaserIDs:

- Red: 1
- Green: 2
- Blue: 3
- Yellow: 4
- Turquoise: 5
- Violet: 6
- Gray: all others

- a. The **BLUE** outline shows the screen outline as determined by the camera calibration data.
- b. The **RED** outline shows the area of interest as specified during the calibration process. The camera ignores all signals outside of the area of interest.
- c. The **Fullscreen** button switches the camera view to a fullscreen mode **mapped into screen space**. If this view is presented on the projected screen, the diagnostics tool will show exactly where the shots go as they are taken. This view can also be entered by double clicking on the camera view.

**Important Note:**

The windowed view for all views shows the camera view. That means if the camera is installed upside down, at 90 degrees and/or behind the screen (for a rear project), shots in this view may appear on the opposite side of the screen than expected. Only the fullscreen view of this tab will show the shots mapped properly into screen space as they are sent to the client simulator. This will also compensate for any distortion the screen image has on the camera view indicated by a curved edge of the blue screen outline.

Right clicking on the fullscreen view reveals the following options

- Hide** – Switches back to the regular view
- Toggle LaserIDs** – Shows or hides the LaserID number next to the shot
- Clear Shots** – Clears the shot buffer

- d. The **toggle buttons** show or hide the screen outline and the area of interest outline
- e. The values at the edge of the screen show the size of the recorded screen area in pixels, as a fraction of screen size and in meters. They are an indication of the camera alignment and distortion.

**Last Shot**

**Last Shot** tab allows for precise analysis of an individual shot or a group of shots. The view shows one or more shots depending on the crop/draw selection.

