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Custom Test Equipment • Mobile Technology Solutions • Inertial Profilers • ADA Compliance • FF/FL Testing

Profiler V3 Operation Manual
CS-9100/9300/9400
Version 3.4.2.70.

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Data Collection

Safety

Turn on headlights when profiling to alert other drivers and co-workers of your presence.
Road profilers are precision instruments, handle with care. Improper maintenance and use will reduce system life and collection accuracy.

Storage

Truck Mounted Inertial Profilers

When the inertial profiler is not in use remove the lasers and store them in a dry, shock protected place. This will protect the glass sensor windows that are commonly damaged by rocks. Remove the DMI (Distance Measurement Interface) when the IP will not be used for long periods of time or during long distance traveling.

Lightweight Inertial Profilers

Place the lightweight profiler on stands with the wheels elevated off the ground. This will ensure that the wheels remain true and round. Remove the lasers and protect them in a shock proof case when not in use. When parking the lightweight in a trailer or truck bed, focus on the DMI and the front of the cart so they are not damaged.

System Setup

Run as Administrator (Windows 7)

Certain laser models with ethernet connection require Profiler to be run as Administrator. Go to the Desktop, right click on the SSI Profiler icon and select the "Compatibility" tab. At the bottom of the window under "Privilege Level", select the check box for "Run this program as an administrator."

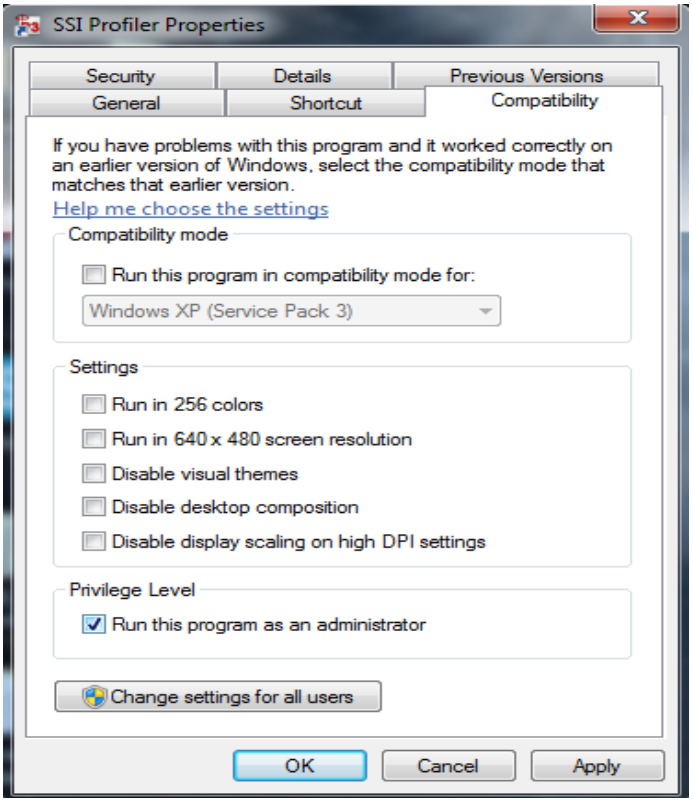


Figure 1: Compatibility window for running Profiler software as an administrator in Windows 7.

Run as Administrator (Windows 10)

Certain laser models with ethernet connection require Profiler to be run as Administrator.

Right click on the Profiler V3 icon ‘P3’, go to More>Open File Location.

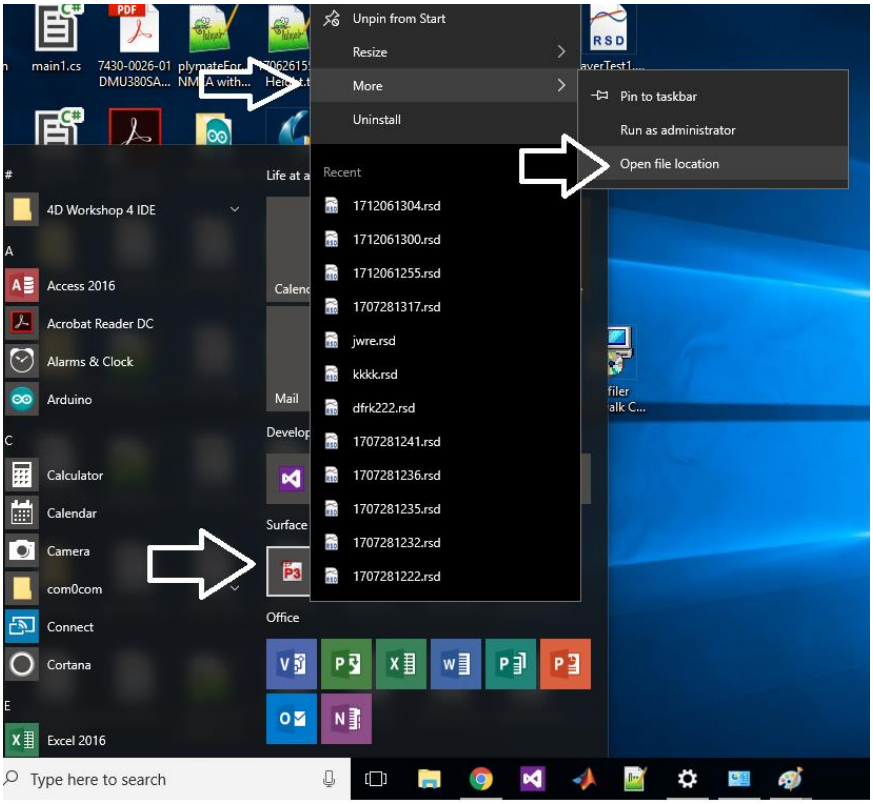


Figure 2: Searching for Profiler V3 program file.

Right click on SSI Profiler shortcut, go to properties

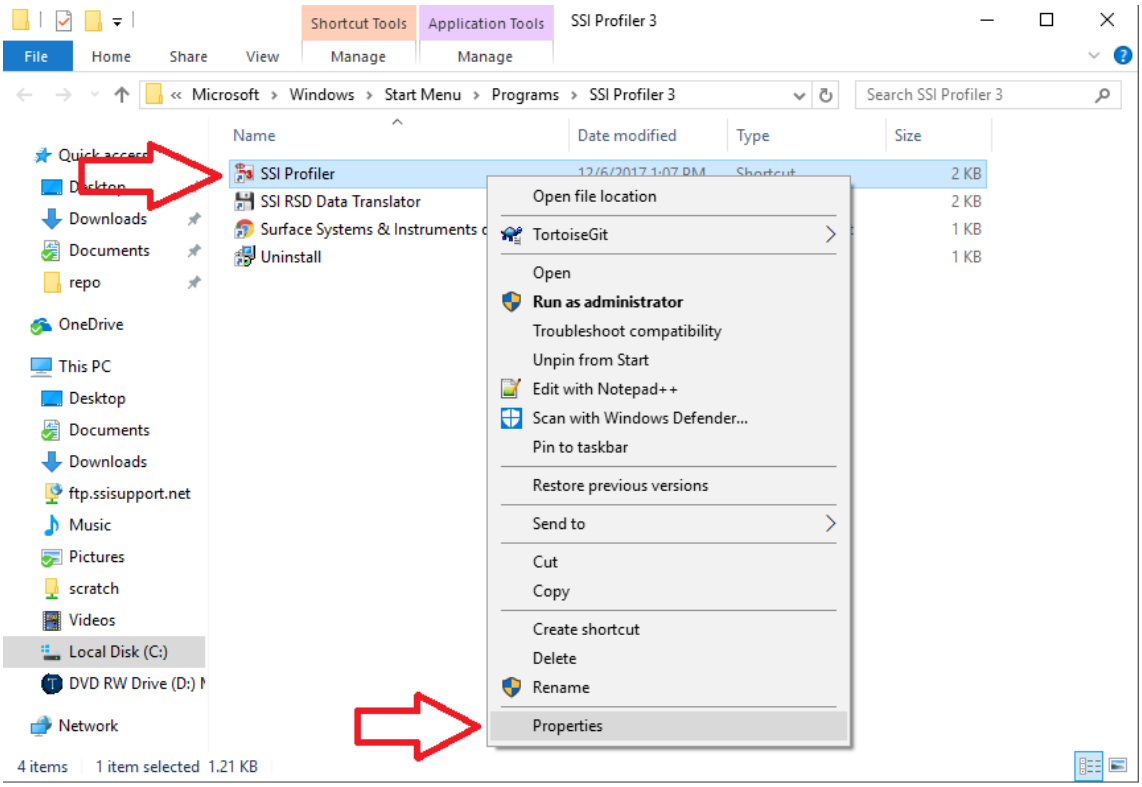


Figure 3: Selecting ‘Properties’ from drop down menu.

In Shortcut tab go to Advanced... Check ‘Run as Administrator’ and then ‘ok’.

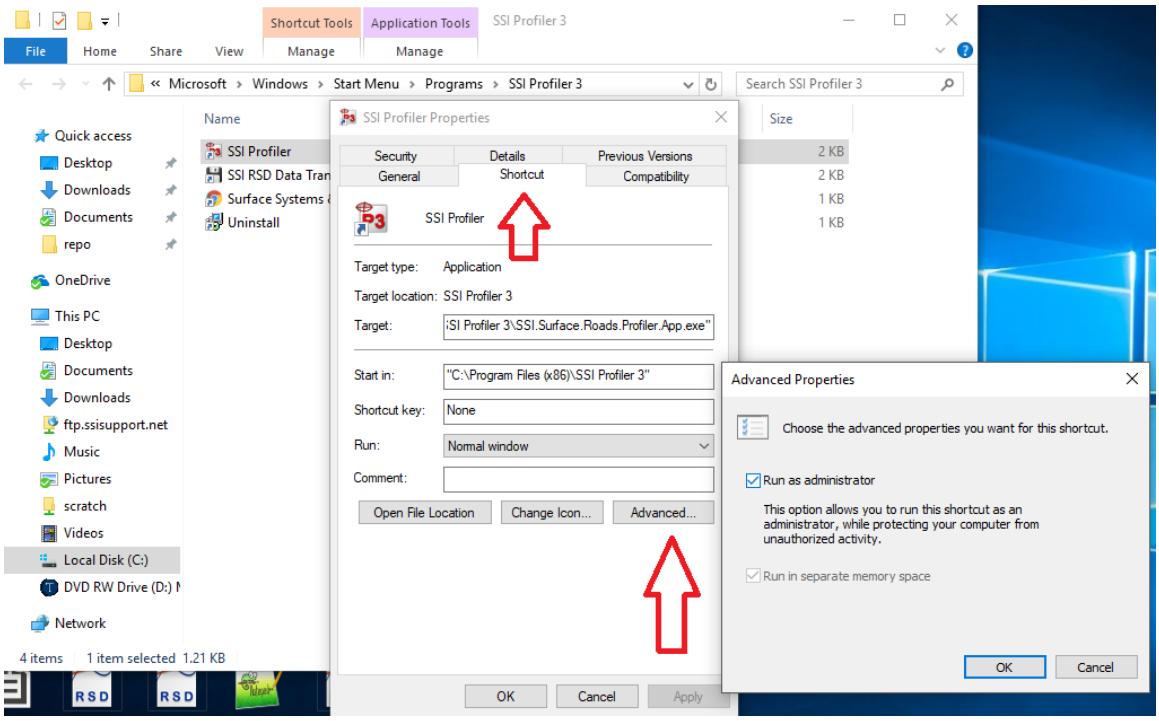


Figure 4: Check ‘Run as Administrator’ in the Short Cut tab.

Click ‘Continue’, in Access Denied window for Profiler to run as Administrator every time.

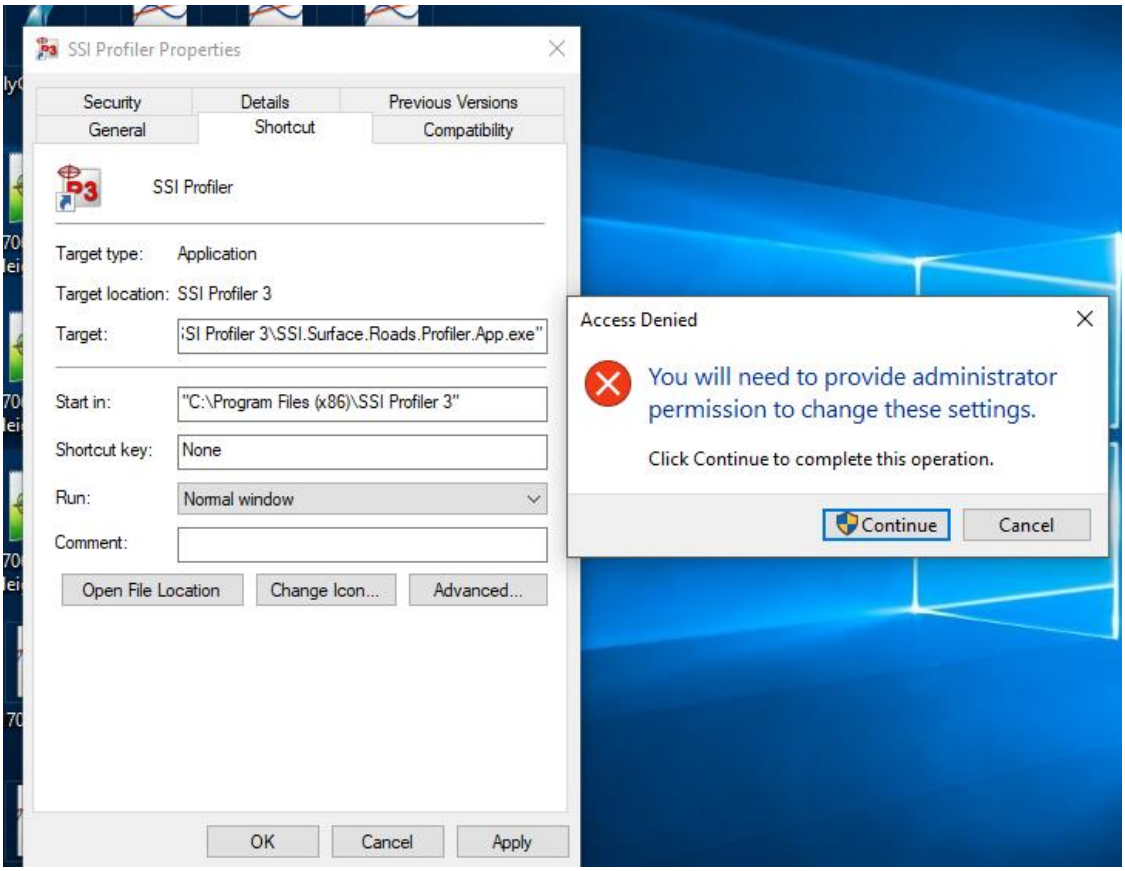


Figure 5: Click ‘OK’ and ‘Continue’ to confirm and run Profiler as Administrator.

After setting Profiler V3 to run as Administrator, a popup with appear every time you open the program. To get rid of the popup search "user account control" and set to "never notify" (this is Optional)

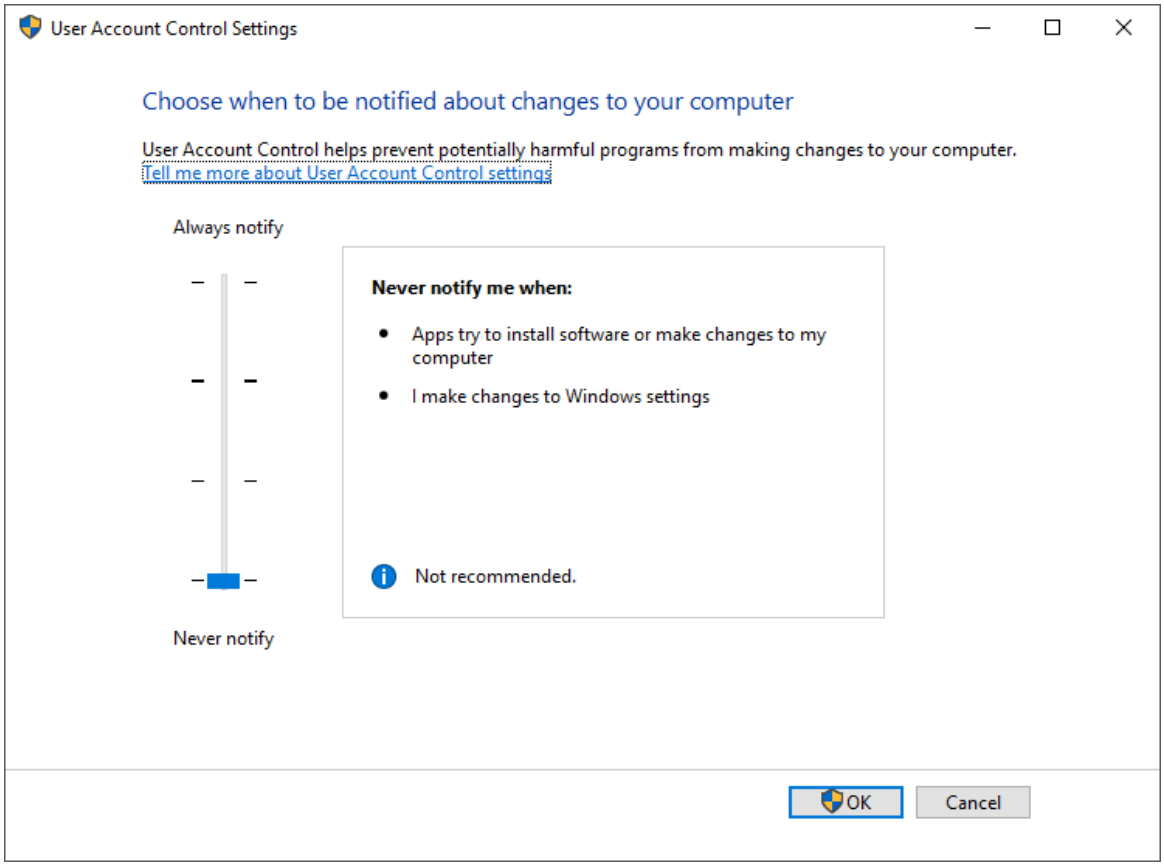


Figure 6: Window for disactivating notification of changes to computer.

Note: The settings.xml file goes in C:\Users\SSI PROFILER\AppData\Roaming\SSI\SSI.Surface.Roads.UDP.LaserRec

DMI Assembly

The installation of the DMI encoder assembly to the vehicle rim is the initial step of distance calibrations. If the vehicle is a Polaris 570 the DMI may be embedded and does not require assembly. Install the supplied collets onto the lug nuts of the vehicle. The collet assembly includes the collet, the housing and a machined bolt with both male and female ends. Space the collets depending on the number of lug nuts. For a six-lug wheel, use three collets in an approximately equilateral triangle formation. For an eight-lug wheel, use a square collet formation. There are machined numbers on the internal ring of the DMI disk to determine to correct placement and number of collets. The design of the DMI forces the collets to center themselves if the collets are in the correct position. If the DMI is installed off-center, the vertical movement of the position pole will be large. The wire harness for the encoder can be tied to the vertical position pole to avoid damage from tangling with the vehicle. Keep slack in the wire at the top of the pole using gear ties or zip ties so there will be no tension on the wire. To install the position pole correctly, insert the pole into the delrin guide attached to the vehicle body before attaching the DMI disk to the lug extenders.

Figure 8: The DMI pole and receiver

Figure 7: DMI wheel attached to 8-lug vehicle with a 4-lug extender configuration.

Main Electronics Housing

CS9300 Bumper Mount

The main housing for the 9300 systems is mounted to the hitch receiver. The 9300 hitch receiver is bolted to the back plate of the housing. The height of the profiling system can be adjusted through the machined slots on the hitch receiver. The laser heights can be changed by adjusting the dovetails mounted on the laser plates by loosening the ½ inch set screw with a ¼ inch allen wrench. The receiver hitch bolt is used to secure the system to the vehicle along with the supplied receiver tube brackets. The thicker end of each bracket is bolted against the white receiver tube. Always use both brackets and the receiver bolt to mount the profiling system. If the brackets are mounted backwards, the face of the brackets will not be parallel to the walls of the vehicle's hitch receiver. Power to the main housing is supplied by the seven pin connection through the trailer wiring. To determine if power is reaching the profiling system, check the LED at the top of the housing. The LED will illuminate when power is being supplied.

CS9300 Hitch Receiver Mount

The hitch receiver tube is connected to the vehicle using the hardware supplied with the system. There will be four 5/16"-24 bolts supplied with the system that mount the receiver tube to the aluminum back plate. The supplied bolts and bracket for the hitch receiver are oriented so that the thicker end of the brackets are in contact with the profiler's male end of the receiver tube. This assembly can be seen in **Error! Reference source not found.**.

Front Mount Hardware

When the system is mounted to the front of the vehicle by the tow-hook mounting tubes, there are six bolts supporting the system; four 5/16"-24 bolts (1/2" wrench) and 2 U-bolts at the ends (9/16" wrench). The U-bolts are paired with the plastic sleeves. Make sure that the system is as level as possible when attaching the U-bolt supports.

CS9100 Mid Mount

The main electronics housing is mounted under the back seat for the CS9100 mid-mount profiling systems. The laser heights can be changed by adjusting the dovetails mounted on the laser plates by loosening the ½ inch set screw with a ¼ inch allen wrench. Power to the housing is supplied by a 12V DC cigarette lighter plug. When power is reaching the housing the blue LED will be illuminated.

Note: Connect the Amphenol harnesses to the housing without torsion being applied to the wire. Turning the entire harness instead of the threaded connector will break off the soldered wires within the harness.

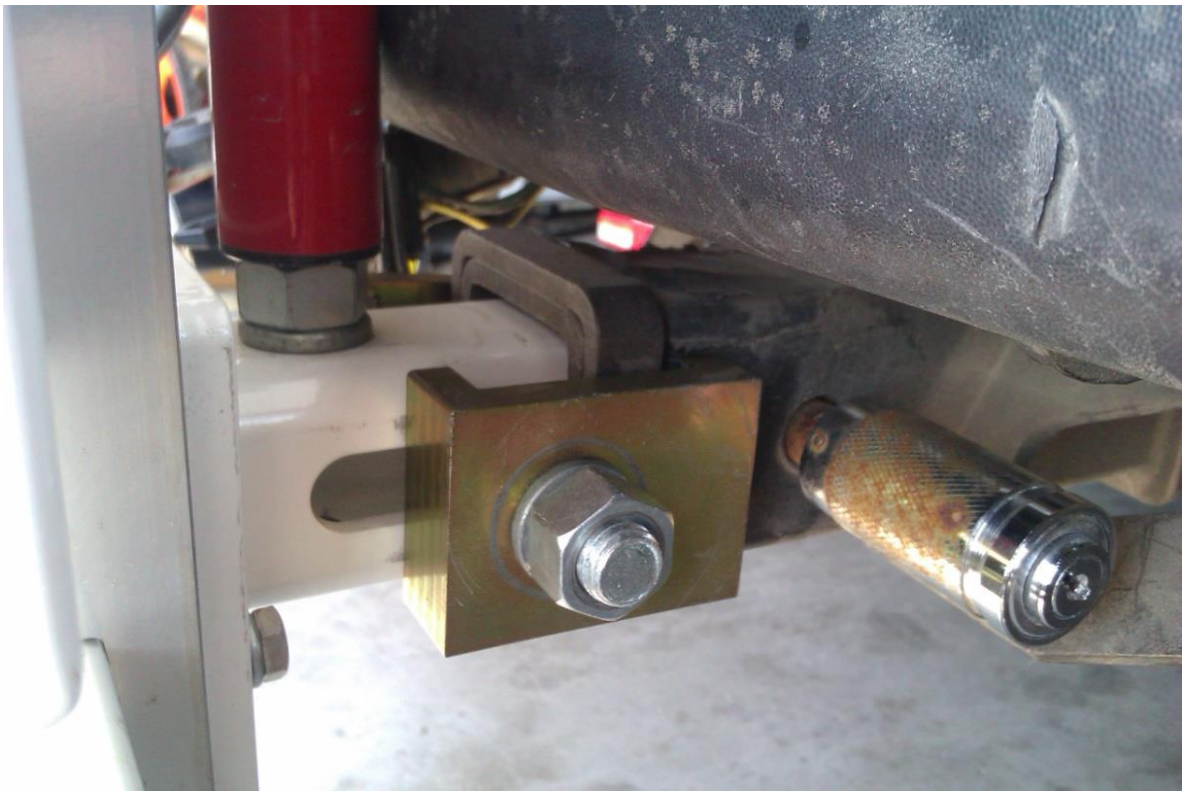


Figure 9: The hitch receiver mount with lock brackets.

Connecting Hardware

During assembly, connect the serial cable coming out if the pelican case or the white housing (6 pin amphenol) to the computer's DB-9 serial port. Once the program is opened and Collect is selected the software will search for hardware.

Disconnecting Hardware

If the hardware, lasers, GPS, and DMI do not need to be used while the system is connected through the serial port then the operator may use the Hardware Disconnect button at the bottom right of the collection screen. To reconnect the hardware again, select Collect and the software will search for hardware.

Figure 10: The LED power indicator

GPS Setup

Models with high resolution GPS for survey and cross slope applications may have additional steps to set up GPS. For all internal GPS receivers built into the SSI electronics the operator will use the USB cable to send commands. Otherwise, the commands will be sent through a serial or USB cable directly connected to the GPS receiver. If the receiver is powered on and connected with no signal, the SSI Profiler program wil display “No GPS Signal.”

9350 Survey System

The survey consists of three key components: base station receiver with tripod, pole with receiver and the rover or embedded GPS board. The base station is the main transmission point. It receives static GPS points for corrected GPS. The position of the profiling system is referenced off of the base station to determine the corrected GPS coordinates.

Note: The base station in not needed for profile smoothness data. It is used only to receive corrected GPS for survey data.

The GPS pole is secured by threading the pole to the bracket mounted to the backside of the white housing. The cable from the antenna receiver is connected to the rover or SSI electronics box. If no GPS signal is found, make sure the baud rate for the GPS receiver is matching the SSI electronics at a rate of 9600, 38400 or 115200. This can be changed in the GPS manufacturer software. For more assistance contact SSI Support.

Novatel GPS Setup

The Novatel GPS receivers used on the CS7900 and most high and mid-resolution GPS options have multiple platforms for programming. Contact SSI if you are unsure which system you have and the electronic limitations. Novatel systems can be mounted as stand-alone receivers, embedded inside the SSI electronics or mounted in a self-contained Pelican case as in the CS7900. If the receiver is embedded within the SSI electronics housing do not attempt to open the electronics or program the board. Contact SSI for a technician assist. All external receivers (Flex2, Flex6 and Span-CPT) can be programmed through a USB or direct cable.

Inertial Systems With Novatel External GPS Receiver

These systems run at 10Hz with a GPGGA string through the serial port on the outside of the White SSI housing. If the receiver needs reprograming, enter the following commands in Putty or Novatel Connect. You should see an “OK” after each command is entered.

1) unlogall
2) com com1 38400 n 8 1 n off on
3) log com1 gpgga ontime 0.1
4) saveconfig

Note: Newer systems with the latest firmware have a baudrate of 9600. Note the baud rate in which you connected to the receiver and use the same number.

CS9300 Bumper Mount GPS Setup

Measurements must be taken to set up the GPS in order to accurately pinpoint the defects detected by the inertial system. For this process a tape measure is required. There is only a need to re-measure when the system changes dimensions or changing the vehicle host. A new dimension is mainly from a change in the length of the arms from disassembling the system for storage. The measurements are from the left laser (track 1) to the center laser (track 3), from the track 1 laser to the track 2 laser, and the elevation measurement. The elevation measurement is

the distance from the bottom of the center laser (track 3) to the top of the GPS pole. The top of the GPS pole does not include the antenna and is only to the end of the cylindrical pole.
The “GPS Distance Forward” is the distance from the center laser to the GPS antenna going from back to front of the vehicle for rear mounted systems (it is a positive value when the GPS antenna is closer to the front of the vehicle than the laser). For front mounted systems, this measurement is from front to back of the vehicle (it is a positive value when the GPS antenna is closer to the vehicle’s body than the laser).

Trimble 5kHz GPS

The Trimble GPS system is fully integrated to the profiler system. The coordinates will be found when the collection program is initiated as long as the GPS antenna is not obstructed. The GPS coordinates will be shown in the Main Collection Window beneath the status bar. Details about the GPS system and the coordinates of the system can be viewed by selecting the GPS Details icon. The electronics is searching for GPS signal when the GPS status bar displays, “No GPS Signal.”

Arm Adjustment and Laser Placement

The arms or dovetails of the profiling system can be used to move the lasers over the tracks that need to be profiled. To adjust the arm length on the CS9300 and CS9350, all three brackets must be loosened, a total of four bolts. If the profiling system has three lasers, the center laser is mounted in front of the center 2 bolts. To adjust the arms, the center laser must be removed so that the two bolts at the center of the system can be accessed. The laser heights (vertical distance to the ground) can be adjusted through the receiver tube plate or the dovetails mounted to the laser plates. The dovetails are secured by tightening the 1/2“set-screw which acts on nylon bushings to compress the dovetail pair together.
High standoff spot lasers (Selcom SLS5000 325/400) have a recommended height of 15 inches above the ground. The range is plus or minus four inches of the recommended height (±4 inches). The Selcom RoLine 1145, LMI Gocator 2342, and the Selcom low standoff (Selcom SLS5000 200/300) lasers have a recommended height of 12 inches above the ground. This is the reason the RoLine three laser systems use a low standoff spot laser in the center track (Track 3). The minimum height above the ground is 200mm or 7.8 inches. The height range is between 7.8 and 15 inches.
Gocator 2375 high standoff infrared lasers should be mounted 26 to 78 inches above the ground.

Be aware of the minimum laser range when performing the height verification. Always place the lasers at the correct height. Be aware of your systems laser type if you fail the height verification. The operator can view the laser type when System Settings is selected.

Even if the laser configuration is set to auto detect, review the laser type under system settings to confirm its accuracy. The laser type can be reviewed under the Collect Window, after selecting the System Settings icon.

Figure 11. Laser out of range. Range LED must me on.

To adjust the height of the lasers, loosen the set screw in the center of the female dovetail with a ¼ inch allen wrench. The set screw does not need to be completely removed. When tightening the set screw, do not over-tighten. The nylon bushing can be damaged when excessive force is used. Tighten the set screw so that the laser plate cannot slide vertically when pulled.

For the CS9100 Mid-mount systems the operator must slide the horizontal dovetail outside the truck body to install the vertical dovetail and laser plate assembly. The horizontal and vertical dovetails of the mid mount assembly can be adjusted by loosening the set screw with a ¼ inch allen wrench. Set the laser height and spacing with this method. Only tighten the set screw so that the dovetails cannot move when firmly pushed.

Figure 12: The vertical dovetail and laser plate assembly

Calibration

Accelerometer Calibration

The accelerometers are an important component of the inertial profiling system. They are used to determine the vehicle chassis' vertical motion. The vehicle's vertical motion is then subtracted from the laser readings to determine the profile of the surface (integrating this data with the distance encoder readings). It is important that the accelerometers are calibrated properly and their position on the profiler is constant and correct. The accelerometers should always be in the upright position except during calibration (Accelerometer is upright when the arrow etched in the accelerometer on the opposite side of the wire is point up). If the accelerometer is oriented in any other way the data will be incorrect. Be aware of any vibration in the laser or accelerometer hardware. Vibration will cause anomalies in the data.

Note: All accelerometers are calibrated at the same time. Make sure the vehicle is off, out of the wind, untouched by others, and on a level surface. To calibrate the accelerometers start with both in the upright position (they should already be in this position). Follow the instructions on the computer screen to complete the calibration. The accelerometers will be rotated from upright, to upside down, to on their side and finally returning upright again to complete the calibration.

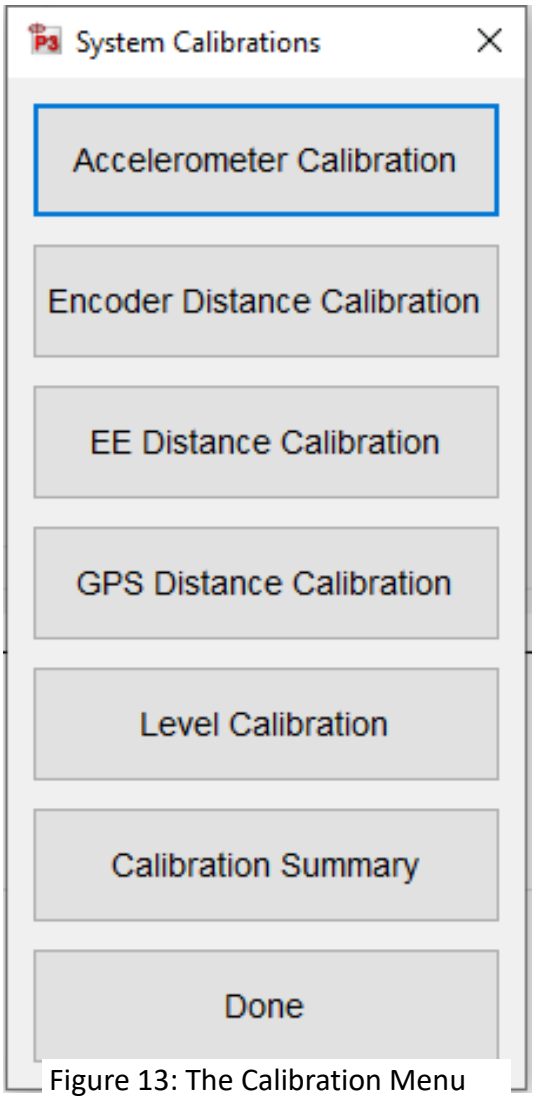


Figure 13: The Calibration Menu

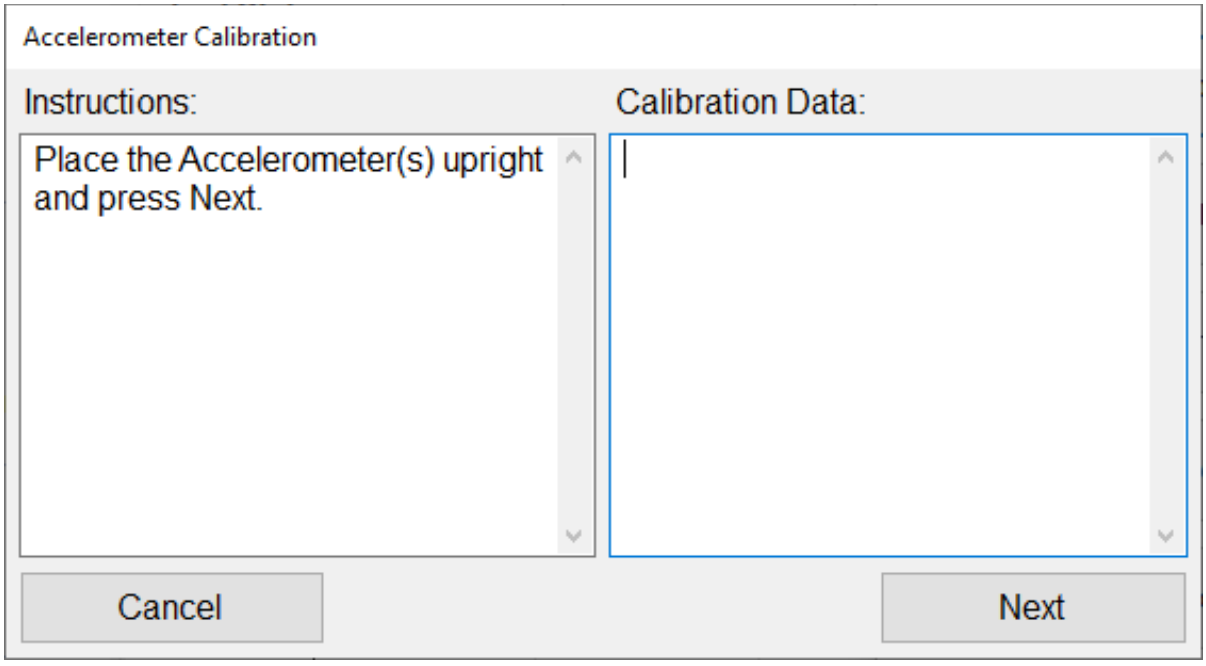


Figure 14. The first step of the accelerometer collection

Calibrate all of the accelerometers at the same time. The calibration is to begin with the accelerometers in the upright position. This is the normal functioning position, the position the accelerometers should be in during collections.

Figure 15: The upright accelerometer position

Figure 16: The accelerometer upside down

Figure 17: The accelerometer on its side

When placing the accelerometer on its side during calibration, the wire may face up or down.

Distance Calibration

A precise distance calibration is crucial to collecting accurate surface profiles. The distance calibration is traditionally performed on a tenth of a mile track (528 feet or 160 meters) or whatever distance is used for reporting (100m or 200m international). The key component of the distance calibration is the DMI assembly and encoder (figure 8). Prior to calibrating, measure a tenth of a mile track over an ideally straight, flat and clean area.

It may be necessary to perform multiple distance calibrations within a day of profiling. As temperature changes the air pressure within the tire also changes, modifying the wheel circumference. Whenever this happens, the collected data will become further and further from the actual distance depending on the temperature gradient and the distance traveled. If the distance seems to be deviating from the actual stationing, take the time to recalibrate.

Always calibrate on a straight 0.1 mile (or 100m/200m) section of pavement at the speed you will be collecting.

Encoder Distance Calibration

Press the Encoder Distance Calibration button on the Calibration and line the lasers on the starting line of the calibration track. The first window will instruct the operator to "Move Unit to start of Calibration Track. Then press NEXT button." Follow the calibration instructions to complete the distance calibration.

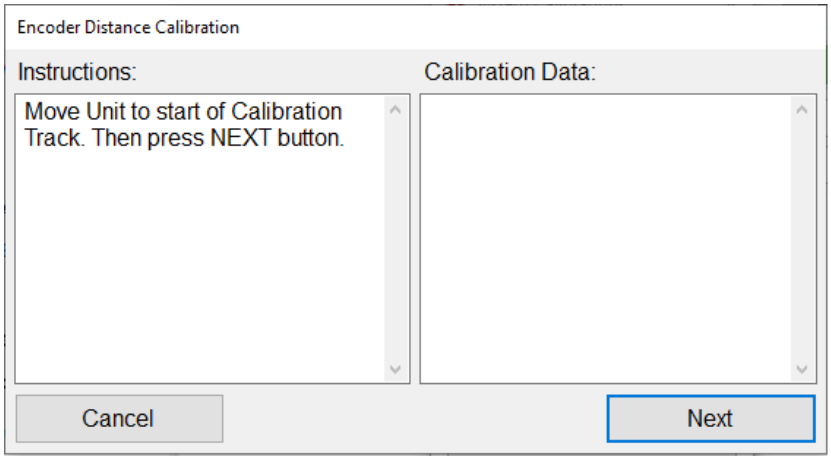


Figure 18. First window of the encoder distance calibration

EE Distance Calibration

Distance calibrations can be completed quickly and efficiently by using the electric eye (EE) to mark the beginning and end of the calibration length. This feature requires two points with **DOT-C2** compatible reflective tape in range of the electric eye sensors. These two points should be at least 528 feet apart (or 100m/200m), or another distance given by the resident engineer. It is important that the two reflective tape stations are at accurate positions for the calibration track.

To begin, press the EE Distance Calibration button on the Calibration Menu window (See figure 12). The first message will say 'Hit NEXT to arm the electric eye. After pressing Next, the following window will say 'Electric Eye armed. Waiting for trigger to start.' Once the reflective tape gets passed, the window will show the ESTIMATED PRE-CALIBRATED DISTANCE. Hit the Next button again to arm the Electric Eye for the ending reflective tape.

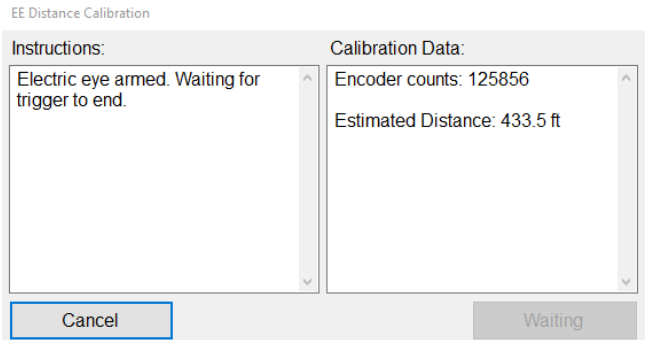


Figure 19. Third window of EE distance calibration with NEXT pressed

Upon passing the second reflective tape at the end of the test section, the operator will be prompted to enter the correct distance traveled (the calibration track length).

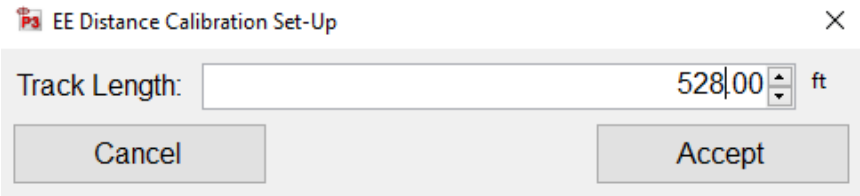


Figure 20. Enter length of calibration track

The units can be easily changed by clicking on the current unit and choosing from the drop-down menu.

Do not be alarmed if the Estimated Distance shown on the final window is way off from the actual calibration distance. This is normal for recently built systems, recently modified systems, systems that have been in storage, computer/software change change. Simple enter the correct distance traveled and press the ´Accept´ button.

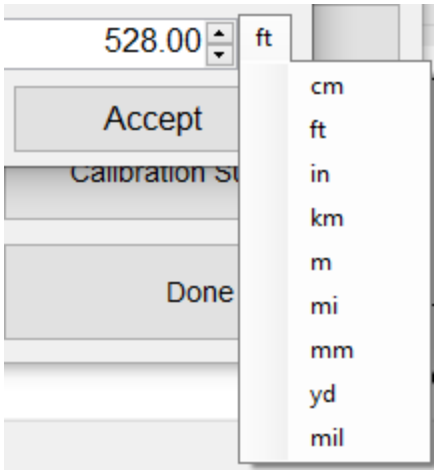


Figure 21. Drop down Units menu

GPS Distance Calibration

Before performing a GPS Distance Calibration, go to Systems Settings and under the first tab Sensor Setting, change the Distance Measurement option from ´Encoder´ to ´GPS/OBD´. See figure 21 below. **Note: For Zero-Speed systems, the Distance Measurement options are under Settings/Device Setup (See figure 38 below under the Zero-Speed system section).**

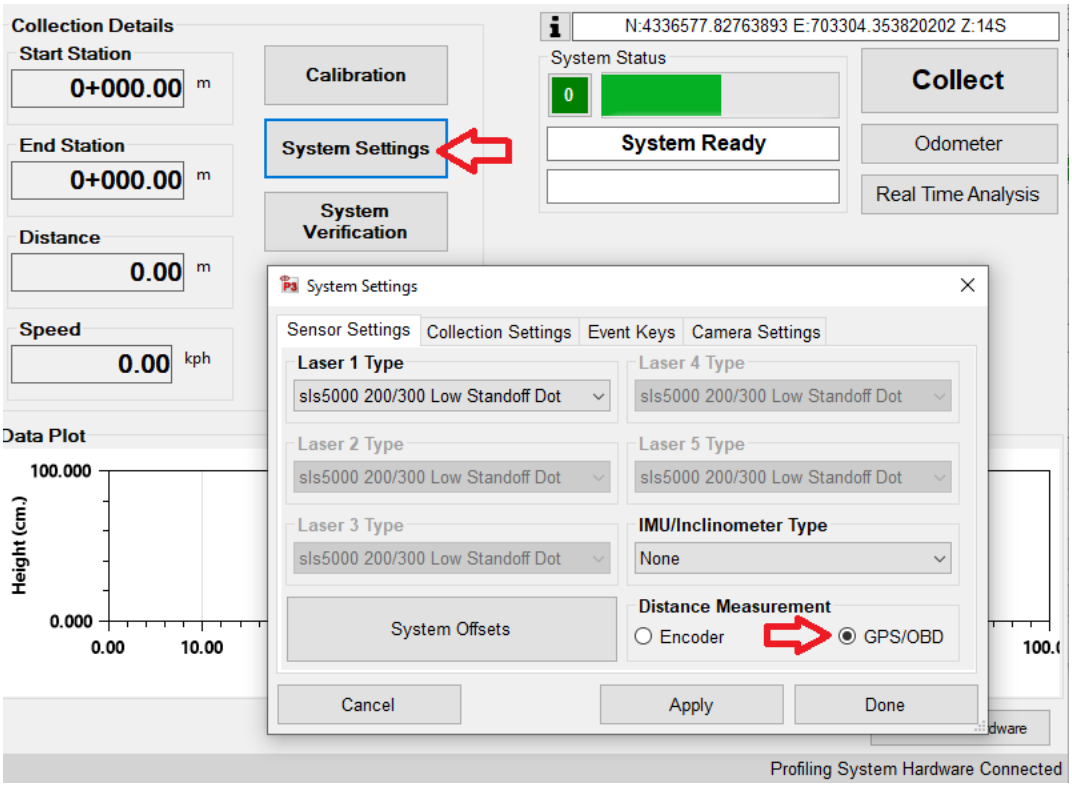


Figure 22. Distance measurement sensor options

The GPS calibration is for GPS-DMI boxes. It essentially uses the GPS to calibrate your encoder counts (not the GPS/OBDII. The GPS/DMI has no calibration). Drive at a constant speed, start the calibration and within a 300-500 feet it calibrates the encoder to the GPS. This helps to eliminate the operator having to measure out and set up a distance track to calibrate the encoder. Follow the instructions to complete the calibration.