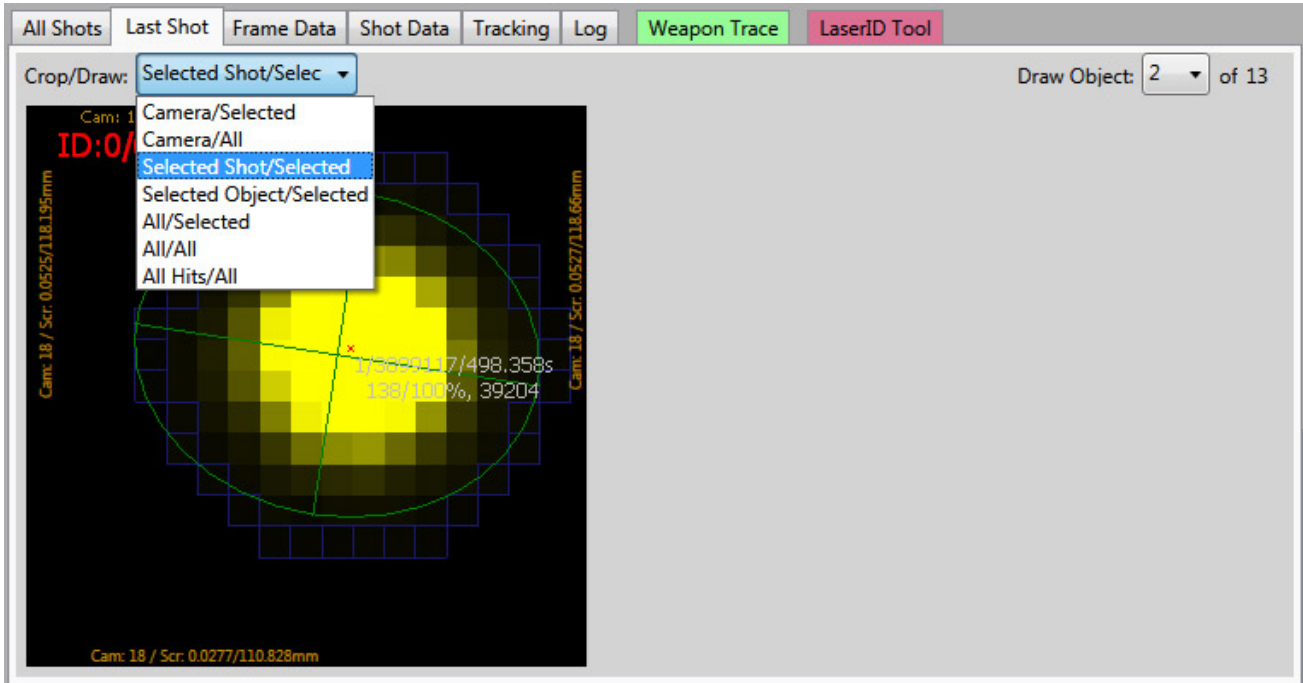


Fig.30 Last Shot Tab

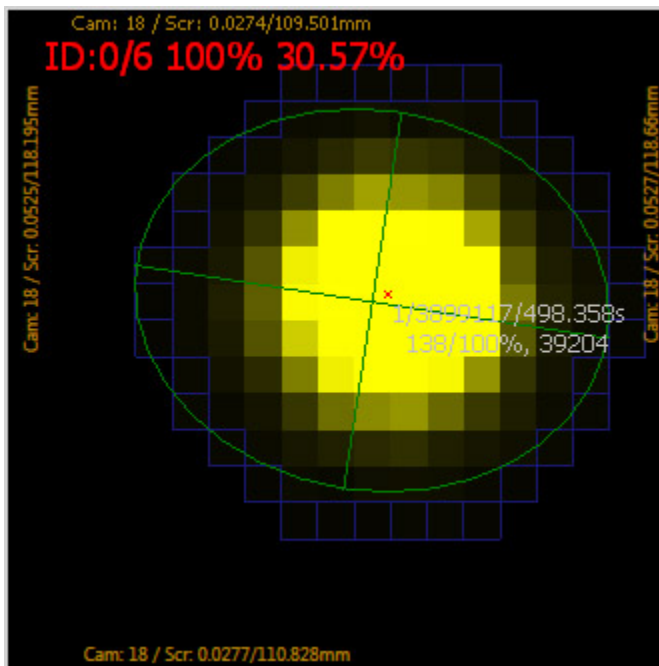


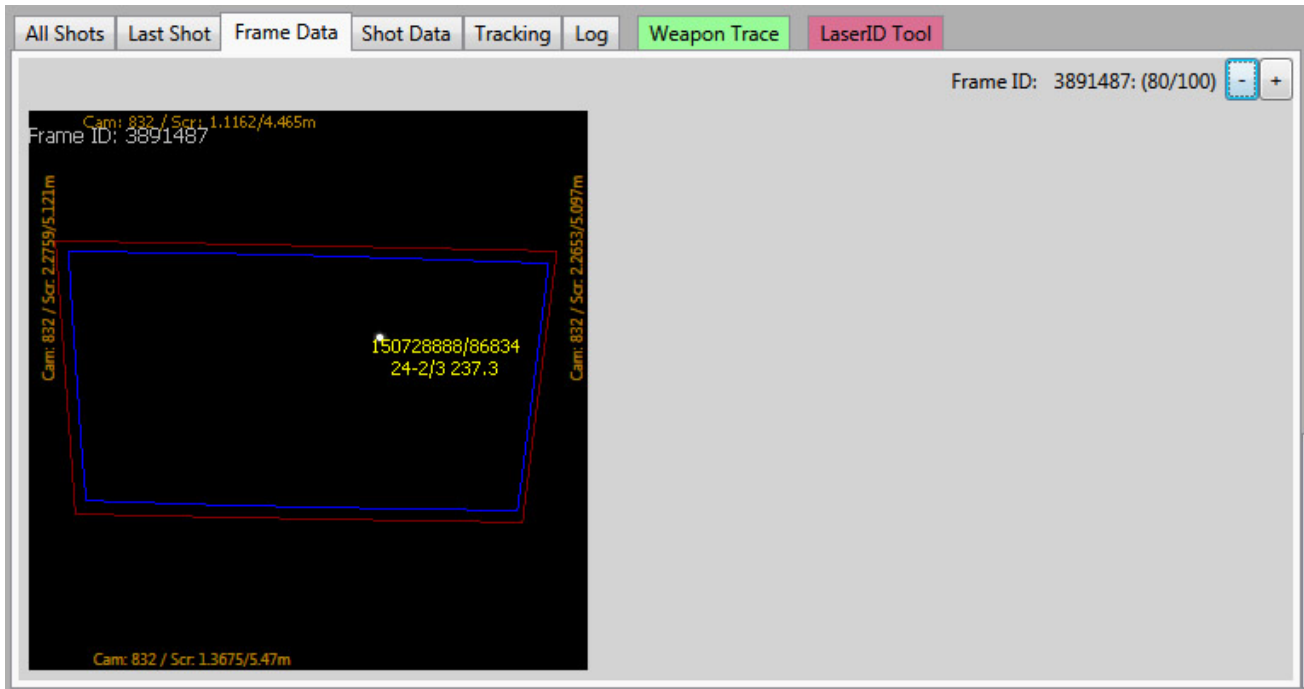
Fig.31: View of shots

- The blob pixels are drawn in gray or yellow shades representing their brightness value. Gray pixels indicate that they were used to determine the actual shot location. They are determined by the shot algorithm used to analyze this shot. See Fig. 31 to the right.
- A **GREEN** ellipsis shows the size and length of the major and minor axis of the blob shape.
- A **RED** cross shows the determined shot location based on the shot algorithm being used to analyze this shot.
- WHITE** lines connect the shot objects in the order they were read.
- Labels show shot and object data depending on the current **Crop/Draw** and **Draw Object** selections. The labels have tool tips

which upon rollover show more detail as to what each value means. See Fig. 32 above.

- f. The values at the edge of the screen show the size of the cropping area in pixels, as a fraction of screen size and in meters.
- g. The **Crop/Draw** selector (**advanced UI only**) offers the following options for viewing one or more shots:
  - i. **Camera/Selected** - Don't crop view, show entire camera field of view and draw only selected shot
  - ii. **Camera/All** - Don't crop view, show entire camera field of view and draw all shots
  - iii. **Selected Shot/Selected** - Crop view to selected shot including its blob extents and draw only selected shot
  - iv. **Selected Object/Selected** - Crop view to selected objects blob extents and draw only selected shot
  - v. **All/Selected** - Crop view to all shots including their blob extents and draw only selected shot
  - vi. **All/All** - Crop view to all shots including their blob extents and draw all shots
  - vii. **All Hits/All** - Crop view to all shots hit positions, ignoring shot extents and draw all shots
- h. The **Draw Object** selector switches between showing all blobs of a shot or the blob of an individual frame

**Frame Data (ADVANCED UI ONLY)**



The **Frame Data** tab shows the blob data frame by frame in order to analyze designation of blobs to individual shots. This view is important when shots were taken simultaneously and it is necessary to see which blob was assigned to which shot.