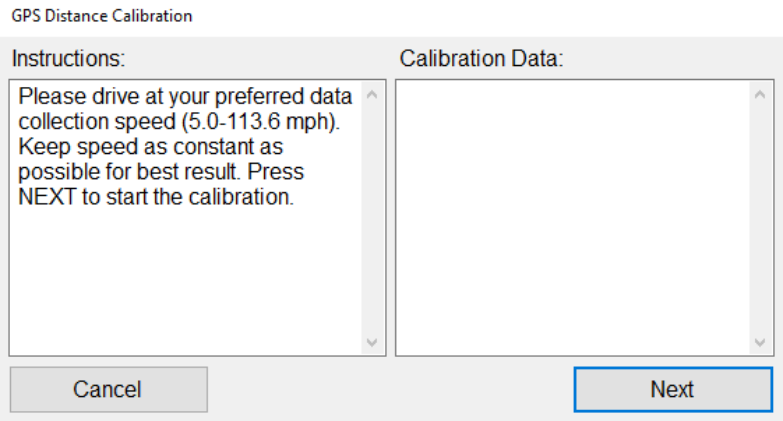


Figure 24. First window of GPS Distance Calibration

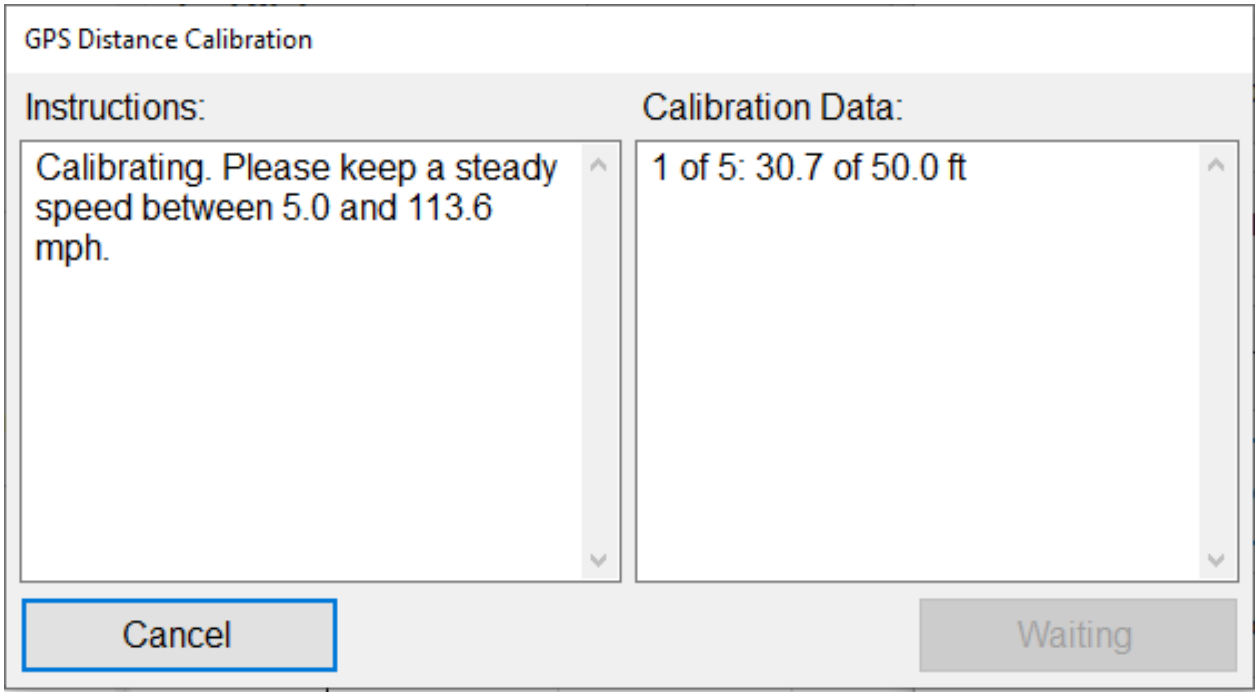


Figure 23. Second window of GPS distance calibration

The GPS-DMI has no calibration. It uses gps as the primary source. It will auto calibrate the OBD signal in real-time when it has good gps data and constant speed. If there is too much variance in the gps solution, it will revert to the calibrated OBD signal. You can monitor the GPS-DMI status when you pull up the information window for gps. It should say “ratio good” if the OBD signal is correctly calibrated after driving around. The only time the encoder is used when in GPS-DMI mode is whenever the vehicle speed drops below 5.

Level Calibration

For systems with rutting and/or systems with an inclinometer/IMU used to calculate the cross slope. All of the survey systems are equipped with some type of incline measurement device. The inclinometer is located under the grey electronics box inside the white housing or is embedded within the electronics housing. ***For the inclinometer mounted UNDER the grey box, the lead wire of the inclinometer is always pointed in the direction of forward travel for the vehicle. The high side of the angled block always faces the passenger side.*** Make sure to use a straightedge. Any variation in the surface during the calibration will be reflected all data collected.

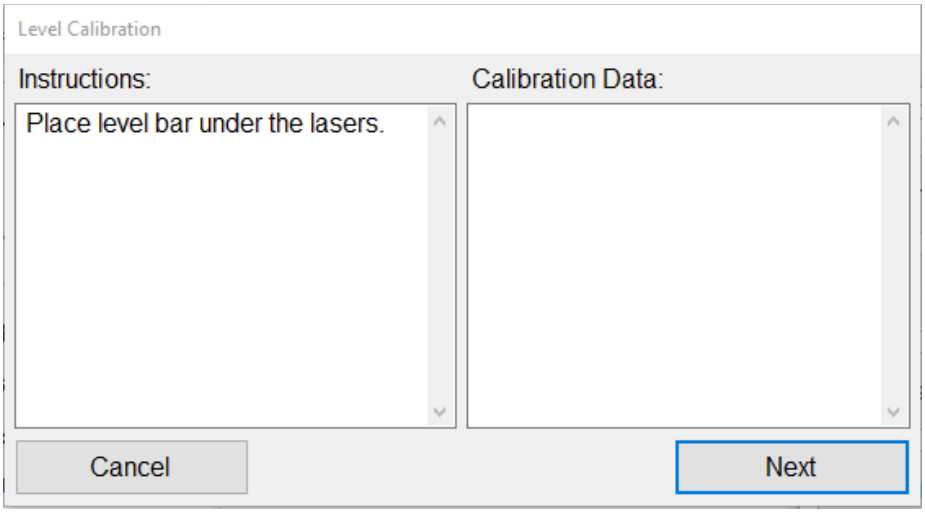


Figure 25. First window of Level Calibration

Figure 26. Bar under the lasers and leveled.

The bar must be leveled before pressing 'Next'. The level calibration will initiate its measurements. Upon finishing, the window will change and show the results of the level calibration.

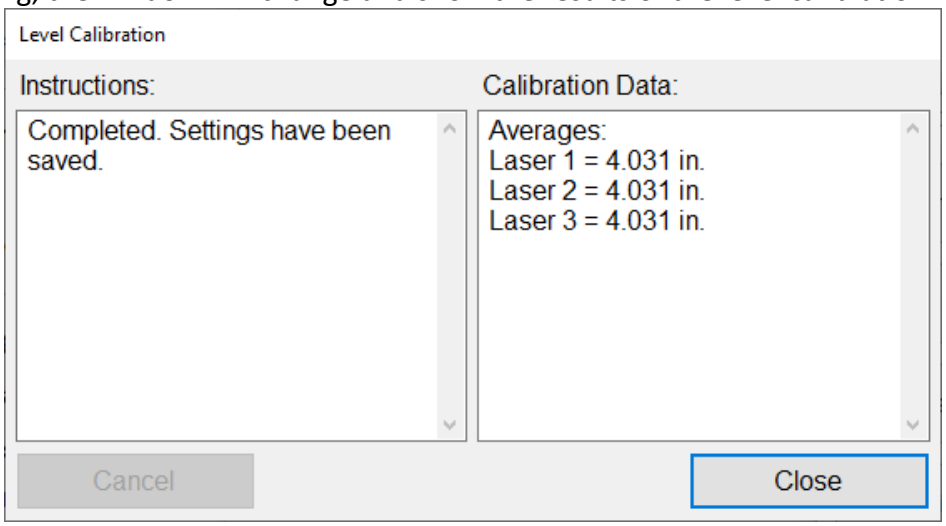


Figure 27. Last window showing the results of the Level Calibration

Level Calibration for Rutting

If a system has multiple lasers but no INS/IMU, the level calibration is still a calibration option available due to people that want to zero their lasers for 3-point or 5-point Rutting.

Closed Loop Calibration

The closed loop calibration is specific to any SSI system with INS/IMU or cross-slope sensor and will only appear as an option in the calibration menu if the system is equipped with such sensors. These systems include Zero-Speed systems, Survey systems,and Inertial systems with INS. Please see the Zero-Speed section below in the manual for all details regarding this calibration.

Alignment Calibration

This calibration is only available on the CS9500 survey systems (Please see separate Transverse Survey System manual for instructions).

The Alignment Calibration sets the Gocator 2375 transverse lasers at the correct offsets to measure a level line. ***This calibration is required only when the supporting hardware is changed or adjusted.*** This calibration shall be completed on a flat, level floor or long, flat and level straightedge. The laser beam can be found by using an infrared card indicator. **Do not look into the laser emitter at any time when the system is on.** Level the truck and IMU (if applicable). The calibration will first level all of the lasers through the calibration menu. Follow the prompts on the screen and verify that the post-calibration graph is acceptable within tolerance.

A secondary calibration within the Gocator browser window may need to be completed if the lasers are moved or the frame and mounting position is adjusted laterally. The lateral calibration starts at an arbitrary number like 7000 for the X-axis value of the Gocator measurement output. From the browser window, the two adjacent lasers are turned on and an object is placed between the laser within the overlapping beams. The laser reading is fixed for the left laser, but the right value is adjusted until the objects coordinates match between the two lasers. Save all changes within the browser window. The Gocator IP address will be specific to the laser position and will be with your profiler documents.

Calibration Summary

The current calibrations for the inclinometer, accelerometers, distance encoder and level can be viewed be selecting the Calibration Summary icon under the Calibration Menu.

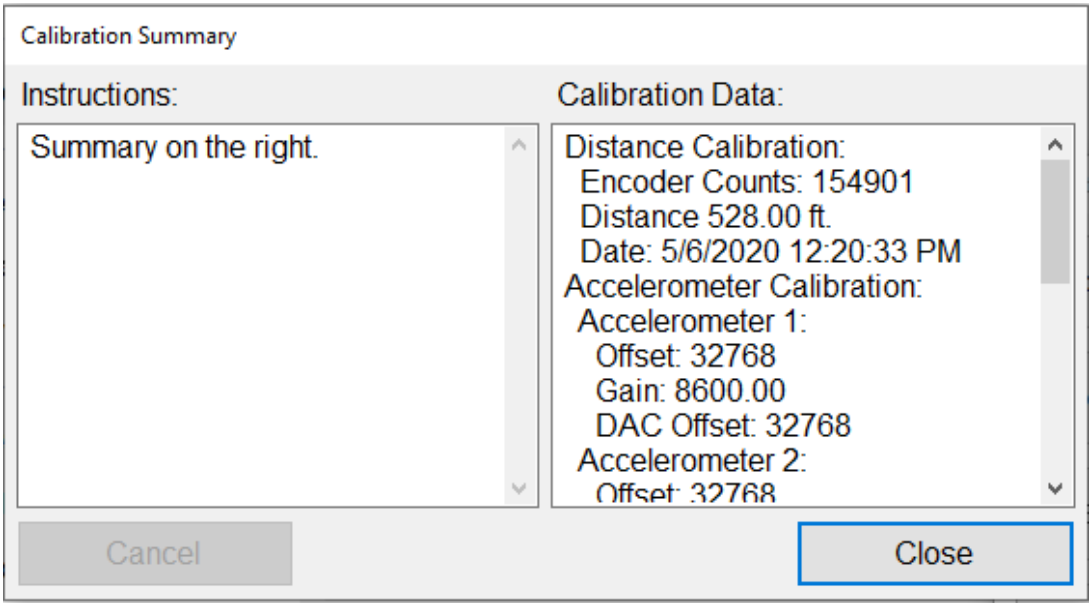


Figure 28: The Calibration Summary

System Settings

Sensor Settings

Laser Type

The laser type must be chosen within the System Settings. If the system in your possession is a RoLine/Gocator three laser system, the center laser is a Low Standoff Spot Laser. If the laser type is saved incorrectly, the laser height verification will be inaccurate. If the laser height verification ever fails, review the laser type. **Note: Zero-Speed and Survey systems will have different tabs for its Systems Settings. See the Zero-Speed section below.**

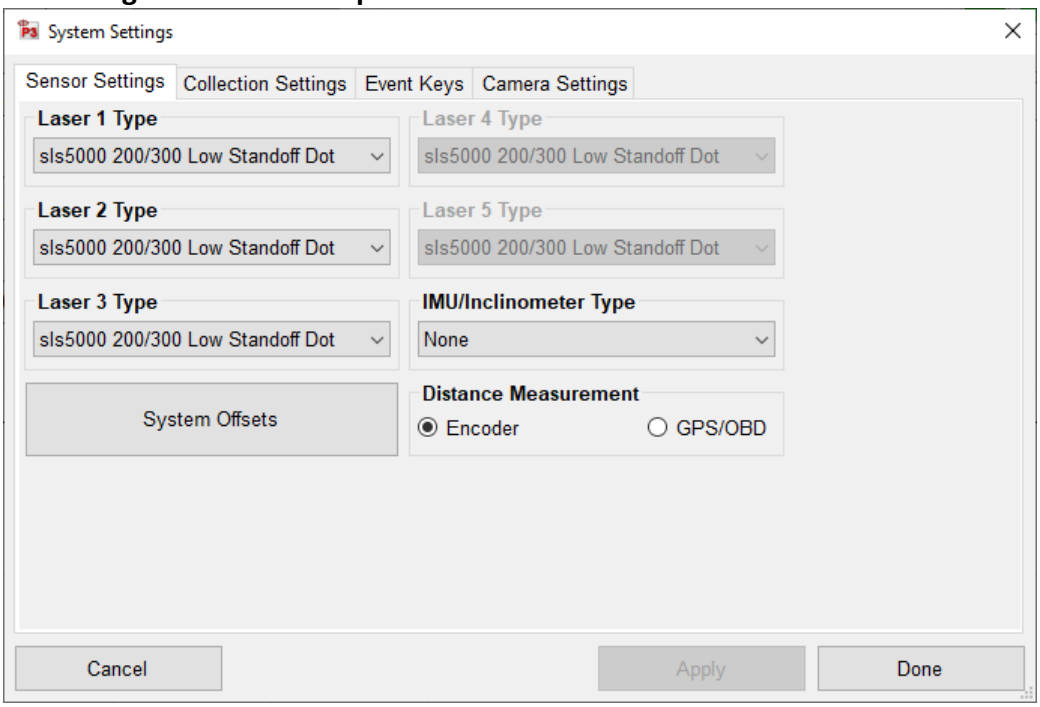


Figure 29: Sensor Settings tab for a 3-Laser system

It is very important that the laser type is correct. Incorrect laser settings will cause inaccurate profiles and surveys. The inclinometer calibration will receive an error when the lasers are incorrectly set. The error will state that the laser heights differ more than 1.5 inches. Completing a height verification also determines the problem, which is resolved by changing the laser type to match the actual lasers.

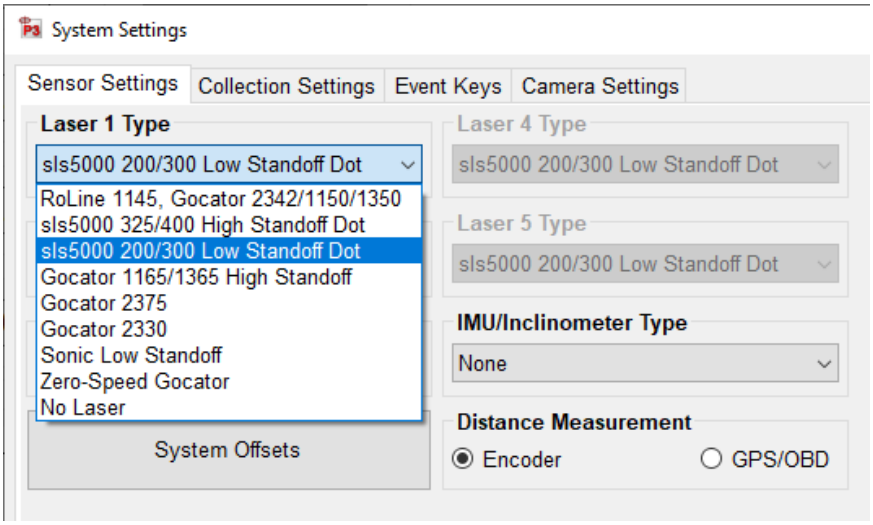


Figure 30: Laser options drop down menu

System Offsets

For systems with 3 lasers or more, press the ´System Offset´ button under the laser types. The window in the figure below will appear called GPS Measurements. Under Top View, enter the system offsets for the Left laser (Track 1) to Right laser (Track 2) Process A. Repeat the process for the rest of the lasers (processes B,C,D) and for the GPS antenna, Process E (The left to right distance).

Note. Process C and D with lasers 1 and 5 are only for Transverse systems. Mid-mount laser rut systems have their own diagrams.

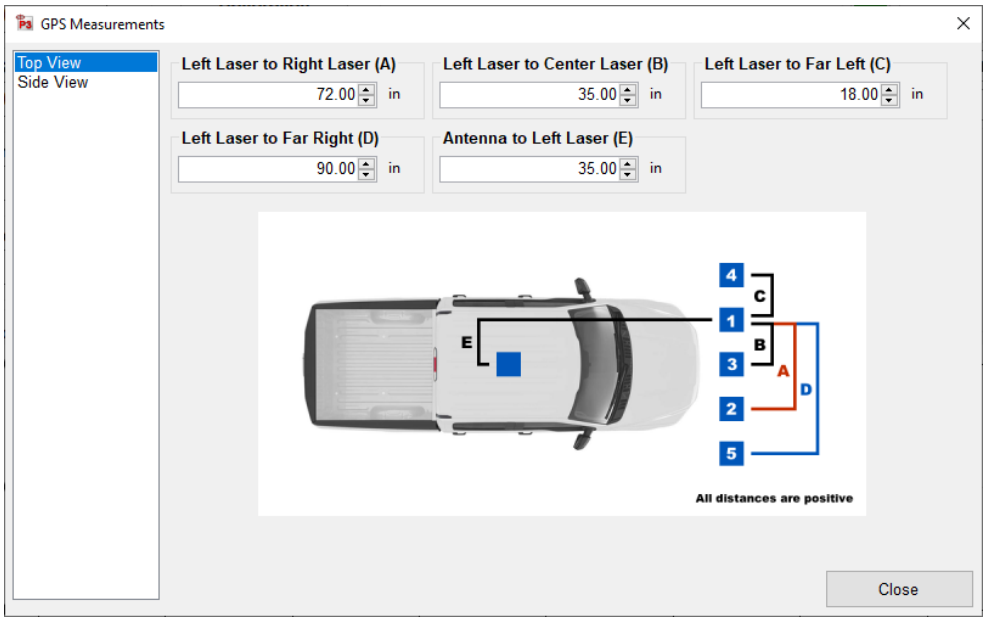


Figure 31. The Top View of the GPS Measurements window with values entered

For the side view, additional offsets can be entered for GPS height and GPS forward (Laser 1 to IMU or GPS phase center. A is the front to back distance and B is the vertical distance. Side view offsets are fundamental to survey systems, but not influential on profile/rut measurements.

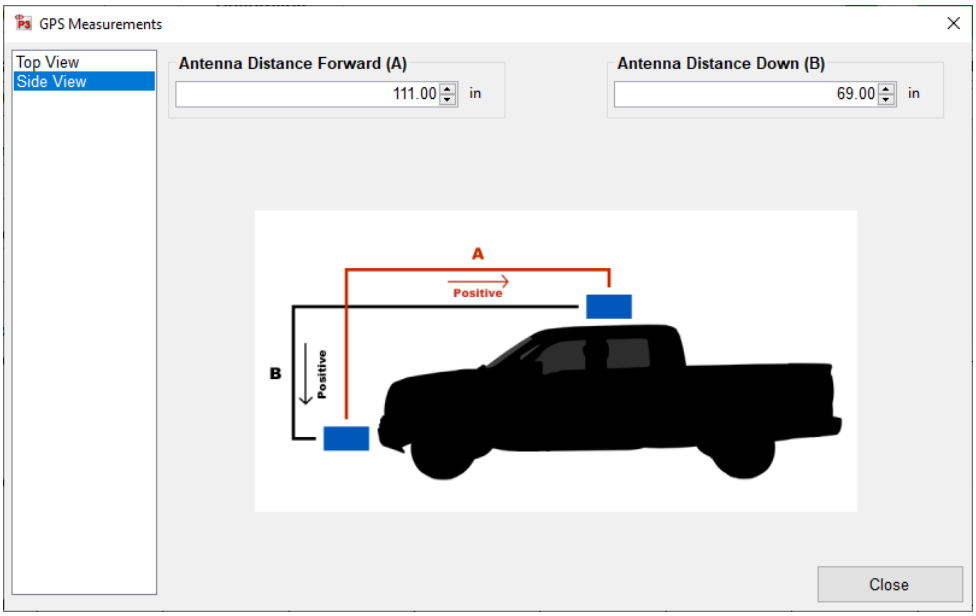


Figure 32. Side View of GPS measurements for the vertical and forward GPS distances

Collection Settings Tab

Choose Bounce Test Limits, Start Station options, Station Direction, Spike Threshold and Enable the desired tracks. Under Collection Information, Simulated Travel is for troubleshooting and bounce tests. Simulated travel sends the system through a simulated profile collection without moving. Laser data is still collected, but real distance is not recorded. The sampling interval is the distance between measurements of the simulated travel option.

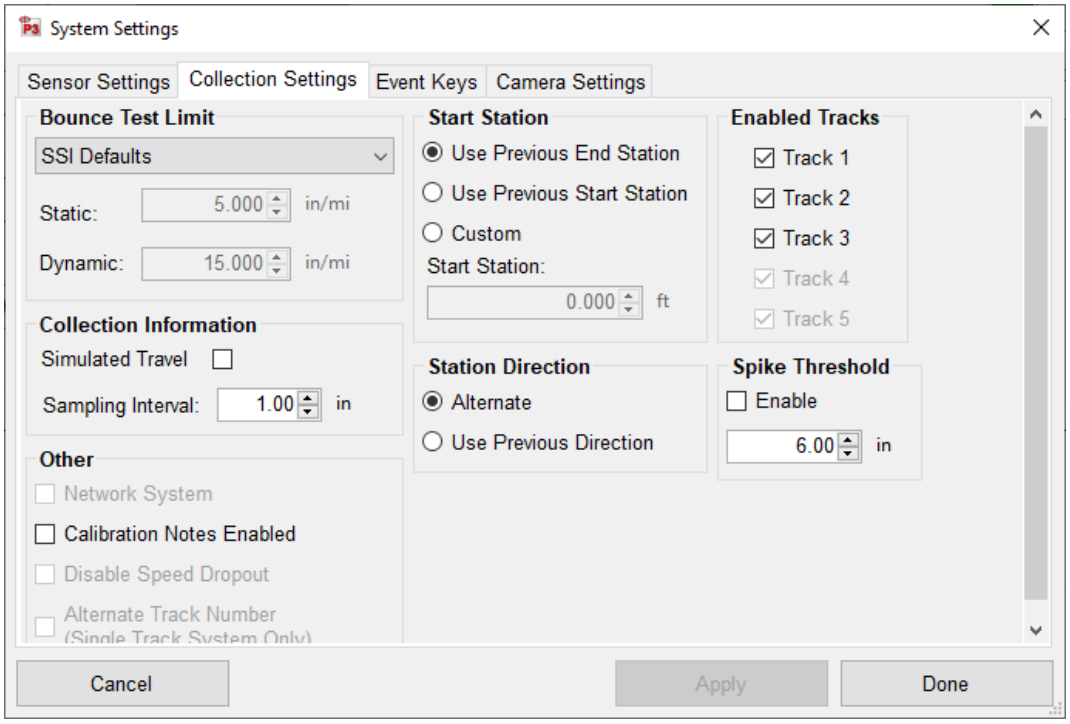


Figure 33. The Collection Settings tab under System Settings

Event Keys

The Event Keys are used programming a specific key on the keyboard to execute a certain function of the collector software. This helps operate the system if there is only one person, which can drive and activate the program using certain keys without having to use the cursor to press buttons.

All Events and Exclusions can have a front and rear buffer.

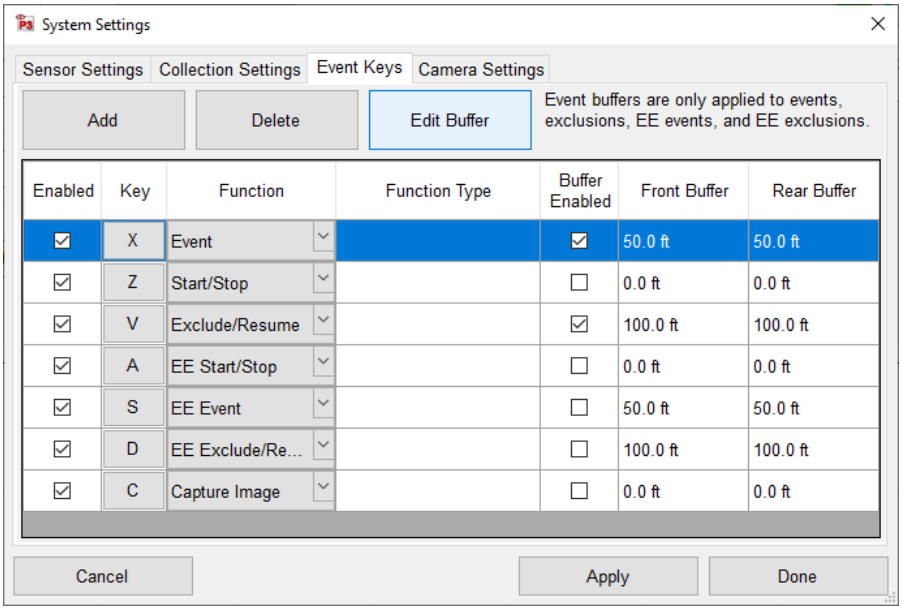


Figure 34. The Event Keys tab under System Settings

Camera Settings

How to Use the Camera

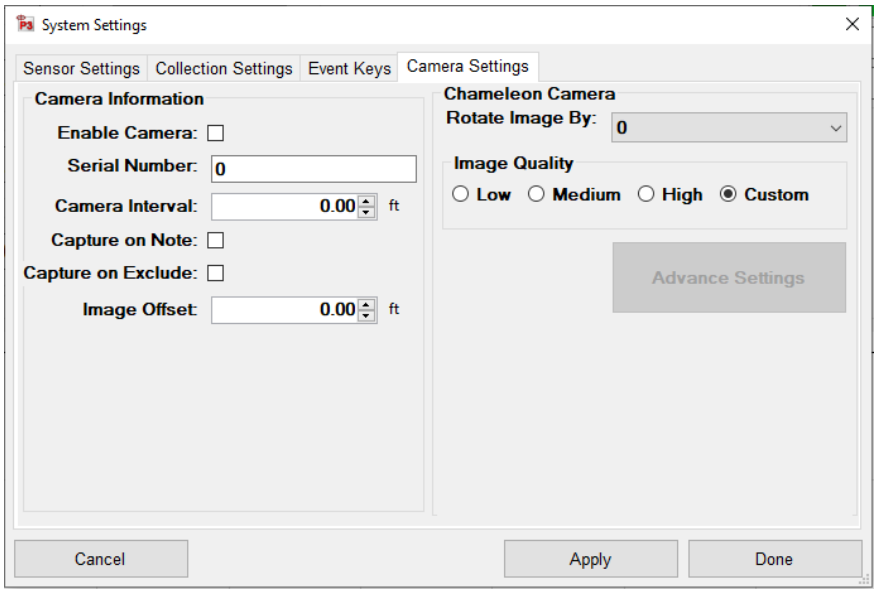


Figure 35: Camera Settings

Install the Flycap2Viewer driver located on the disk supplied by SSI (or already installed on the computer). The correct driver depends on if the computer is 32 or 64 bit. To check this, open the start menu and right click on My Computer (or My PC) and choose 'Properties'. On this window find the System Type and view if the system is 32 or 64 bit. If the computer is 32-bit, install the x86 flycap2viewer. If the system is 64-bit, install the x64 flycap2viewer. Once the driver is installed, plug in the Chameleon Camera to the computer's USB port.

Enabling Camera Settings

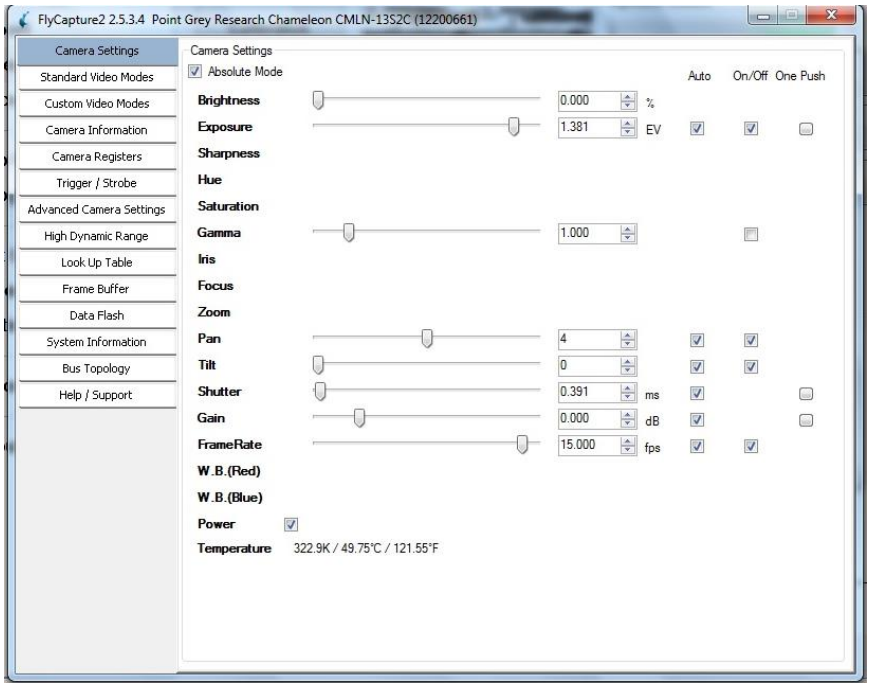


Figure 36: Advanced camera settings

Once the profiling system is connected and the Collect tab is open, the operator can enable the camera. At this time make sure the flycap2viewer driver is installed and the camera is connected. Open the collect window and once the hardware is found, select System Settings. Under the system settings window, select the Camera Settings tab. To enable the camera feature select the check box under the Camera Settings Tab. The camera interval is the distance traveled between each picture. This can be set to any interval however, the more pictures taken results in more data saved to the computer and more time that post-processing will take. If the camera is not mounted upright, enter the correct rotation angle in degrees, selecting one of the four options. The camera is focused on the physical lens. Enter the serial number of the camera which is on the sticker on the back panel of the camera. Once apply

is selected the camera will be found in under one minute for the first use. Once the settings are saved, the serial number will fade out, as seen below.

The image preview should appear in the Collect window in color and at the correct orientation. If not, change the settings to the appropriate orientation or open the Advanced Settings.
To reduce the size of the image, change the resolution of the camera to 640x480. This will decrease the processing time and RSD file size. Under Custom Video Modes the operator can adjust the resolution and see the estimate of the file size.

Custom video modes can also be used to crop or adjust the viewable image area for each camera. There will be a red border for the active area for the camera. The user may adjust the height and top values to change the position of the camera frame. The end result should be to reduce the sky's influence on the picture to keep sunlight or other reflective surfaces out of the frame.

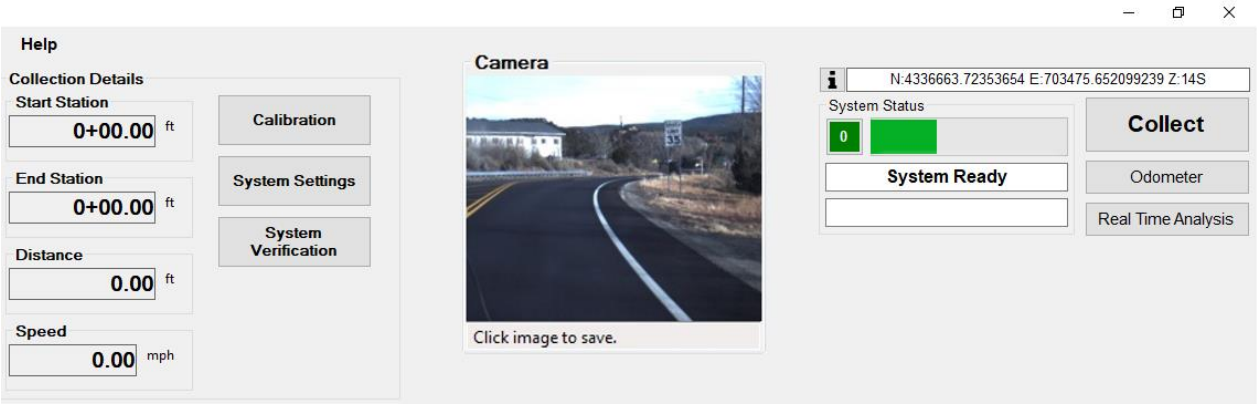


Figure 37: Camera Preview window in Collect Screen

Zero-Speed Systems Settings

Zero-Speed systems feature INS and additional laser sensors for stop and go inertial profiling *in each wheel path, ideal for urban environments. The Zero-Speed inertial profiling system collects longitudinal profiles like standard inertial profilers except that it allows you to collect accurate data through vehicle stoppages (stopping at stop signs, traffic lights, slowing down, and speeding up). This eliminates spikes and gaps in profile data from speed drop outs and pauses, and eliminates data degradation from traffic signals and project site limitations.

Set Up

(1) Connect associated RS-422 cable (for main electronics communication)

(2) Boot the system by going to collect button in Profiler (See main manual for Inertial Profilers).

(3) Obtain the IMU to GPS antenna offsets by measuring the distance from the IMU phase center to the GPS antenna phase center in the X, Y, and Z directions for each antenna. The IMU center can be found by locating the decals on the white housing, or separate INS enclosure. The GPS antenna phase center is described on

a diagram on the antenna. The centrifugal center of the antenna is the X and Y center. The Z phase center (or L1 phase center) is located 0.050-0.062mm above the bottom of the antenna (where it meets the GPS mast) depending on the antenna used (These depend on the installation location of the antennas, IMU and white housing.) *Note: Any changes made to the antenna offsets are not applied until the "Set Offsets" button in clicked*.

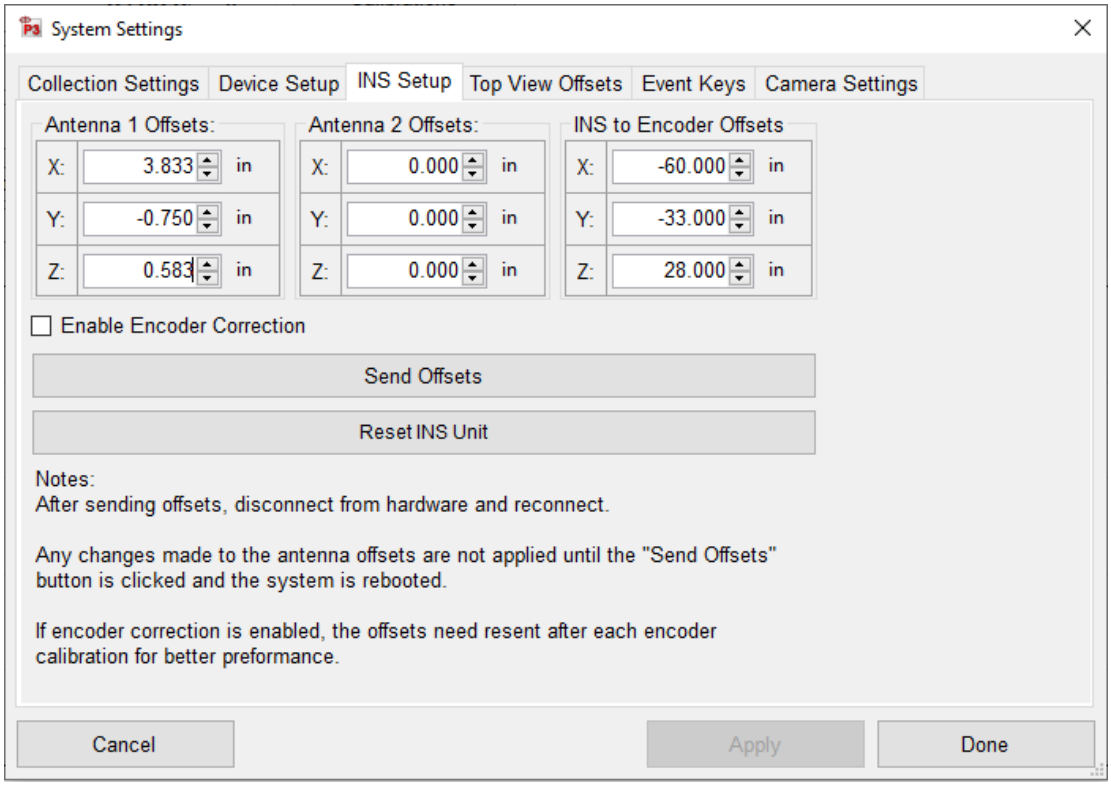


Figure 38. The INS Setup tab with Antenna and INS Offsets entered.

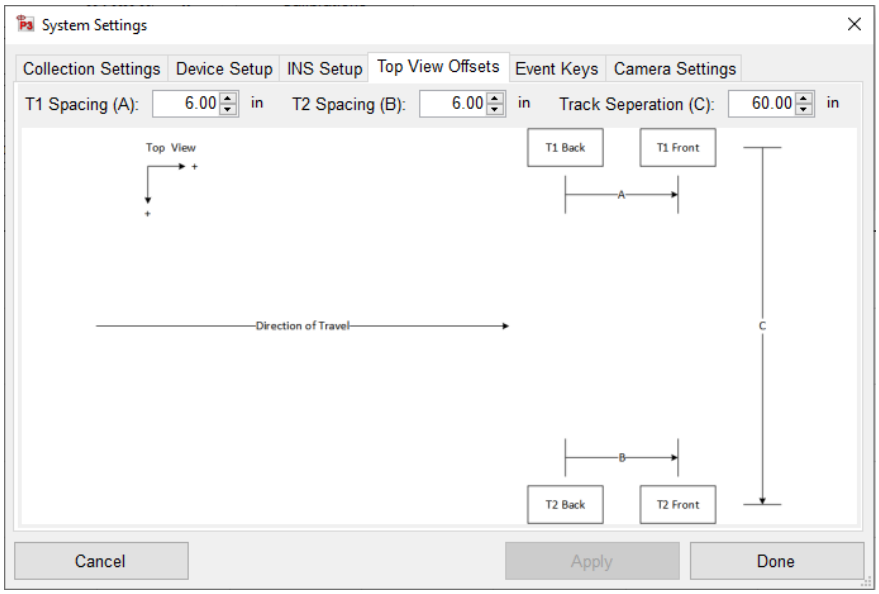


Figure 39. Top View Offsets tab in System Settings

(4) Make sure the Back to Front offsets between front and rear lasers are entered in the Device Setup. Also label where the accelerometer is mounted (Front or Back laser).

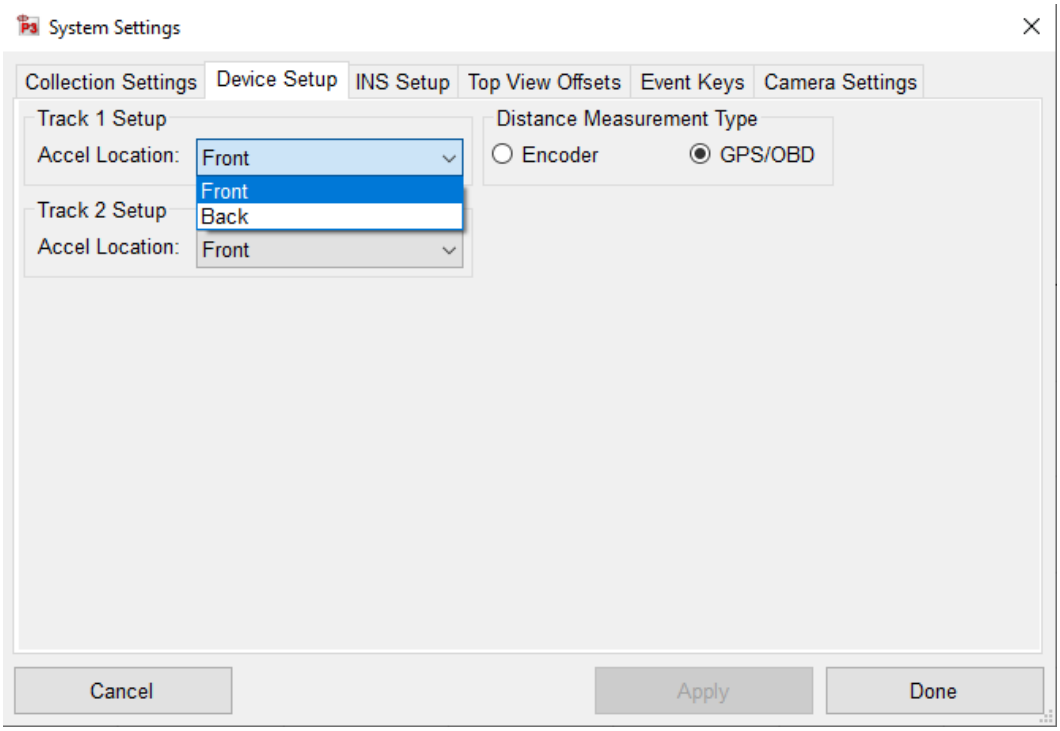


Figure 40. The Device Setup Tab in System Setting with Laser Spacing and entered and Accelerometer Location selected.

(5) Perform the accelerometer calibration prior to doing any longitudinal profile collection (Please see the 'Accelerometer Calibration' section of the manual).

(6) Obtain GPS in open sky and allow INS solution to get to "INS Solution Good". For single-antenna systems, this may require driving the system around until alignment process is completed. Driving in figure 8s helps for single-antenna solution.

(7) After you have "INS Solution Good", you can park the vehicle on a level surface and perform the level calibration. **IMPORTANT: ALWAYS PERFORM THE LEVEL CALIBRATION BEFORE THE CLOSED LOOP CALIBRATION (Step 10).**

(8) Proceed to calibrate distance (please the Distance Calibration section of the manual).

(9) The last calibration is the "closed Loop" calibration. **DO NOT PERFORM THE LEVEL CALIBRATION (Step 8) AFTER THE CLOSED LOOP CALIBRATION.** This calibration tunes the slope and pitch of the INS aligning it with the lasers. Make sure the INS status is "INS Solution Good" and then perform the calibration by collecting in one

direction, turning around, and then collecting in the opposite direction along the same exact lane. (Driver wheels where Passenger wheels were the first direction). To do this you will need a start cone at both ends of the track, but on opposite sides of the roadway. You will also need to know the exact distance between these two cones prior to starting the calibration.

a. At the end of this calibration you will be given a plot of the results. The operator can view the roll, pitch T1 and Pitch T2 profiles for the forward and reverse runs and make sure they are satisfactory before saving. It is good practice to do a second (or multiple) calibration(s) to verify yielding the same offsets.
b. **NOTE: DO NOT DO A LEVEL CALIBRATION AFTER THE CLOSED LOOP OR IT WILL DEGRADE YOUR "TUNED" CALIBRATION OF THE CLOSED LOOP.**

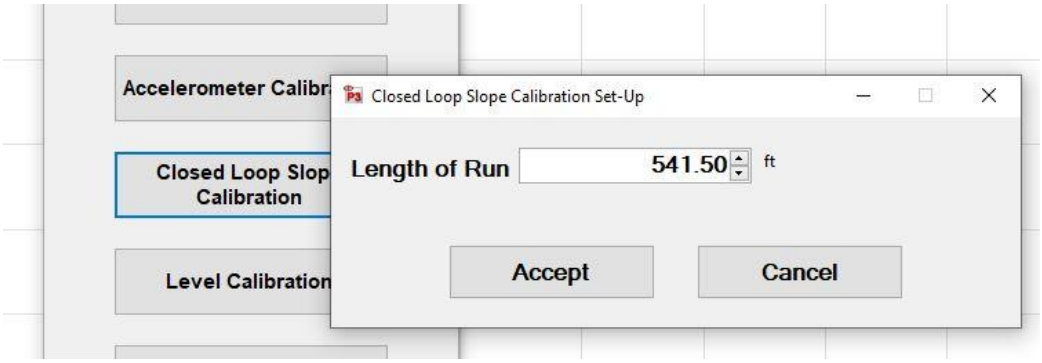


Figure 41. The Closed Loop Calibration Set-Up window

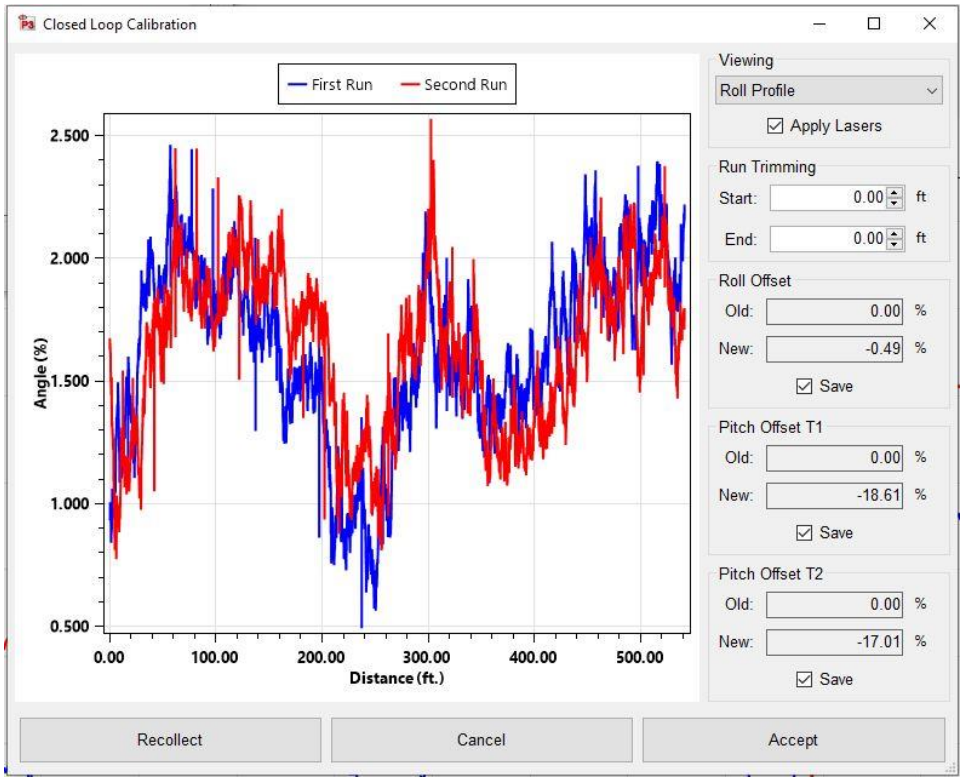


Figure 42. Roll Profile results window for the Closed Loop calibration

System Verification

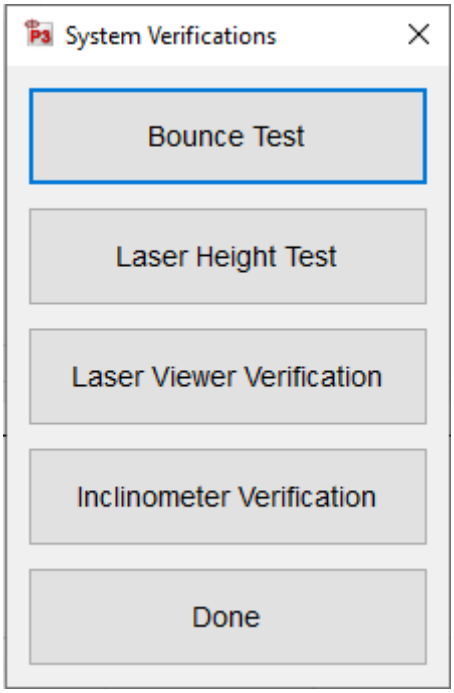


Figure 43: Verification Menu

The system verifications of the Profiler program for systems with 3 or more lasers are the bounce test, Laser height test, Laser View verification and the Inclinometer verification (For systems with 1 or 2 lasers there is only the Laser height test and the Bounce Tests). The bounce test checks the validity of the accelerometer calibration and the correct laser type. Depending on the values of the static and dynamic bounce tests, the health of the system can be determined. The height verification is used to diagnose potential problems with the lasers and the cables and/or if the correct laser type has been chosen. The verification will show if the lasers are connected incorrectly, or if the heights they are set to are outside of the recommended range (distance from the ground to the bottom of the laser). Another potential problem is the settings have the wrong laser type saved for the current system. See figure 29. The line lasers (Selcom 1145, Gocator 2342) should be 12 inches above the ground surface and their laser difference for the height verification should be less than one hundredths (0.01) of an inch. The dot lasers (Selcom SLS5000 325/400) should be 15 inches above the ground surface and have a measurement error of less than one hundredths (0.01) of an inch.
If the laser type is saved incorrectly, the laser height verification will be inaccurate. If the laser height verification ever fails, review the laser type.