Fig.33: Frame Data Tab

- a. Object blobs are drawn as white pixels in camera space. On the top left the Frame ID can be seen. Frame IDs are in sequence and only frames that have any frame data are being drawn. Clicking "+" and "-" next to Frame ID moves back and forth in the frame data. However empty frames are ignored.
  - i. Hold the SHIFT button while clicking to jump 10 frames per click
  - ii. Hold the CTRL button while clicking to jump 100 frames per click
  - iii. Hold the SHIFT and CTRL button while clicking to jump 1000 frames per click
- b. The **Frame ID** shown at the top left of the view turns green when it is the beginning of a sequence of recognized blobs and indicates that the previous frame had no data.
- c. The label next to the blob shows the **Blob ID**, the blob weight, the shot number of the shot it was designated to, the frame number and the frame count of that shot, the average pixel weight of this blob. An individual blob may be designated to multiple shots which can easily be verified here.

**Shoot Data (ADVANCED UI ONLY)**

<span>All Shots</span> <span>Last Shot</span> <span>Frame Data</span> <span>Shot Data</span> <span>Tracking</span> <span>Log</span> <span>Weapon Trace</span> <span>LaserID Tool</span>											
Nr: 273 Pos: 0.675/0.855 Id: 0/6 Frames: 13 FPS: 250.5 Exp: 3800 Time: 1/12/2015-12:07:34 Id: 489315130 Total Weight: 521138											
X	Y	Left	Right	Top	Bottom	Area	Radius	Roundness	Weight	Width	Height
308.577	290.207	303	316	284	297	137	3.277217	0.7276069	39048	13	13
308.432	290.065	302	316	284	297	138	3.288244	0.7937618	39204	14	13
308.418	289.865	302	316	284	297	143	3.398203	0.7781745	41563	14	13
308.488	289.714	303	315	284	297	136	3.324488	0.7340905	39796	12	13
308.530	289.417	303	315	283	297	138	3.259265	0.7495317	38595	12	14
308.888	289.128	303	316	283	296	141	3.305471	0.7896388	39792	13	13
309.344	288.875	303	316	283	296	143	3.392689	0.8232726	41473	13	13
309.902	288.600	304	317	283	296	138	3.372021	0.7276069	40887	13	13
310.427	288.422	305	317	283	296	132	3.366835	0.7071068	40530	12	13
311.034	288.138	305	318	282	295	139	3.292796	0.7896388	39477	13	13
311.566	287.792	306	319	282	295	139	3.341902	0.6749486	40417	13	13
312.114	287.763	306	319	282	295	143	3.366464	0.8232726	41288	13	13
312.349	287.636	306	319	282	295	138	3.284066	0.7071068	39068	13	13

Fig.34: Shot Data Tab

The **Shot Data** tab shows a table with the data for each individual blob object recognized in this shot. The title row shows shot specific data like shot number, the shot location in normalized screen space, the Laser ID/Trace ID, the number of frames, the actual framerate in frames per second at which the shot was recorded, the shot date and time and the shots Guid and the total weight of all shot blobs.

## Tracking

The **Tracking** tab shows a real time view of the camera space. See Fig 35 below.

- Any IR signal recognized by the camera will show up here in real time in simplified form.
- The number of recognized objects is indicated in the top left corner.



Fig.35:Tracking Tab

**Log (ADVANCED UI ONLY)**

The **Log** tab exposes the log data generated by the shot tracking service.

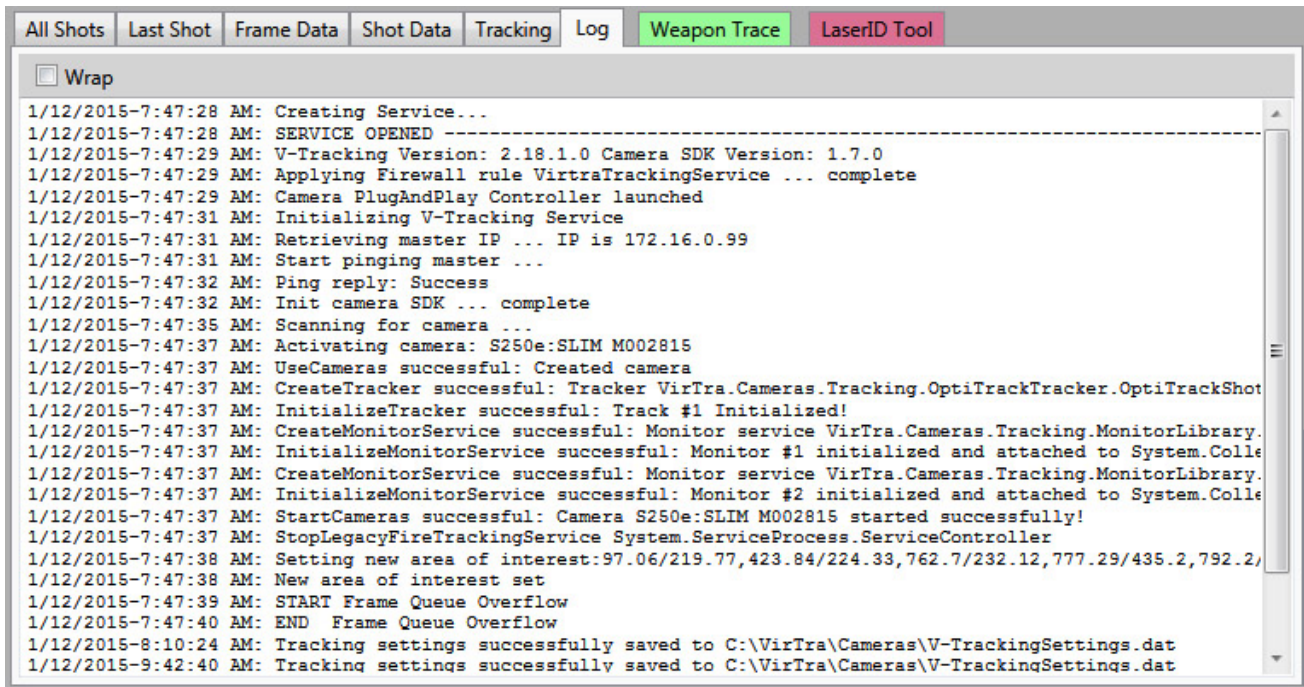
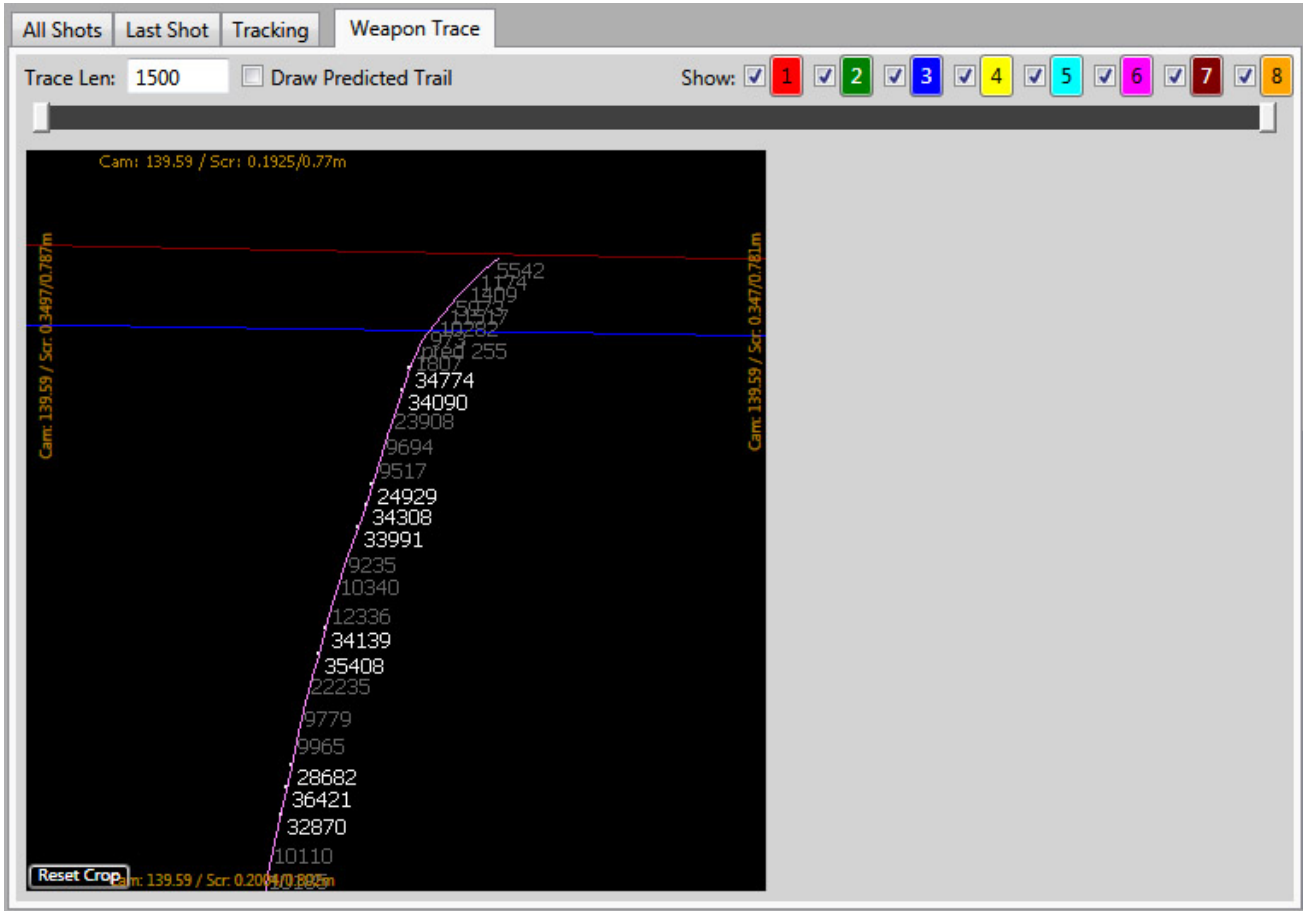


Fig.36 Log Tab

The **Wrap** toggle switches wrapping of lines in the log buffer

**Weapon Trace Tool**





The Weapon Trace tab helps with analyzing the behavior of instrumented trace weapons. The most recent trace data is shown here. In advanced UI mode the View Settings tab of the Shot Tracking Settings Tab set has numerous options to control the displayed data.