Note: These procedures are *not* calibrations, only verifications

Laser Height Verification

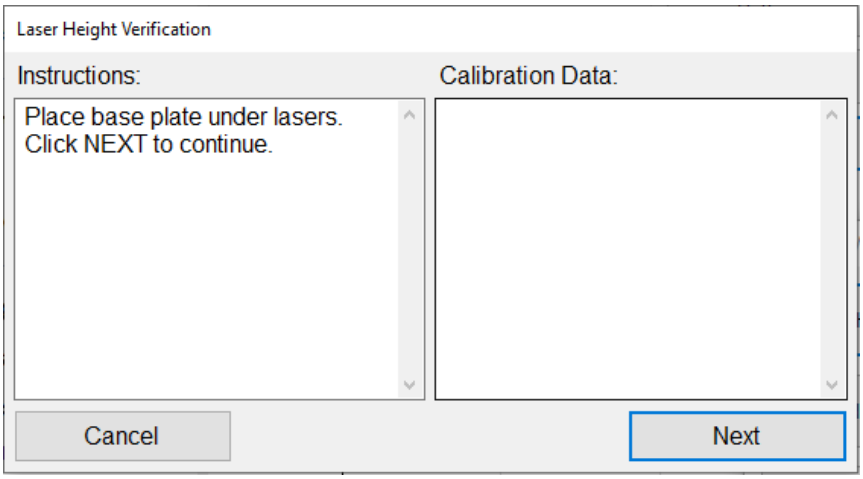


Figure 44: The initial step for a height verification

The height verification assures the operator that all of the lasers are working properly. The height verification is deemed a success when each individual laser deviates less than a hundredth (0.01) of an inch. The height verification will also determine if the laser types are correct. The laser types can be viewed under System Settings.
The first step of a height verification is to choose the location on the computer to save the height verification text file. Once chosen the program will ask the operator to place the base plate on the ground below the laser beam. ***Check that the base plate does not wobble and there is not a glare on the measurement blocks***. Once base plate is firmly on the ground, select next and start placing blocks according to the verification procedure.

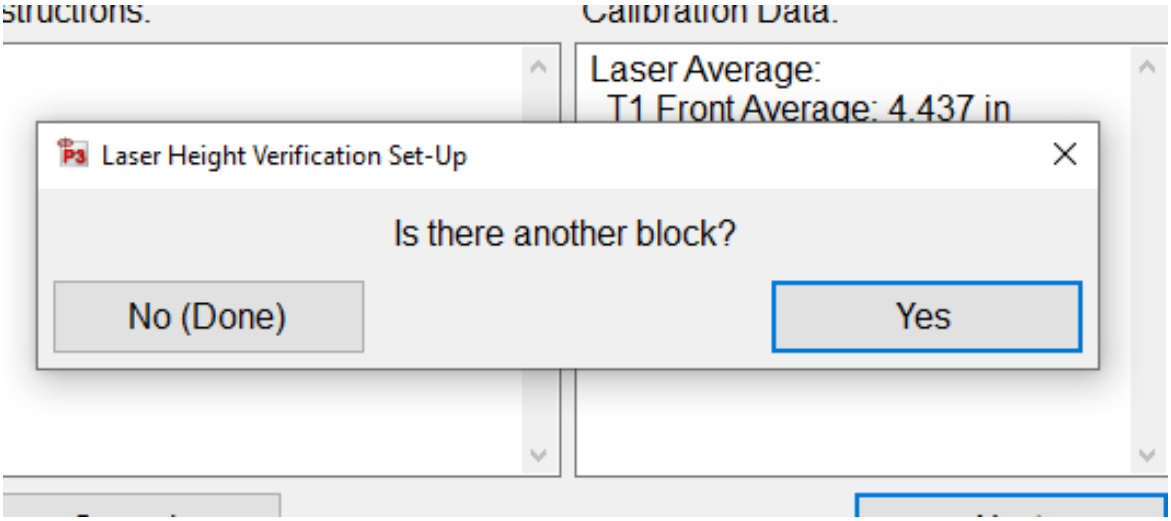


Figure 45: To continue height verification, select “Yes”

Once all of the blocks have been placed by following the procedure, select “No (Done)” to set the saving preferences in the next window. By shifting the bubble to “No” or “Yes”, choose the laser reading to save in the text file and if the user would like to view the report instantaneously.

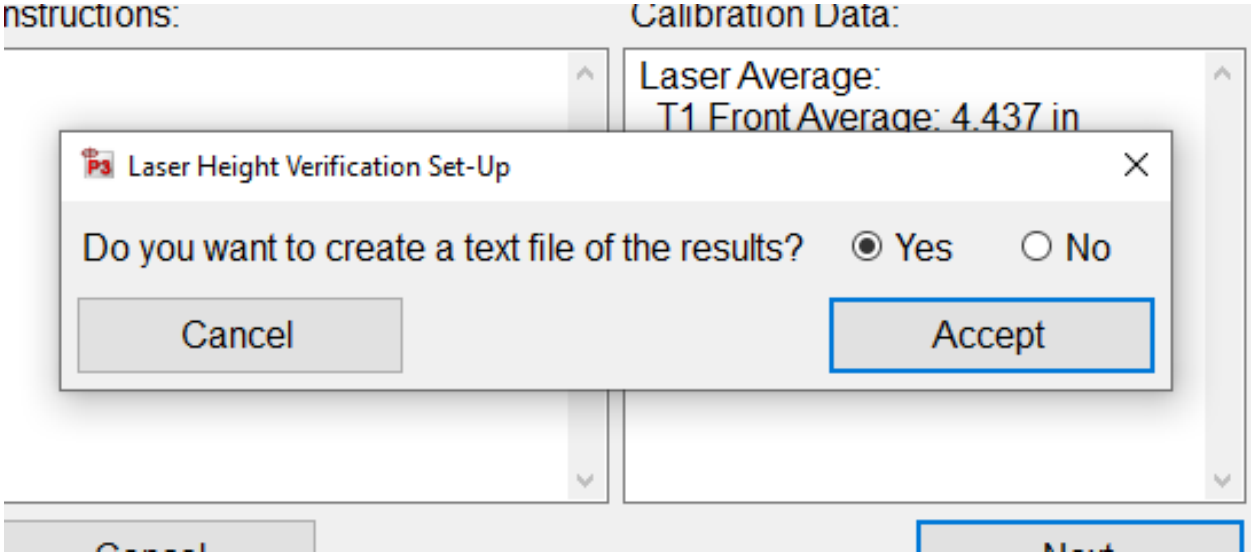


Figure 46: Saving Preferences after a Height Verification

After the laser verification the user will have the choice to save Laser 1, Laser 2, Laser 3 readings and to view the results instantaneously. Only choose the laser the height verification was performed under. If the results are viewed instantaneously a text file will appear showing all of the laser readings. The calculated height of the blocks will be displayed at the far right of the text file. These values must be within a hundredth on an inch (0.01”) according to AASHTO r57.

Bundling Multiple Height Verification Reports

If the operator is running two successive laser verifications they will have the option to add the results of the last verification to the current verification report. In this way there will be two or

three verification results in the text file. If bundled reports are not desired then select 'No' on this option. The Profiler V3 program will ask the operator to choose to bundle the height verification at the beginning of the second verification procedure. Select ´yes´ to bundle the files and ´no´ to keep the next verification as an individual file. This option will appear after the

When performing the height verification make sure the receiving sensor has an unrestricted view of the calibration block, as shown in the figure below. The high side of the calibration block should be outside the body of the laser, not below the middle of the laser (see image below).

Figure 47: The correct block Orientation for the Height Verification

Bounce Test

The bounce test is a diagnostic procedure used to determine if the system's accelerometers and height sensors are working in unison and calibrated correctly. The bounce test is not a calibration procedure and its results are not used to reset or adjust the profiling system. After the bounce test has finished, three data segments will be saved within a data file; two static and one dynamic bounce test. The results of the bounce test consist of an IRI value and detailed profile for each of the three tests. The IRI value is displayed at the end of the test, and the detailed trace can be viewed like any other data file in Profiler V3. A successful bounce test results in a completely flat profile trace and low IRI values. Industry standards and requirements vary as to whether a bounce test is required, and as to the results required from the test. For SSI's inertial profiling systems, static bounce test IRI values below 5 in/mi (78.9 mm/km) and dynamic results below 15 in/mi (236.7 mm/km) are within manufacturer's specifications for a properly functioning system. Some agencies follow AASHTO R057, which specifies a static bounce test IRI under 3 in/mile (47.35 mm/km) and a dynamic bounce test IRI under 8 in/mile (126.26 mm/km). The bounce test procedure is sensitive and must be properly performed for successful results.

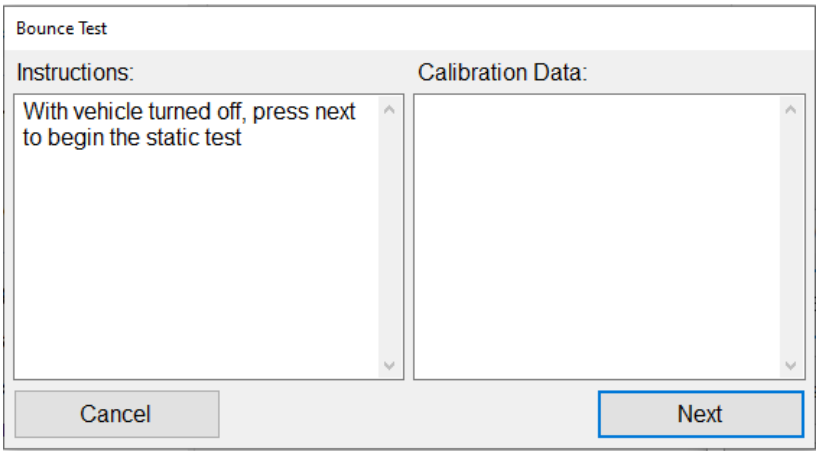


Figure 48: 1st window of bounce test. Do not move vehicle.

Procedure

Once a bounce test is initiated, the program will ask to name and save the file before the test begins. The static, dynamic, and again static data will be included in this file as Run 1, Run 2, and Run 3 respectively.

Verify before starting test that:

1) Only perform bounce test on a level surface, after accelerometers have been calibrated.
2) Vehicle's engine is off. No one is touching vehicle or inside. Out of wind. No movement.
3) Front tires are straight and in-line; Parking brake is off; No wheel chocks or other braces are to be used
4) A smooth, non-metallic surface is beneath the lasers (at the appropriate standoff)
5) The operator should introduce 1 inch (25.4 mm) of vertical travel at the laser modules

With the vehicle turned off, begin the static test. **Do not touch the vehicle at this time**. No movement should be introduced to the vehicle (Do not perform the static test in cross winds, with big machinery passing by or during an earthquake). For the dynamic test, introduce one inch of vertical travel into the vehicle's suspension at a frequency between 1.25 Hz (which is a bounce every 0.8 seconds) to 2.5 Hz (which is a bounce every 0.4 seconds). Do not dramatically impact, or jolt the vehicle suspension. Use only fluid movement (it can be done pushing down on the main system mount). Only introduce vertical motion into the vehicle suspension during the dynamic portion bounce test. No lateral or side-to-side vehicle motion should be introduced. Make sure the wheels are in a straight line. Allow the vehicle to sit motionless for the final static test.
Press the NEXT button in figure 47. A window will appear indicating the preparation of the static test and will give a 10 second count down before it starts. After the countdown another window will open indicating the test is in process and the percentage of the test completed. See figure below.

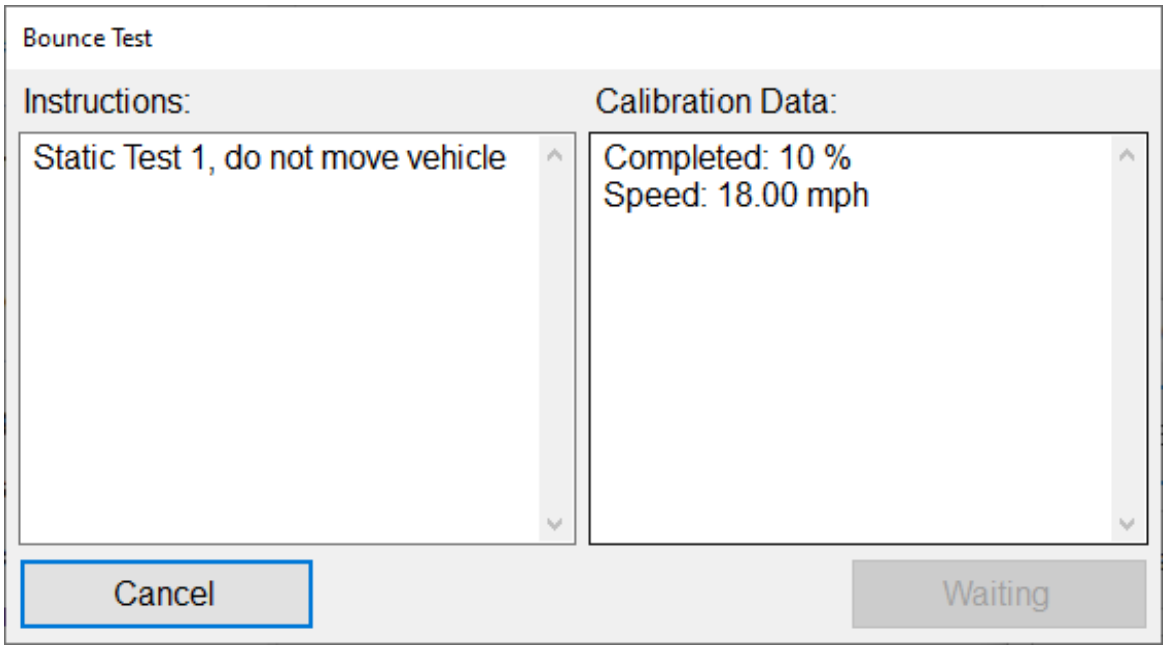


Figure 49: The static test being performed

After finishing the Static bounces test, the window will automatically show the results. Press next to continue to the dynamic part of the bounce test. Again, there will be a 10 second count down.

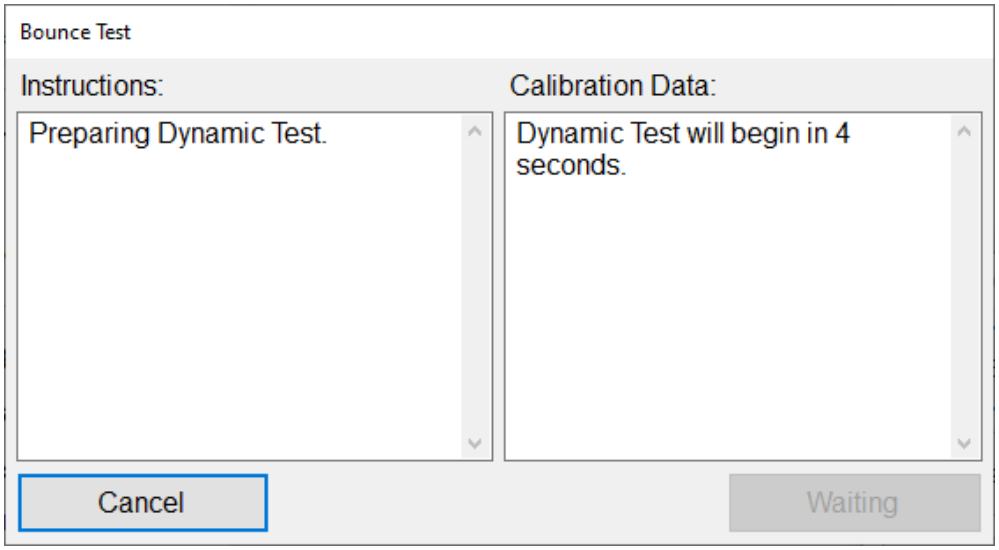


Figure 50: The beginning of the Dynamic Bounce Test

Figure 51. The next 2 windows of the bounce test. Follow the instructions

Introduce vertical movement (about 1 inch) by pushing down on vehicle once per second until the Stop window appears. The data will be processed, and the final window will show the results. See figure below. Press NEXT and the routine will execute one more static test before finishing.

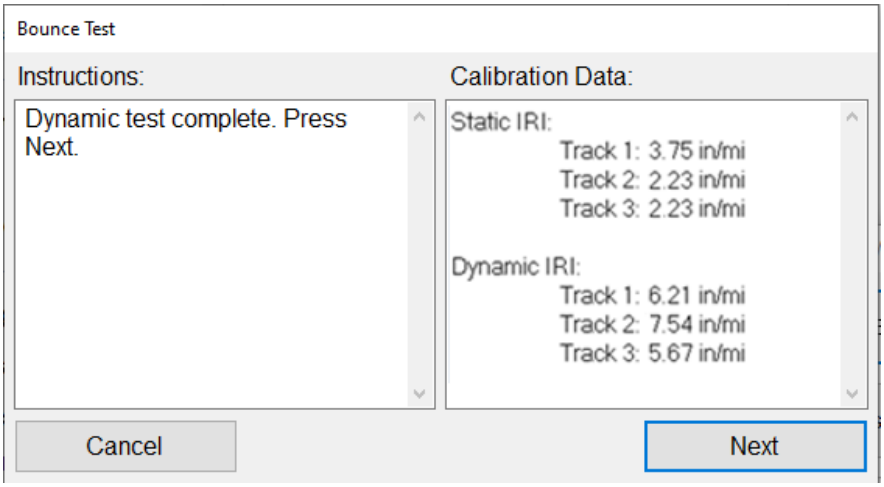


Figure 52: The dynamic test is performed by bouncing the vehicle vertically

Bounce Test Verification Graph

After performing a bounce test, the operator will be able to view a Laser vs Accelerometer data graph by using SSI's Validation Engine (open the bounce test rsd file and use Raw Data Viewer. An ideal bounce test will appear as figure 52 below showing the laser data as an approximate opposite of the accel data. The Combined trace in the graph shows how both the Laser and Accelerometer traces should mostly cancel each other out. Variations from the figure below from either the Laser or the Accelerometer trace will indicate a possible fault with the sensor. Remember to calibrate accelerometers, make sure the lasers are at the correct height and have no obstruction at the lens (they must be out of the light and on a non-shiny surface) and avoid any movement of the vehicle (it must be out of the wind, nobody inside, etc. for the bounce test).

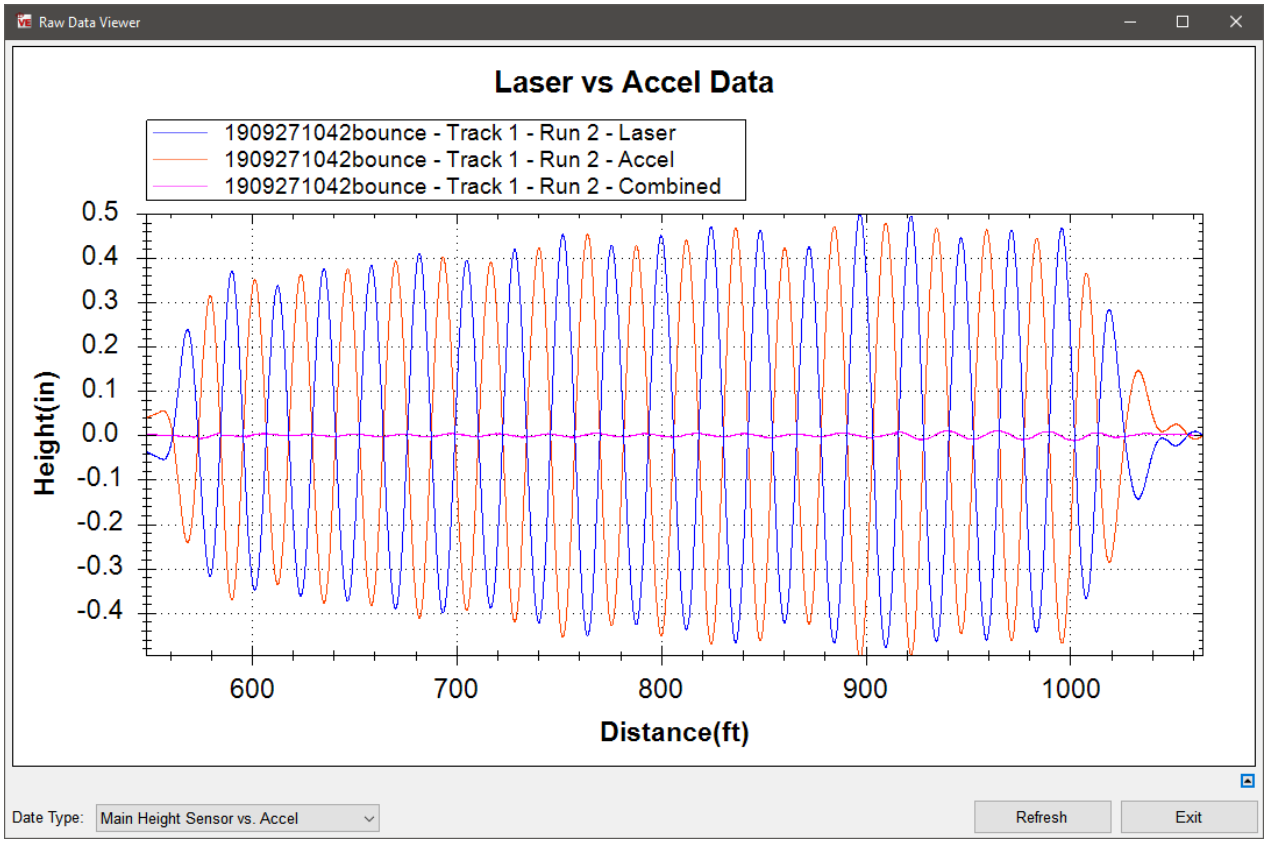


Figure 53. Bounce test Laser vs Accelerometer data graph

Inclinometer Verification

For older systems with Cross-Bow inclinometers, when IMU/Inclinometer Type is set to "inertial inclinometer" in System Settings/Sensor Setting tab, the inclinometers can have their outputs verified by using the mounting block. Enter the block angle when prompted by the program. The block angle is supplied with the system and can be found on the label attached to the grey box cover within the white housing. Follow the instructions prompted on the screen. For detailed help, contact support@smoothroad.com

Collect

The optimal speed of collection is ***20+ miles per hour***. Accelerometers are most accurate within 20-55 miles per hour for high speed profilers and trailers. Height data cannot be collected if the vehicle is traveling slower than 5 miles per hour (except for SSI´s Zero-Speed systems).

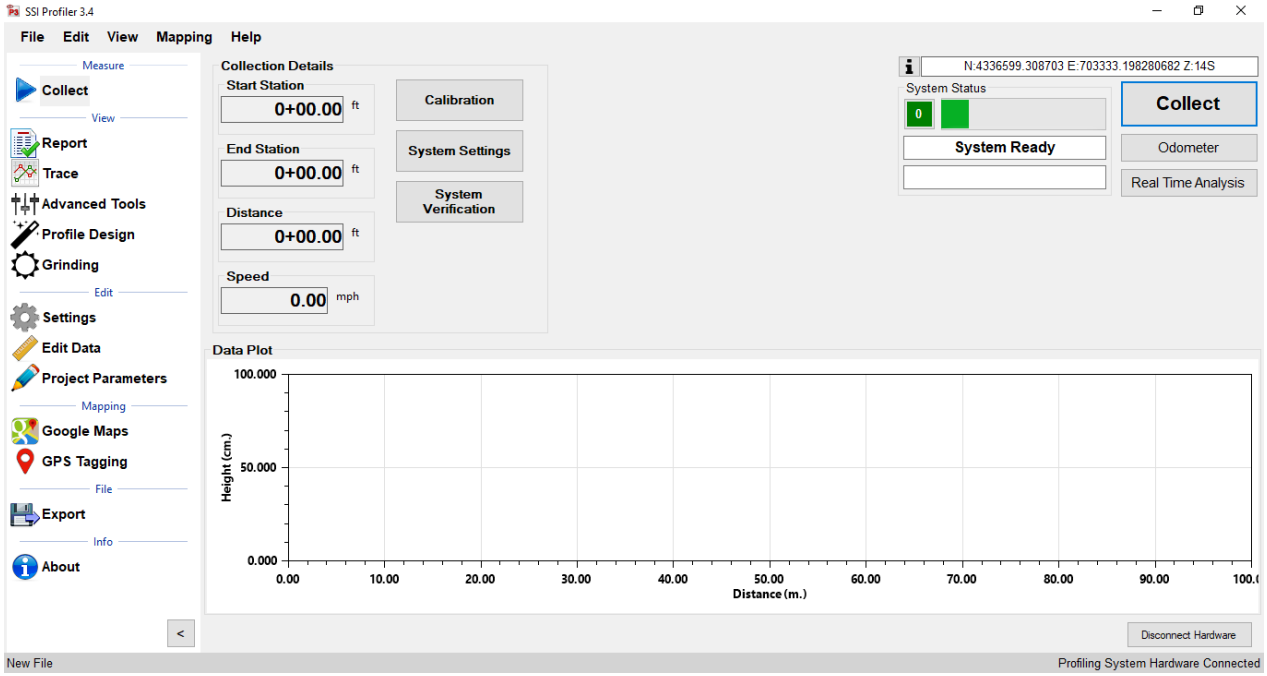


Figure 54: The main collection window.

System Status

The systems status icon (the colored box with a number inside) is used as a diagnostics tool for Profiler V3 collection systems. This window detects connection problems with the housing and electronics. SSI support staff may ask the diagnostic string (health string) while troubleshooting. ***The type of lasers connected should be shown correct automatically based on the type of system connected.*** Select the diagnostic information button at the top right of the window to better understand the purpose and meaning of the health string.

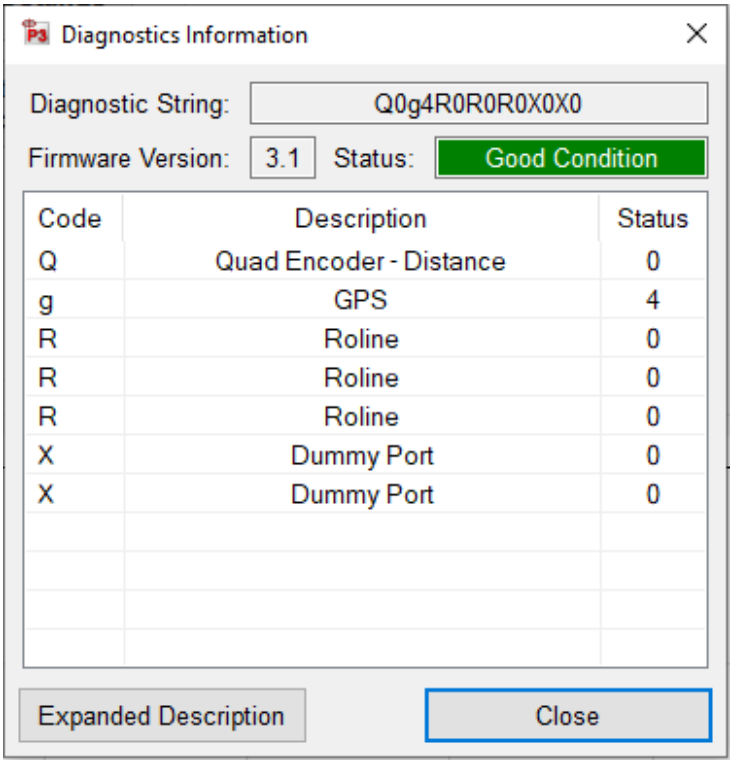


Figure 55: The System Diagnostics

Pre-Collection Information

The Pre-Collection Information window appears when the Collect button is selected (see figure 53 above). The most important information is the Start Station and Station Direction. The "Station Direction" is the direction of travel of the profiler (up station or down station, and stationing will ascend or descend accordingly). It is important that the direction is correct. Stationing can be changed at a later date if the direction of travel was incorrectly entered. Click on unit icon to change units. The Run Up and Run Out length is the minimum distance traveled before/after a collection. The buffer length is an excluded section before and after a collection.

When this window is open, the profiling vehicle should be in a position near to the beginning of the collection track. As soon as the operator selects the ´Begin´ button, the collection will be ready to start. If the operator plans to use the 'Back up/accelerate' collection option, the lasers should already be lined up with start station. If the collection will be started using ***Starting Forward*** or through the electric eye, "Begin" can be selected a reasonable distance before the actual start of the collection is to take place (More on the different ways to start a collection below). The Automatic End feature allows the operator to automatically end a collection after a certain distance or station has been reached.

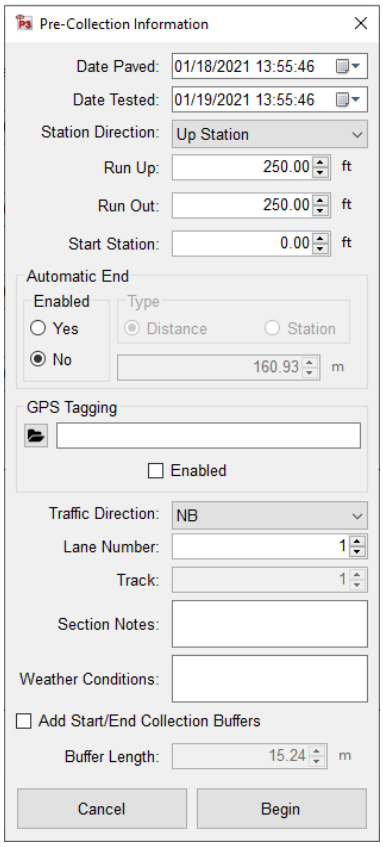


Figure 56. The Pre-Collection window

Collecting Data

The optimal speed of collection is ***20+ mph***. The accelerometers are most accurate within the range of 20 to 55 mph for the high-speed profilers and trailers. Height data is not collected if the vehicle is traveling slower than 5 miles per hour (except Zero-Speed systems).

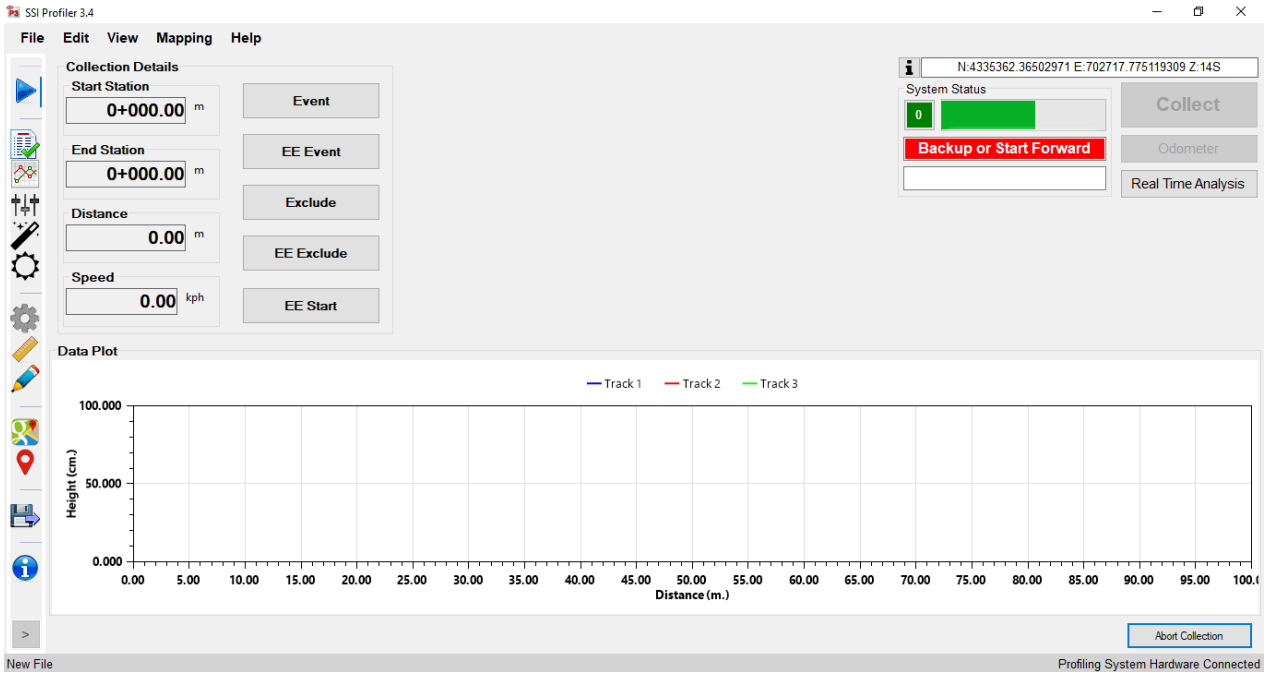


Figure 57: The collection screen after "Begin" was selected

The Three Ways to Start a Collection

The operator can travel forward or backward once a collection is started. If the operator accelerates forward the Run-up procedure will be used with or without an electric eye. If the operator moves in reverse, the back-up collection procedure will be used. Both of these procedures can use the electric eye to end the collection. The benefit of using Run-up is that traffic will not be stalled while the operator begins a collection. The forward motion Run-up option can be started on a shoulder or at a large distance from start point (a large run-up distance).
If the operator uses the back-up option, the vehicle must begin over the starting point and then move in reverse. Back up until the program instructs the operator to accelerate. The collection will begin when the initial point is crossed. Tires must not slip on acceleration.

1) Starting a Collection: Run-up

After "Begin" is selected from the collection information window the vehicle may move forward. Once the vehicle is moving forward over 5 miles per hour and the run-up distance is completed, the collection can be started through an electric eye, selecting the start icon, or selecting a programmed hot key. The collection can be ended by selecting the stop icon or using the electric eye. The stop icon will replace the start icon once the collection has been initiated.
The electric eye is used by arming the eye after "Begin" is selected. Once the electric eye triggers the start of the collection, a new icon appears giving the operator the option to end the collection by using the electric eye. These buttons are labeled "Start EE" and "Stop EE".

2) Starting a Collection: Back up and Accelerate

After selecting "Begin" from the collection information window and the operator has the beams of the lasers over the starting point, the vehicle can be moved in reverse. The status bar will display "Back up or start forward" in a red fill, then "Backing up" as soon as the vehicle starts backward motion. The reverse distance will be measured by the profiling system. After 25 feet, the status bar will display "Accelerate". The operator should accelerate forward along the same path to reach a speed over 5 miles per hour. When the minimum speed and the run-up length has been achieved, the status bar will display "Self-Start" and the collection will begin automatically when the odometer reaches zero.

Note: The path traveled in reverse should be the same path the vehicle makes when moving forward. If the paths are different, the collection's starting point will differ from the initial point the lasers were aligned to.

The collection can be ended by selecting the Stop icon within the main window as the vehicle is moving. The collection can also be stopped by using an electric eye. To use the electric eye, select "Arm EE Stop" and the Profiler program will wait for the EE to be triggered before ending the collection. To trigger the EE properly and consistently, use the recommended DOT-C2 reflective tape and mount it near the path of the vehicle in clear view of the EE sensor. It is recommended to place the reflective tape within 10 feet of the electric eye and at the correct elevation of the sensor's beam.

3) Starting a Collection Using the Electric Eye

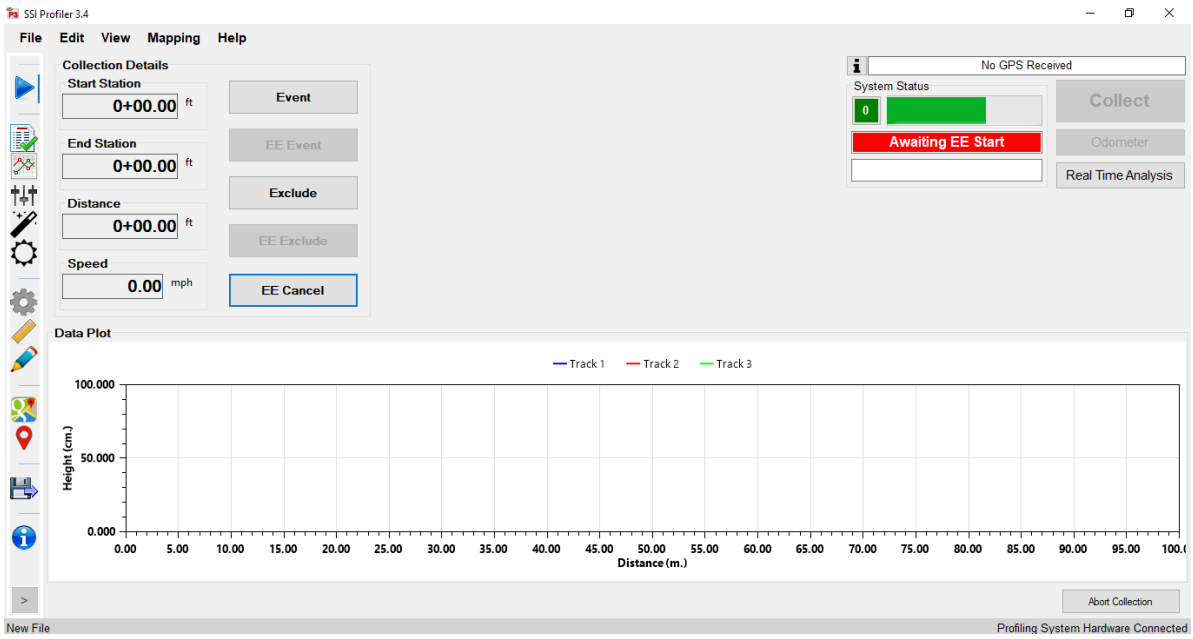


Figure 58: The Electric Eye (EE) is armed to start the collection

The electric eye can be used to start and/or end a collection or end the Run-up and Bach-up collections. The recommended reflective tape to use with the EE supplied by S.S.I. is the DOT-C2 grade tape. Contact SSI for supply information. The electric eye tape can be mounted on a cone or a stationing marker, as long as it is in reach of the EE sensor which has an optimal range of six feet. Sick EE's can sense the reflective tape 18 feet away. The closer the reflective tape is to the EE sensor, the more consistent the starting and ending of collections will be. If the reflective tape is too far from the EE, the sensor may not activate.

Most profiling systems have each side equipped with an electric eye. On the white housing there is a two-way switch with a label of left and right. The left side is the driver's side electric eye. To determine if an electric eye is on, look for the amber light on the top side of the electric eye near the outgoing cable. The diagnostic will also inform the user that the electric eye is attached. The diagnostic will not inform the user which side the vehicle the electric eye is powered on.

Use DOT-C2 grade reflective tape for the electric eye collections. The reflective tape can be mounted on a stationing marker or on a cone for repetitive use. Sick EE's can sense the tape 18 feet away. Other brand EE's should be placed 6 feet away to function.

Ending Collections

1) By Electric Eye

To end a collection using the electric eye, arm the electric eye after the collection has been started by selecting the Arm EE Stop icon on the screen or through a hot key. When the electric eye sensor detects a reflective surface, the collection will be ended and run out will be collected

2) Through the Stop Icon

The collection can be ended by the operator selecting the Stop and Save icon with a left click of the mouse. This option is not as precise as using an electric eye or backing up to end the collection, but it is more efficient when collection multiple runs of data with a loose tolerance and is sometimes necessary when collecting without traffic control.

3) Speed Drop Out and Backing Up – "Save"

When a speed drop out occurs (when the vehicle is moving less than 5 miles per hour) the operator has the option to back up and save the data. This option of ending a collection is an accurate alternative of completing a collection. The operator can just back up to the desired ending location. All of the surface data that was collected when moving forward is omitted while moving backward over the same surface. This creates profiles of the same length which are convenient when comparing the profiles to a reference file.

Aborting Collection

The collection can be aborted at any time before the file is saved. The abort icon is displayed at the bottom right of the Collect window. When a collection is not in progress the abort collection icon is the disconnect hardware icon.

Stopping a Collection

A collection can be ended using the **electric eye**, **selecting Stop Collection**, or **stopping the vehicle and backing up to the end point, then hitting Save**. If accurate end points are needed in a lane closure, it is recommended to use the electric eye or stop and back up option. If operating in traffic at highway speeds where stopping is not an option, use the electric eye end collection, select the stop collection icon on the screen, or select a user programmed hot key. When using the stop collection icon the distance collected may be off of your desired stop station. Post analysis can fix this through the Edit Data feature and crop data tool or the GPS tagging tool in the Trace window.

Saving the Collection

When a run is finished Profiler V3 will open a window automatically asking the operator to save the file. The three options are to **Save as New File**, **Save File**, and **Do Not Save File**. If the file will be saved, windows explorer will open and the operator will be allowed to save the file to any folder location on the computer or external device. If the operator selects do not save, the collected data is still in the program until a new file is opened or the program is closed. If there is any unsaved data when the program is closed, Profiler V3 will ask the operator to save their changes. It is always possible to save the data by selecting File>Save or selecting Ctrl+S on the keyboard. ***To always save a run in a separate file choose Save as New. This is recommended for multiple runs and simple post-processing.***

Changing Units of Plot

To change the units, click on the current units and select from the menu.

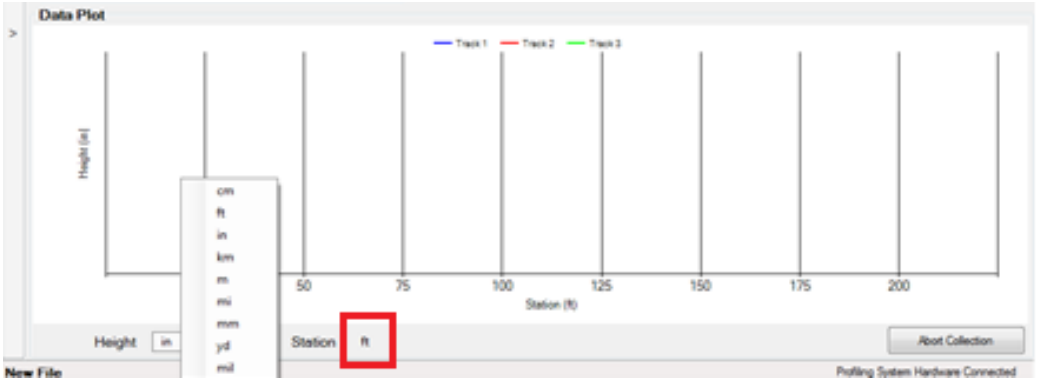


Figure 59. Clic on units icon for the dropdown menu to appear

Post-Collection

Reporting

File Tab

New

Selecting New creates a new project file to be saved on the operator's computer or external device. The file will open automatically and the bottom left corner of the program will display "New File." If data has been collected with this file, the name will be displayed with as asterisk as "New File*."

Open

Opens a project file previously saved on the operating computer or connected external device. Profiler V3 creates RSD type files. The RHD file type from the previous version of Profiler can also be opened Profiler V3. If your file is in another format, use the appropriate translators found on the support website or contact S.S.I. Customer Support. The only two file formats used in the Profiler V3 program are RHD and RSD. Profiler V3 only collects data in the ***RSD*** format. (http://www.smoothroad.com/support/download.asp)

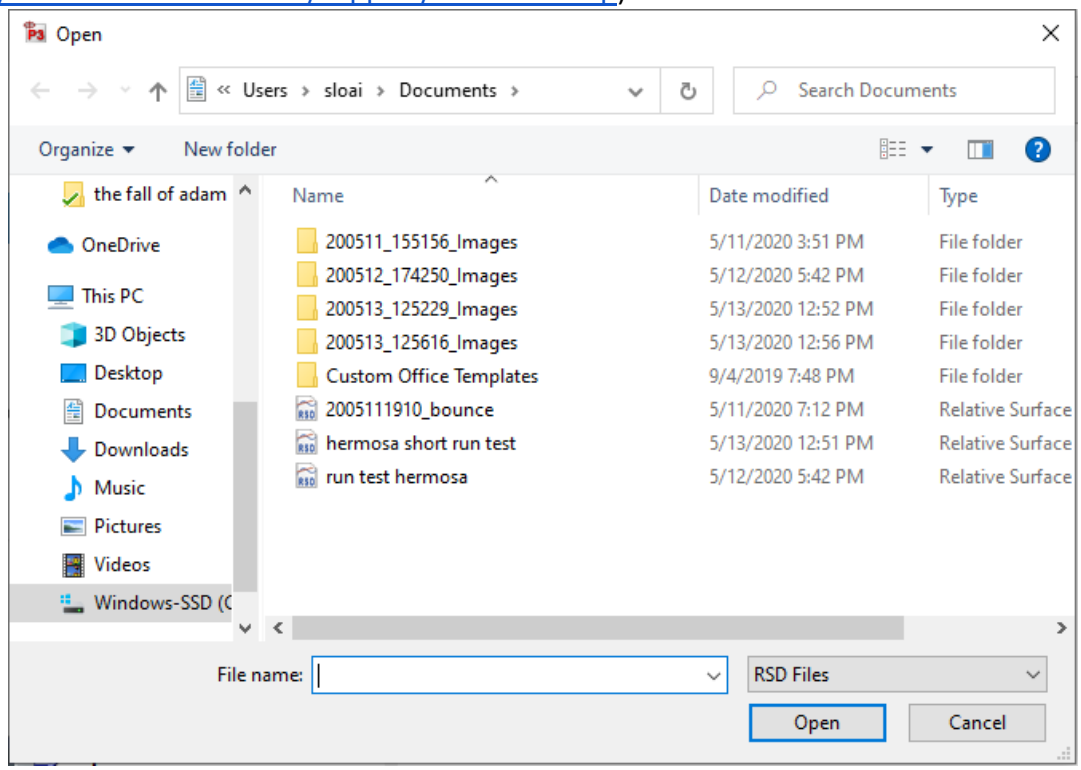


Figure 60: Opening a data file in the Profiler V3 program

Open Recent

Opens recently viewed or created project files. Files will only be available if they are saved on the operating computer or connected external device. The Open Recent feature is a shortcut to find current profiling data. It is also possible to use the File>Open tool to open saved data. The only two file formats used in the Profiler V3 program are RHD and RSD. Files can only be saved in RSD. The default file to be searched for in Window's Explorer can be changed under General Settings and the "Default File Type."