- The **Trace Length** text box allows for increasing the retained trace segment data if needed.
- **Draw Predicted Trail** shows a software generated continuation of interrupted trace segments.
- The **Show** buttons enable or disable viewing of the traces of specific Trace IDs.
- The **gray slider bar** can be used to limit the data being shown in the display by dragging the left and right thumb toward or away from each other.
- If object labels are enabled, the gray and white text distinguishes between segment blobs with a weight of below (gray) or above (white) the power threshold of the particular Trace ID.
- Depending on the enabled options, additional information pertaining to the trace or trace shot is displayed next to the individual trace objects.

**LaserID Tool (ADVANCED UI ONLY)**

The LaserID Tool is used to edit the frame ranges which specify the unique Laser IDs. It also provides an approximate value for the laser time (in milliseconds) a weapon needs to fire to be recognized as a specific Laser ID. That is at the framerate at which the current camera configuration is operating.

Since the Laser ID frame counts are fixed, a weapon with a specific laser time is being recognized as a different Laser ID depending on the framerate at which the camera operates.

The LaserID timings are stored in **C:\VirTra\Cameras\V-Tracking\LaserIdConfiguration.dat**. The LaserID is determined by picking the lowest possible value found that is higher than the recognized time.

The simplest way to modify the LaserID timings and LaserID count is by using the **LaserID Tool** in the **V-Tracking Diagnostics tool**. Start the **V-Tracking Diagnostics tool**, connect to the desired client and click on the **LaserID Tool tab**.