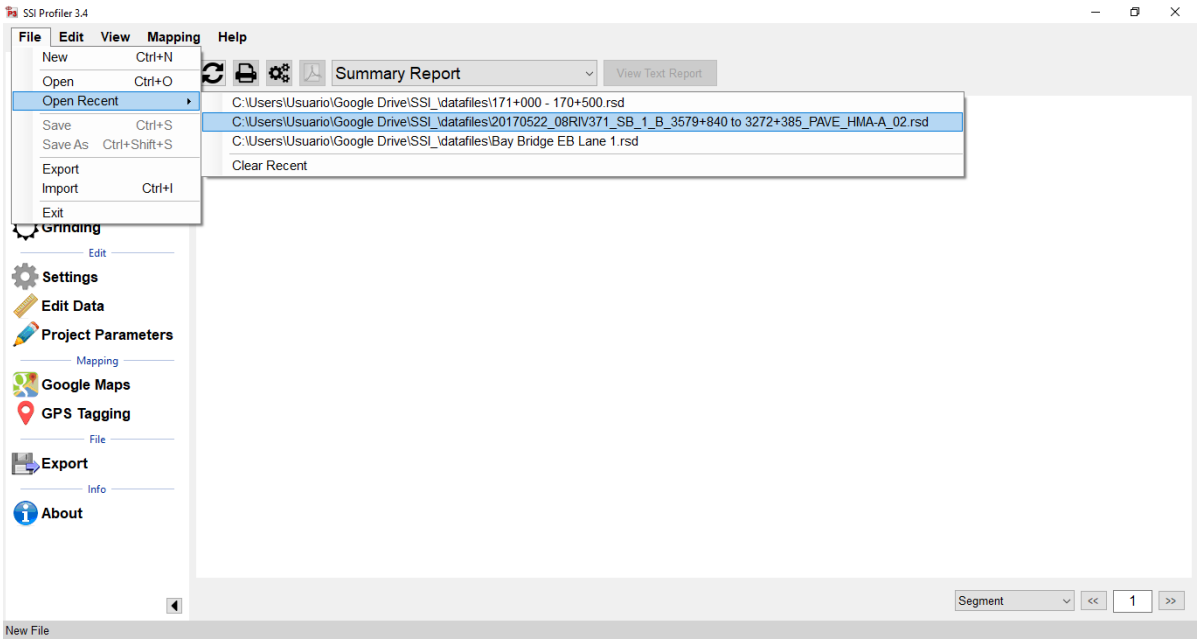


Figure 61: The Open Recent feature

Clear Recent

Clear Recent deletes the history of previously viewed RHD and RSD files. Once the history is cleared it cannot be reversed. The operator must navigate to File>Open to view saved files.

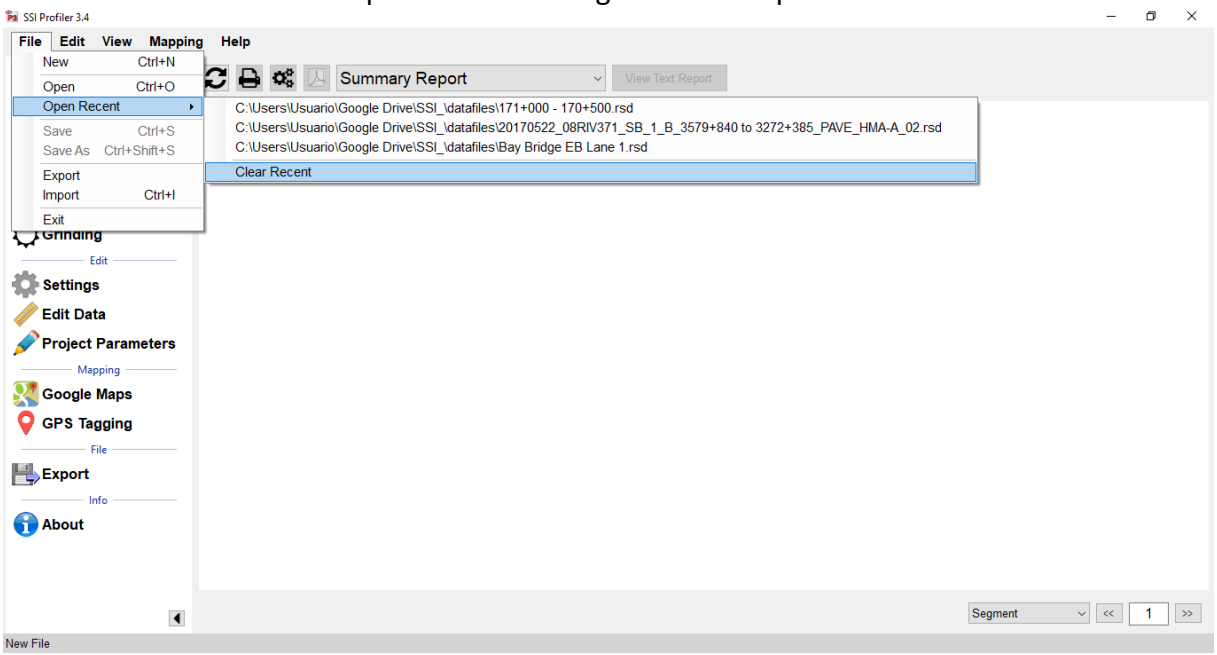


Figure 62: The clear recent feature

Save

Save allows the operator to save the current file in RSD format on the operating computer or connected external device. If ‘Save’ is selected while an unsaved file is open, the operator will be prompted to choose a file name and folder destination to save the current file. The file will be saved in SSI´s patented RSD format. If another format is required, visit the SSI support website

(http://www.smoothroad.com/support/download.asp) to download the latest translators or contact SSI Customer Support.

Save As

When Save As is selected, the operator will be prompted to choose a file name and folder destination in which to save the current file. The file will be saved in SSI´s patented RSD format. If another format is required, visit the SSI support website (http://www.smoothroad.com/support/download.asp) to download the latest translators or contact SSI Customer Support. ***Note: Save and Save As are only available after data has been collected or if changes are made to preexisting file.***

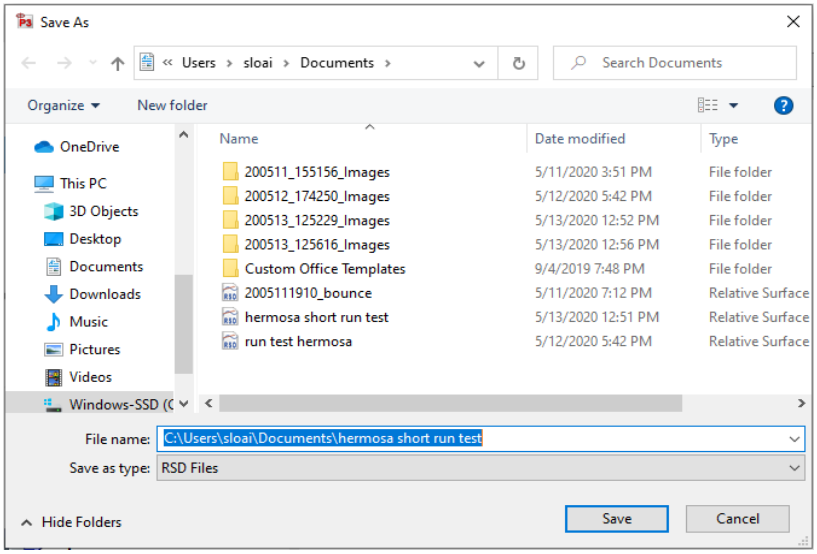


Figure 63: Saving a file through Save As in RSD format

Exporting

Exporting allows the operator to create files in **ERD, PPF, PRO, Survey, GPS Matching, and Excel** formats. The settings for each export feature are described below. For each of the exporting formats, a folder destination is required. The Export feature can be found in the shortcut bar on the left hand side of the Profiler V3 window and in File>Export.

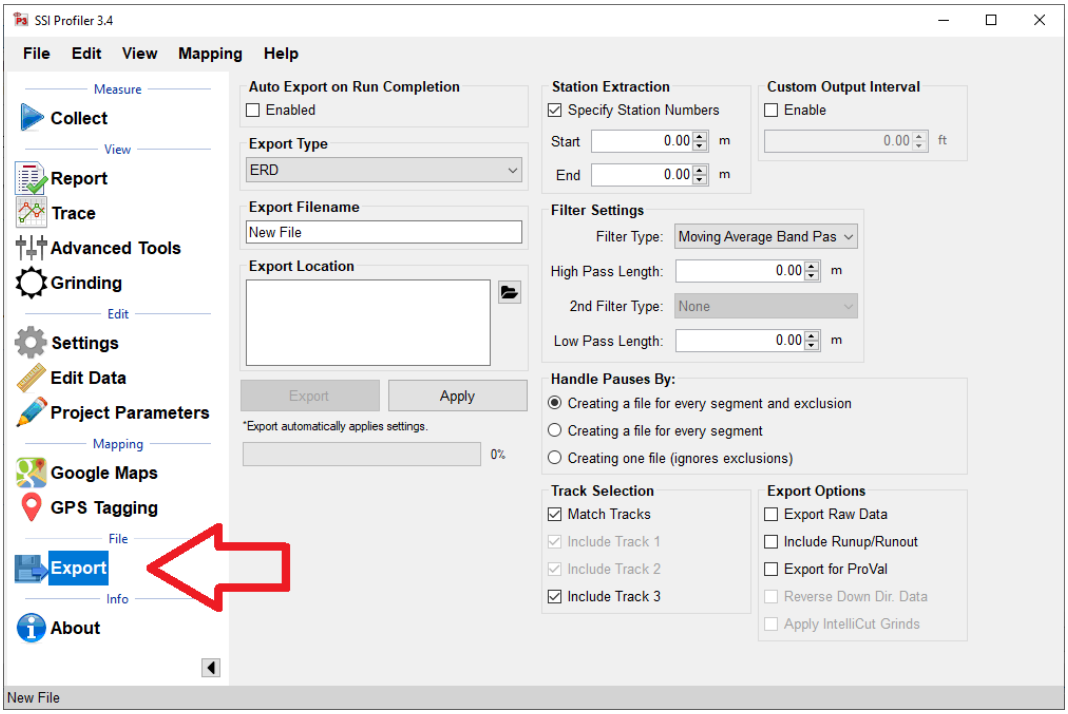


Figure 64: Window for exporting the data into Excel format

Export Location

To select the folder destination, select 'Browse' and navigate through Windows Explorer to the desired folder. Once the folder destination is reached and selected, left click on 'OK' at the bottom of the window to save the folder location.

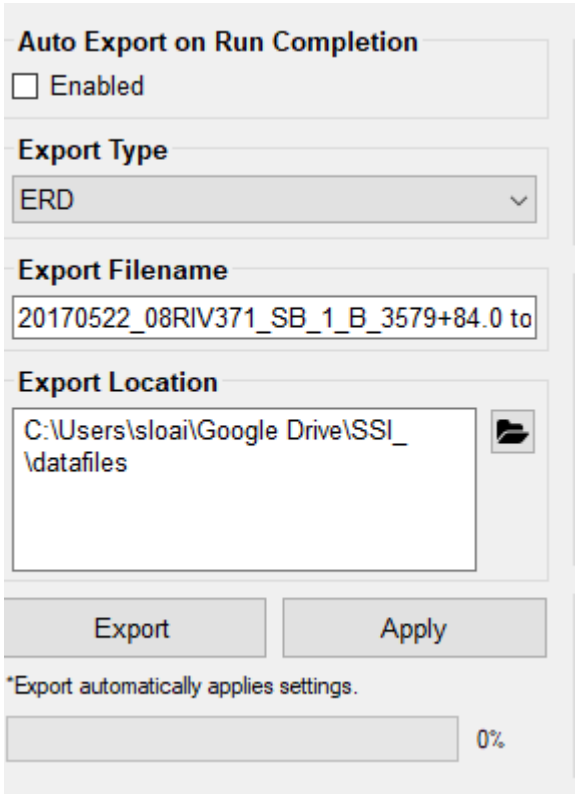


Figure 65. Select location to save the exported file

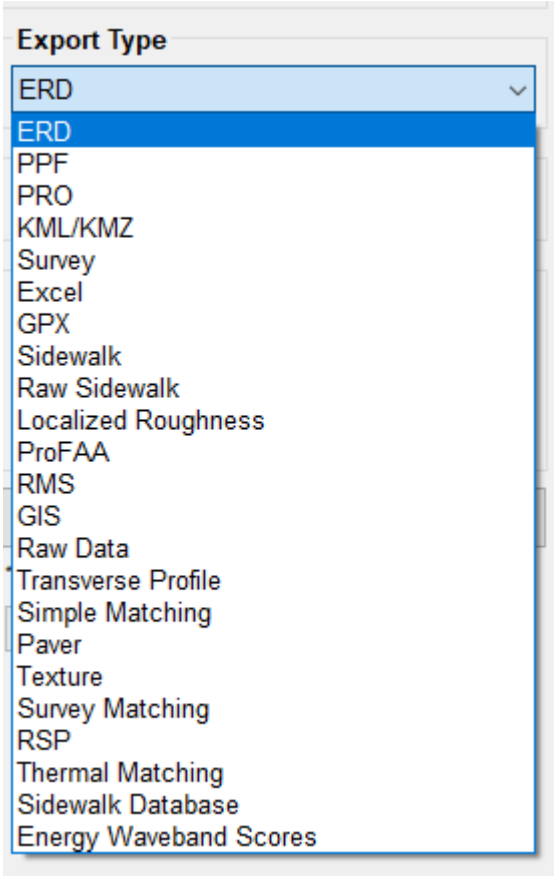


Figure 66. The export type drop down menu

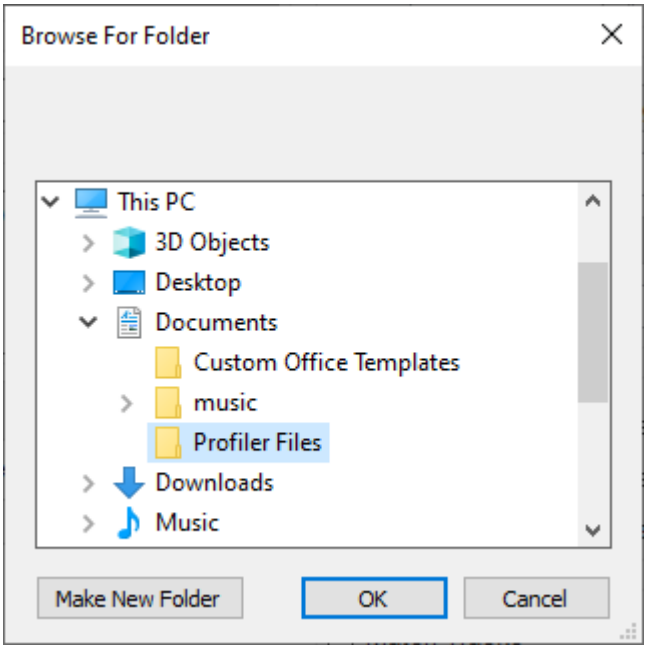


Figure 67. The export folder location selection after pressing the Icon in figure 60

Exporting to ERD Format

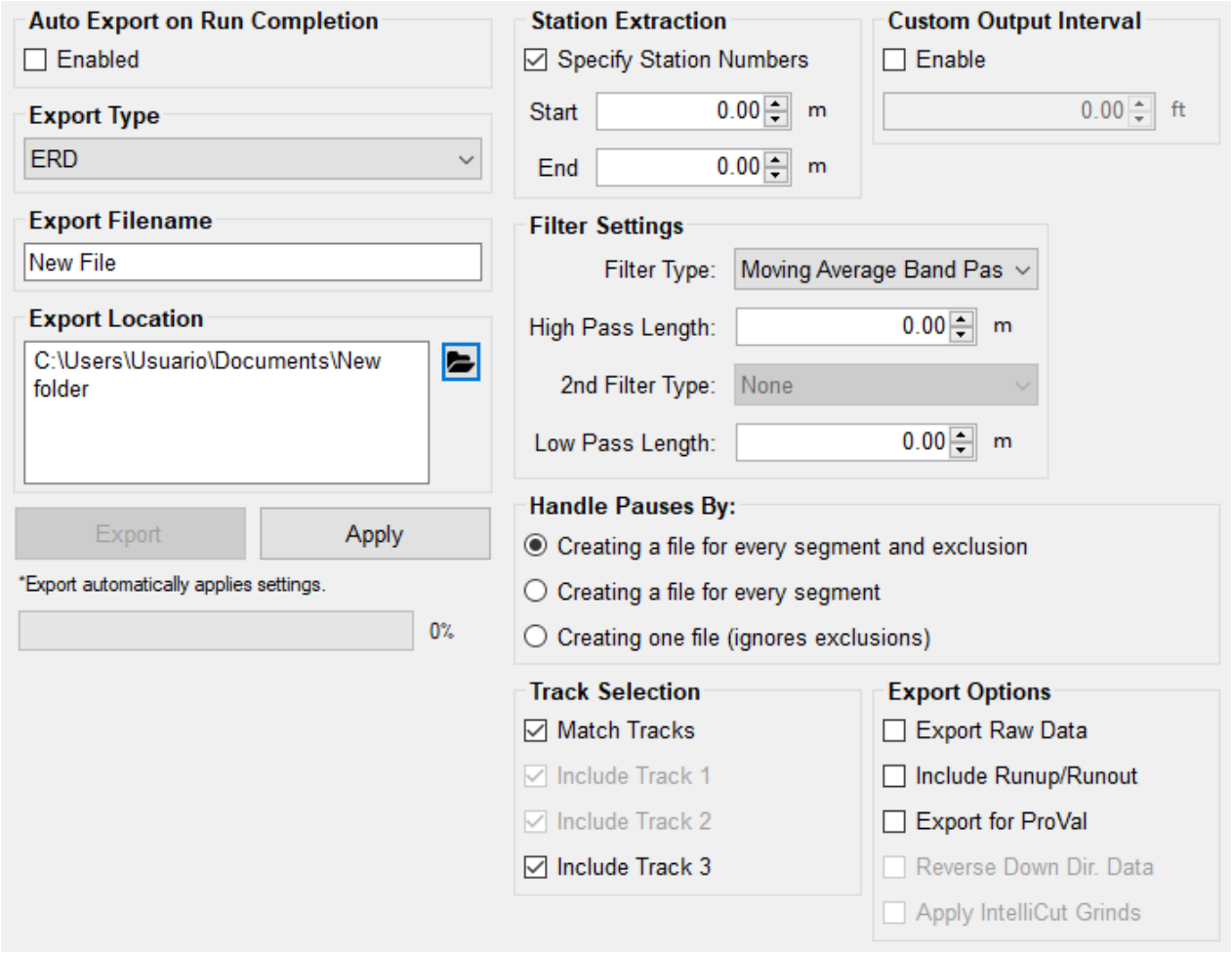


Figure 68. The ERD format export window with match tracks selected

Station Extraction

The operator has the option export only certain sections of the data, based on the stationing set within the profiling data. To use this feature, select the check box near "Specify Station Numbers." When the box is selected, the operator will be able to adjust the stationing numbers. The 'Start' stationing is the initial stationing where the exported file will begin, while the 'End' stationing is the point where the exported file will finish. These values can be adjusted by typing values into the box or by using the arrow keys to the right of the box.

Filter Settings—High & Low Pass length

The exported data file can have additional filters applied while being processed into the chosen format. To not filter the data, leave the filter lengths at the default value of 0.00 feet.

Moving Average High Pass Filter

A high pass filter will remove any trend that is shorter than the selected length. Typical range of length for this filter is one hundred feet (100 ft.) through two hundred feet (200 ft.).

Moving Average Band Pass Filter

This filter only allows the desired frequency of data to be shown. Adding this filter will adapt the profile trace to remove the high frequency motions. Moving average filters are typically used for short data runs less than two hundred feet (200 ft.).

Butterworth High Pass Filter

High pass filters allow the high frequency characteristics of the data plot to pass through while blocking the lower frequency attributes of the data run. Butterworth filters do not introduce a phase shift into the plot like moving average filters. Butterworth filters are traditionally used for longer data runs over two hundred feet.

Butterworth Band Pass Filter

This filter will perform both a high pass and low pass Butterworth filter operation on the data. The result is a run that has frequencies within the lower and upper bounds. Butterworth filters do not introduce a phase shift into the plot like moving average filters. Butterworth filters are traditionally used for longer data runs over two hundred feet.

Include Run-up – Run-up Data

Some High-Speed Profiling data files have Run-up and/or Run out data associated with them, depending on the practice used to collect the data. If this data exists in the data file, it will be included in the exported file if this box is selected. Run Up and Run out is used to allow the electronics to settle on the accurate profile.

Run Up data exists in HSP data files if the operator selected a Run Up and/or Run out distance in the initial stages of setting up a collection. In the HSP collection software, the Run Up and Run out settings are found on the last window before performing a collection. Use run up and run out to stabilize the electronics before the starting location is reached.

Export Raw Data

Selecting the Export Raw Data check box assures the operator that only unfiltered data collected from the profile will be exported into the chosen file.

Match Tracks and Choosing Tracks

Match Tracks

Selecting 'Match Tracks' exports all of the tracks associated with the lane file. For the three laser systems, this includes Track 1, 2 and the center trace. For Profilograph files, the tracks are matched based on the settings entered prior to profiling. The label of the track number and stationing cannot be changed after collection.

Choosing Tracks

The tracks that are exported are checked under "Track Selection." If Match Tracks is selected the user cannot deselect track 1 or 2.

Include Run Up/ Run out

When this option is selected, the Run Up and Run out data collected during the collection will be included in the export data.

Export for ProVal

When the user exports an ERD file for use in ProVal, it changes the file's default filters and settings to more accurately match the values in ProVal.

Exporting to PPF Format

Station Extraction

The operator has the option to export only certain sections of the data, based on the stationing set within the profiling data. To use this feature, select the check box near "Specify Station Numbers." When the box is selected, the operator will be able to adjust the stationing numbers. The 'Start' stationing is the initial stationing where the exported file will begin, while the 'End' stationing is the point where the exported file will finish. The start and end stationing can be adjusted by typing values into the box or by using the arrow keys to the right of the box.

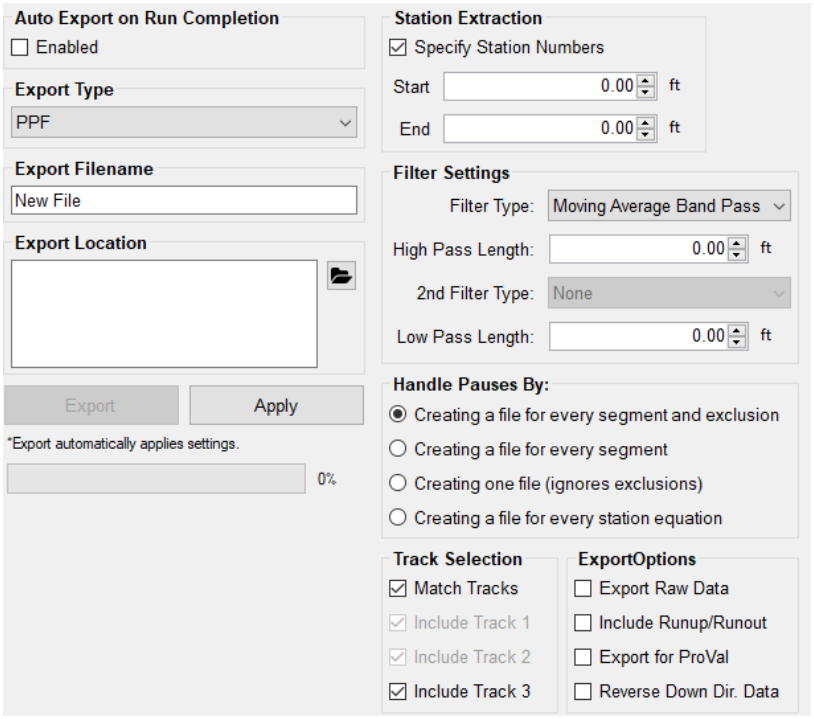


Figure 69: The PPF export window

Filter Settings—High & Low Pass Length

The exported data file can have an additional filter applied while being processed into the chosen format. To not filter the data, leave the filter lengths at the default value of 0.00 feet.

Available Filters:

Moving Average High Pass Filter
Moving Average Band Pass Filter
Butterworth High Pass Filter
Butterworth Band Pass Filter

Include Run Up and/or Run out Data

Some High-Speed Profiling data files have Run Up and/or Run out data associated with them, depending on the practice used to collect the data. If this data exists in the data file, it will be included in the exported file if this box is selected.

Run Up data only exists in HSP (High Speed Profiler) data files if the operator selected a Run Up and/or Run out distance in the initial stages of setting up a collection. In the HSP collection software, the Run Up and Run out settings are found on the last window before performing a collection.