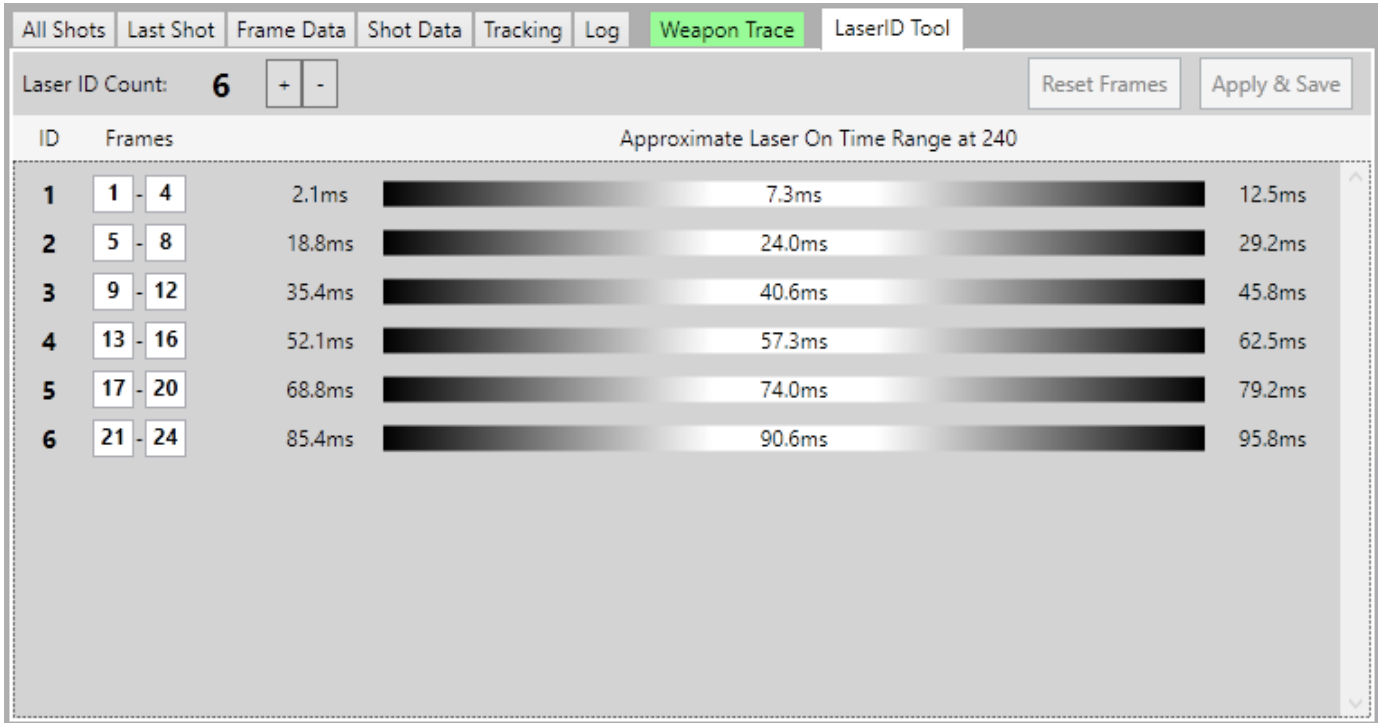


Fig.37 LaserID Tool

- Use the "+" and "-" buttons next to the **LaserID Count** to add or remove recognizable LaserID values.
- The timing columns on the right will show an approximate range of millisecond timings in which a weapon laser has to fall to be specified as that Laser ID at the current framerate. It is best to pick a weapon kit with a timing value that falls as close as possible to the center value shown in this list.
- After typing in new frame values the numbers will turn **RED** to indicate that the data has not been saved. Press the **Apply and Save** button to save the data to the **V-TrackingLaserIdConfiguration.dat** file and apply it to the connected client's **Tracking Service**.
- On multi-screen system the new values will be distributed to all tracking services installations of that system via the VirTra System Services.
- To easily copy the values to a different simulator system it is possible to just copy the **V-TrackingLaserIdConfiguration.dat** file to the desired system. Make sure to either **restart** the **VirTraTrackingService** through the Windows Services panel or **reboot** the computer.

## TROUBLESHOOTING

### Is the tracking service running properly?

- Open the Windows Task Manager, go to the Services tab and verify that the status of **VirTraTrackingService** is **Running**. Do not confuse this service with the Basler shot tracking service called FIRE TRACKING or VIRTRA FIRE TRACKING.
- Run the diagnostics tool on the same system running the tracking service. By default it will try to connect to the local tracking service upon startup. After a few seconds the status should go from **Opening...** to **Connected**. If it does not, the tracking service is not running.

### Why is the tracking service not running or not launching?

- If the **VirTraTrackingService** will not launch and continue running after install or after trying to restart it with the Windows Task Manager or the Windows Services administration tool, check the following:
  - Check if the tracking service install folder (by default **C:\VirTraPrograms\VirtraTrackingService**) contains the file **error.txt**. If so and if the file has a current date and time, check its contents and fix the cause of the reported error message.
  - Open the file **VirTraTrackingService.log** in the folder **C:\VirTraLOGS** and check if it contains an error message or any other relevant information at the end of the file pertaining to its inability to launch.

### Is the tracking service recognizing the currently attached camera correctly?

- Open the file **VirTraTrackingService.log** in the folder **C:\VirTraLOGS** and check if a camera was successfully launched.

- Run the diagnostics tool and connect to the shot tracking computer as outlined in the steps for the manual calibration process. If there is no camera name listed after the word **Connected**, no camera is being recognized by the tracking service.
- If no camera is recognized follow the steps under **Testing if the camera was properly recognized by the computer** in the Installation guide. If no camera is found, verify the USB driver for a USB camera or the network settings for an Ethernet camera.

### Why is the Prime 13 camera not recognized by the system?

- The NaturalPoint Camera SDK has issues with certain NICs which may cause them to not see the Prime 13 camera. If V-Tracking does not appear to recognize the attached Prime 13 camera and the camera goes through a repeating cycle of Green, Yellow and blinking Red LED colors of the switch on its back, make the following change to the NIC settings:
  - In Windows open the camera NICs adapter properties
  - Disable the automatic speed negotiation and force to a speed of 100Mbit
  - The location of this setting might be different for different NIC manufacturers

### What modifications might help to calibrate when automatic and manual processes fail?

- Verify and adjust the area of interest to avoid any light from areas outside the calibration screen.
- Decrease the light level in the environment.
- Use a brighter projector or increase the projector brightness for the purpose of calibration.
- Experiment with different locations for the camera.

### How can the calibration process be cancelled before completion?

- Focus on the calibration screen and press **Alt-F4** to close the fullscreen window.

## CONTACT VIRTRA

If you have any questions/issues with any part of this manual, please see contact below:

VirTra Service Department



7970 S. Kyrene Road Tempe, AZ 85284 USA  
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