Match Tracks

Selecting 'Match Tracks' exports all of the tracks associated with the lane file. For the three laser systems, this includes Track 1, 2 and the center trace (track 3). For the Profilograph files, the tracks are matched based on settings entered prior to profiling. The stationing and number label assigned to the track are settings that cannot be changed after collection.

Export for ProVal

When the user exports a file for use in ProVal, it adds a negative sign in front of all stationing. This is done because ProVal does not use stationing, it only uses forward distance. If you collect data down station, you must check the Export for ProVal box to keep accurate stationing through the collection. ***Always choose "Export for ProVal" when importing into ProVal.***

Exporting to PRO Format

General Settings

Station Extraction

The operator has the option to export only certain sections of the data, based on the stationing set within the profiling file. To use this feature, select the check box near "Specify Station Numbers." When the box is selected, the operator will be able to adjust the stationing numbers. The 'Start' stationing is the initial stationing where the exported file will begin, while the 'End' stationing is the point where the exported file will finish. These values can be adjusted by typing values into the box or by using the arrow keys to the right of the box.

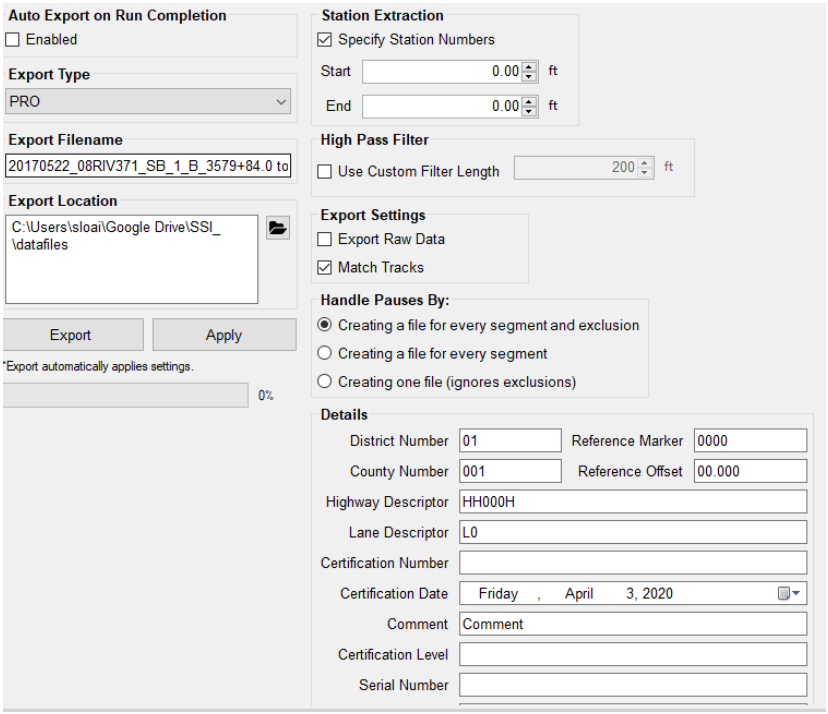


Figure 70. The PRO export window

Filter Settings-High Pass Length

The High pass filter length can be changed when exporting files to PRO format. A High Pass Filter removes all of the data trends below the filter length. The default length of the High Pass Filter is 200 feet. In order to export the data without filtering, the 'Export Raw Data' check box must be selected. See 'Export Raw Data' below.

Export Raw Data

Selecting the Export Raw Data check box assures the operator that only unfiltered data collected from the profile will be exported into the chosen file.

Match Tracks

Selecting 'Match Tracks' exports all of the tracks associated with the lane file. For the three laser systems, this includes Track 1, 2 and the center trace (Track 3). For the Profilograph files, the tracks are matched based on settings entered prior to profiling. The label of the track cannot be changed after collection.

Handle Pauses By:

The paused sections within the collected data can be exported in two ways. Separate files can be created for each segment or the profile data can be exported with the paused sections included in one file. The difference in these two options is that creating separate files for each segment exports multiple files into the folder location, while the "Using pause events" option exports one file including all of the data. If the pauses were used to omit data because of pavement anomalies, use the option of ignoring the pauses.

Details

The details section of PRO exporting is the job specific information saved with the file, such as **District Number, County Number, Reference Marker, Reference Offset, Highway Descriptor, Lane Descriptor, Certification Number, Certification Date, and Comments.** This information is then saved with the PRO file to be displayed when the file is opened or printed using another program.

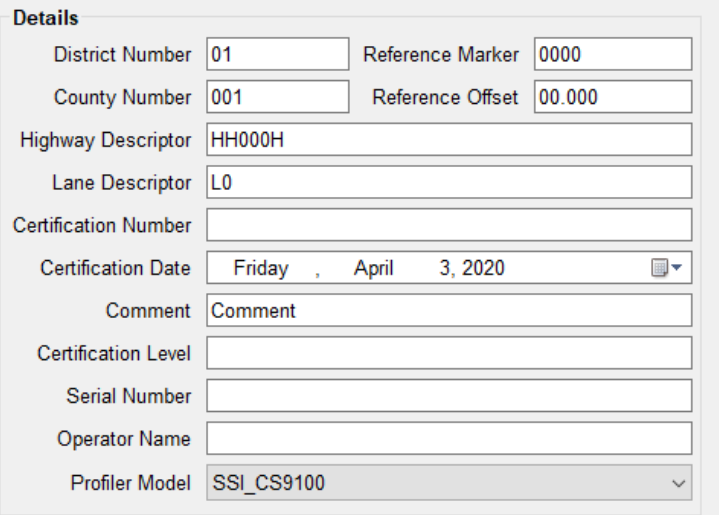


Figure 71. The Details input options for PRO export

Exporting to KML/KMZ Format

The operator can chose to export in the KML/KMZ formats. This format is used for viewing the file as graphic data in an Earth Browser such as google earth. This feature allows operators with Google Earth installed on their computers to view the test data in the real environment, showing the traces superimposed onto the window. The user may view the traces and project from any view or angle.

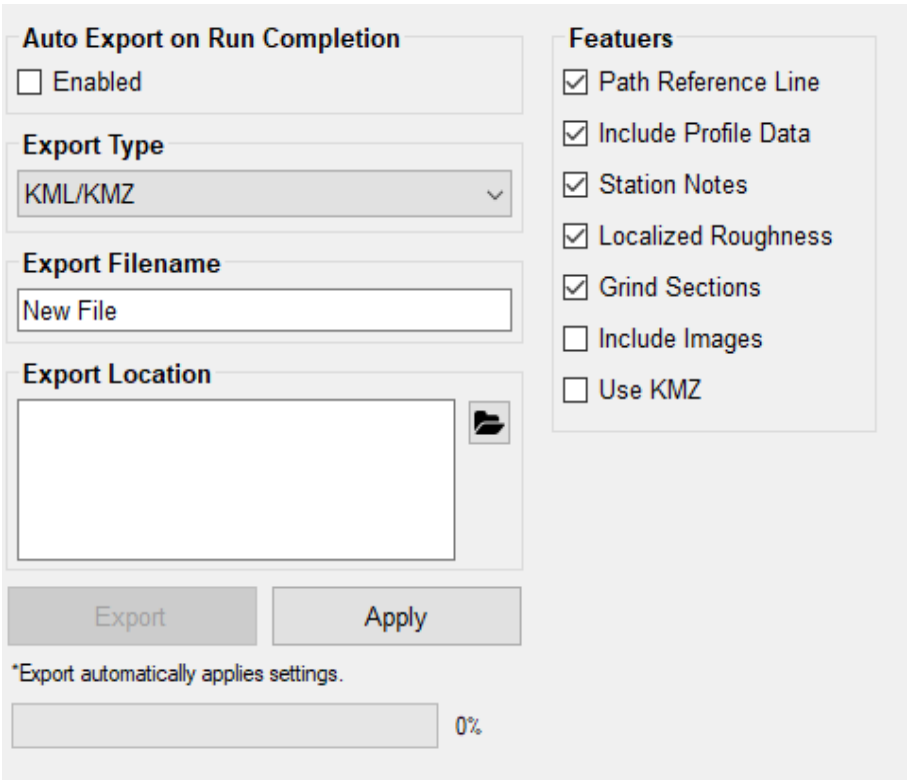


Figure 73. The Export to KML/KMZ format options

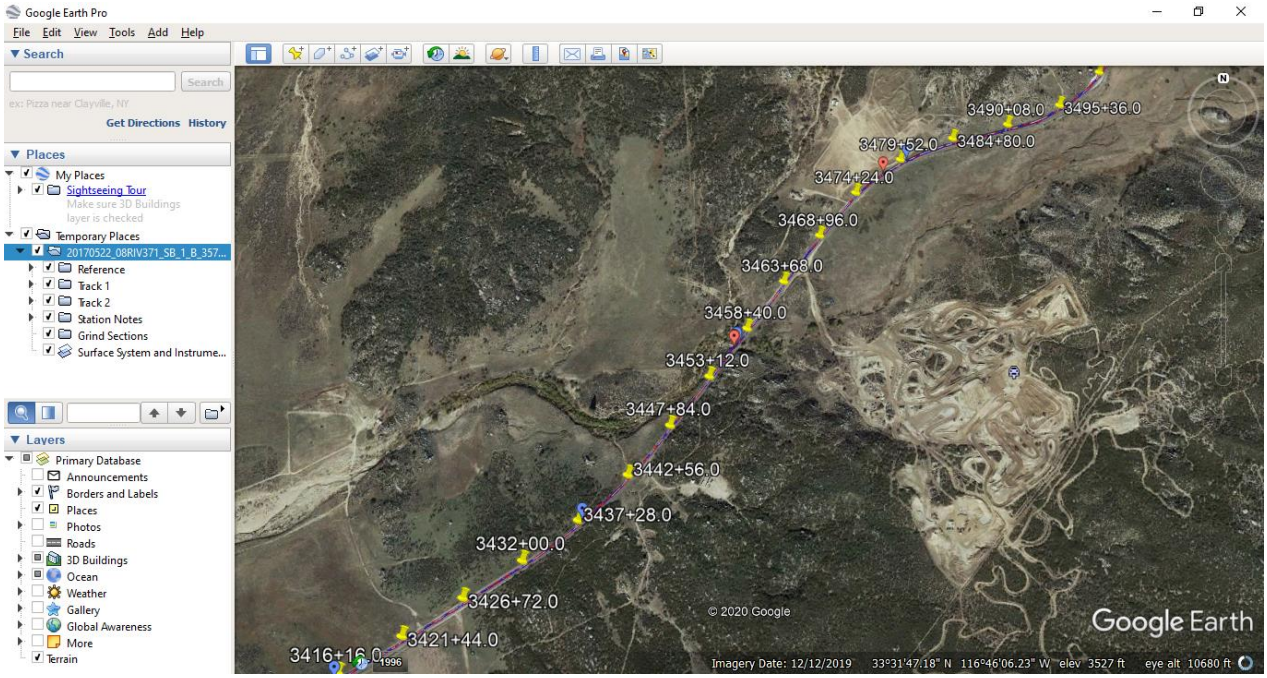


Figure 74. The KMZ/KML file opened in Google Earth

Exporting to 2D Survey Format

Station Extraction

The operator has the option to export only certain sections of the trace, based on the stationing set within the profiling data. To use this feature, select the check box near "Specify Station Numbers." When the box is selected, the operator will be able to adjust the stationing numbers. The 'Start' stationing is the initial stationing where the exported file will begin, while the 'End' stationing is the point where the exported file will finish. These values can be adjusted by typing values into the box or by using the arrow keys to the right of the box.

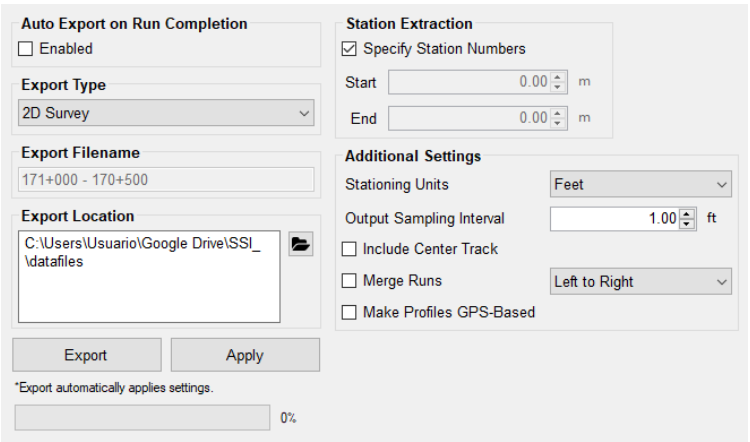


Figure 75: The window for exporting in Survey format

Filter Settings

High and Low Pass filters are optional when exporting to survey format. The exported data file can have an additional filter applied while being processed into the chosen format. To not filter the data, leave the filter lengths at the default value of 0.00 feet.

Available Filters:

Moving Average High Pass Filter
Moving Average Band Pass Filter
Butterworth High Pass Filter
Butterworth Band Pass Filter

**Output Sampling Interval

The sampling interval is the distance between readings of the SSI survey system. The default length of this interval is 1 foot. This feature allows other intervals to be implemented, depending on the accuracy specifications required in the surveying program.

The raw GPS will be exported in a separate text file in a NMEA (GPGGA) GPS string format. To match tracks 1 and 2 within the same file select the match tracks option.

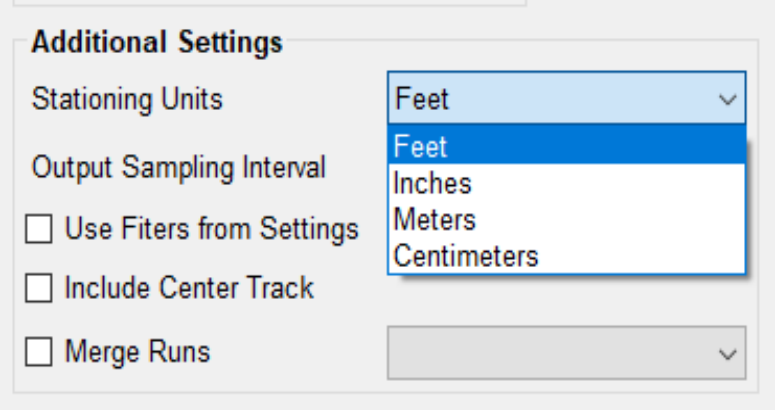


Figure 76: Stationing units dropdown menu and options

Exporting to Excel Format

Exporting the profile data to excel gives the operator versatility and efficiency when an adjustable numerical printout is needed.

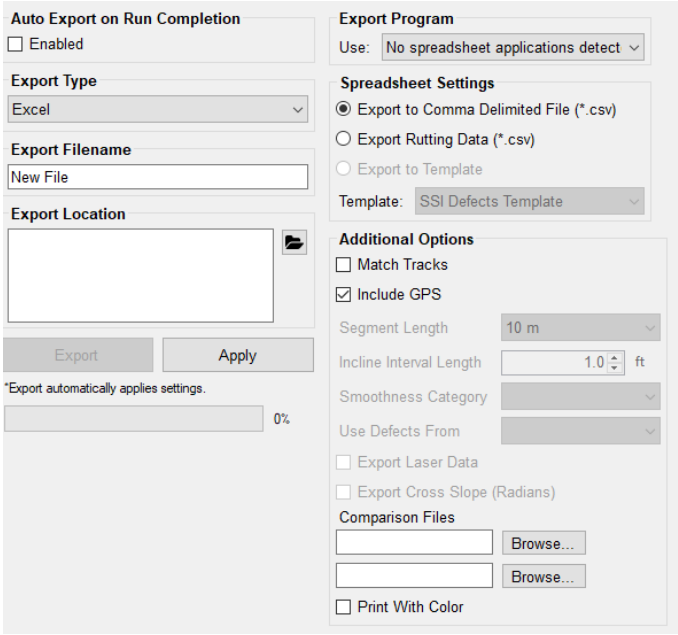


Figure 77: Exporting the data into Microsoft Excel format

Export to Template

To choose an SSI Excel Template, select "Export to Template."

Defects Template

The Defects Template shows the locations and heights of the defects and information about the file in spreadsheet form.

IRI Template

The IRI Template shows IRI statistics along with the defect locations and heights.

PRI Template

The PRI Template lists the PRI for each track along with the bump heights, locations and settings.

Summary Unmatched

The Summary Template shows a version of the summary report the calculated PRI for each track along with the bump heights, locations and settings in spreadsheet form.

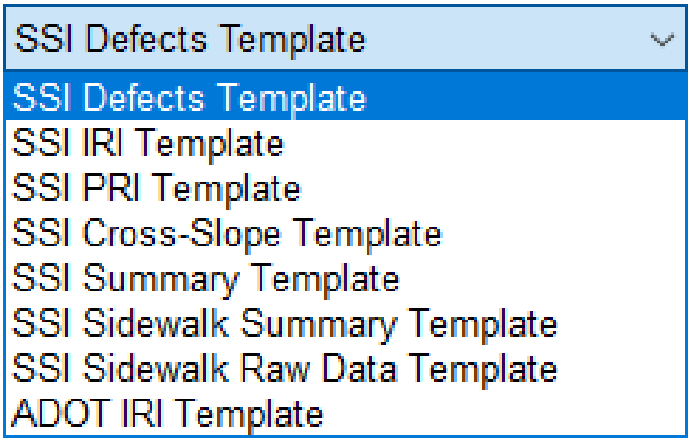


Figure 78: The types of excel formats are listed

Exporting to GPX Format

The GPS coordinates can be exported into a format for submittals. The GPS coordinates of the defect can be viewed through the defect start station, defect end station or the defect peak station. Specific runs can be chosen to retrieve the GPS coordinates by adjusting the drop-down menu under the title, “Select Run to Export.”

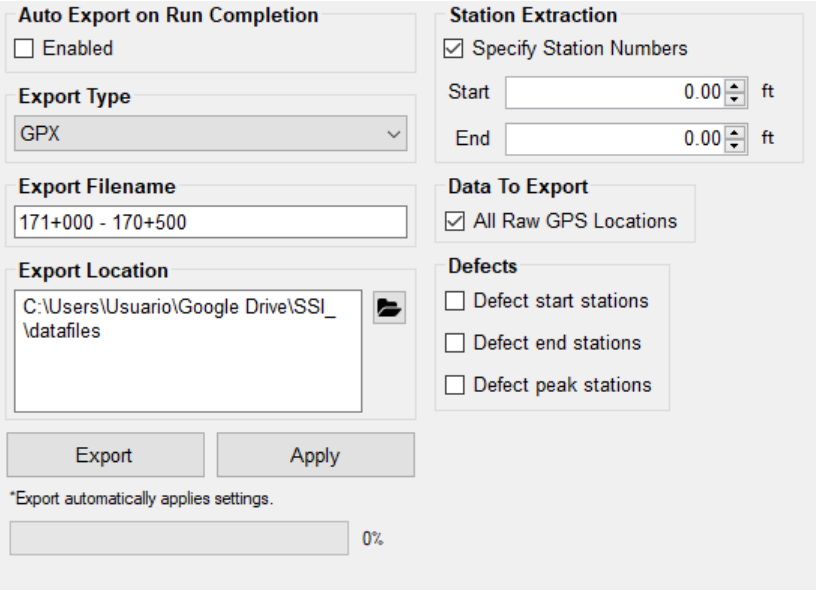


Figure 79: The export window for GPX format

Under the title "Data to Export" there are multiple check boxes. In order to export the defect’s GPS coordinates, the "All Raw GPS Locations" check box must be unchecked. Once the "All Raw GPS Locations" box is deselected, the options to export the defect stationing GPS coordinates become available.

Exporting to Sidewalk Format

This option is only to be used with files collected with the SSI Sidewalk Profiler (CS-8850). The sidewalk format has all of the information of the collection exported into GIS compatible file types. The files types and the corresponding information (See Glossary for explanation) are:

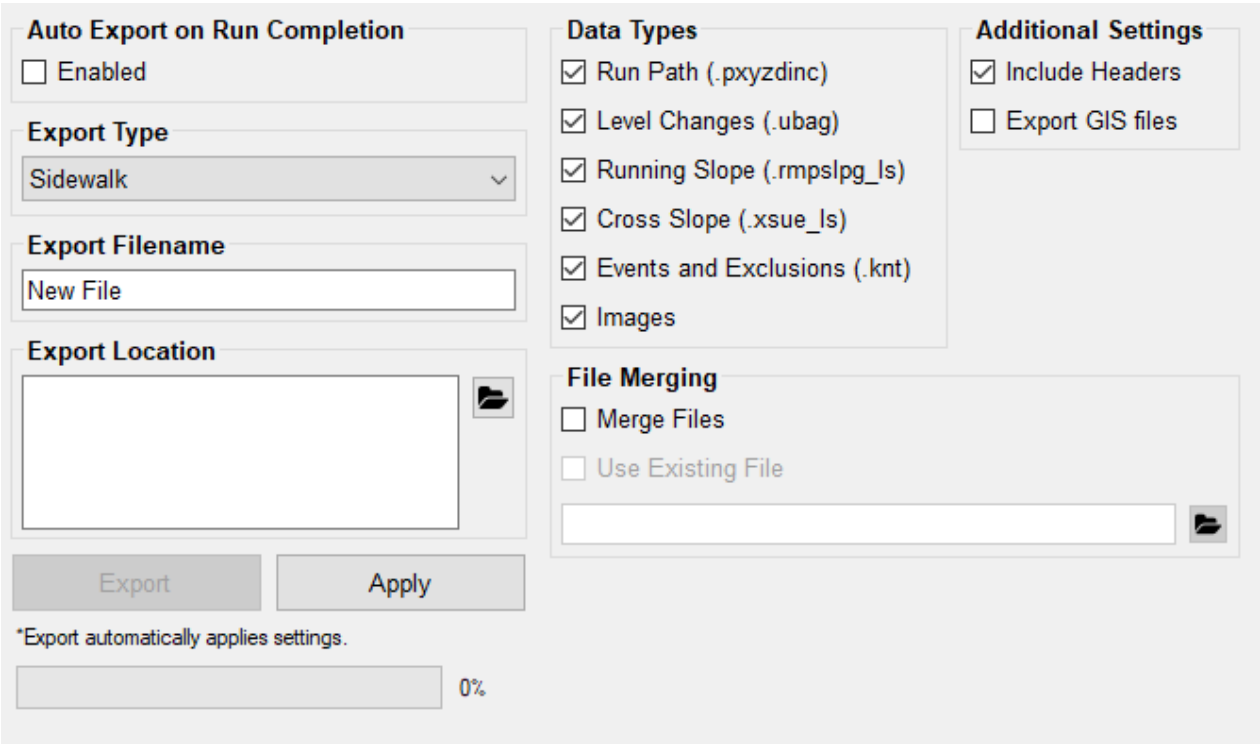


Figure 80: Export to Sidewalk window

Ngd: Contains synchronized distance, time, and gyroscopic data for a specified collection interval.
pxyzd: The three dimensional profile derived from the travel grade and gyroscope.
pxyzdg and pxyzdinc: Same as pxyzd, except without column headers for the data.
rmpslp: Rmpslp is the ramp and running slope exceptions. The column headers are travel distance, marker distance, time, ramp type, and casename.
rmpslpg: Rmpslpg contains the same data as the file rmpslp, except rmpslpg does not have column headers. This format contains travel distance, marker distance, time, ramp type, and casename.
rmpslpg_ls: Rmpslpg_ls is a line segment version of rmpslpg without column headers.
uba: This file contains the bump height and bevel slope data. The column headers are; travel distance, bump type, bump height [inches], bevel slope, and the casename.
ubag: Ubag contains the same data as uba, but ubag does not have column headers for the data. This format contains travel distance, bump type, bump height [inches], bevel slope, and the casename.

Exporting to Localized Roughness

The localized roughness export feature allows the user to create an excel spreadsheet of the localized roughness, or defects, for the collected data.

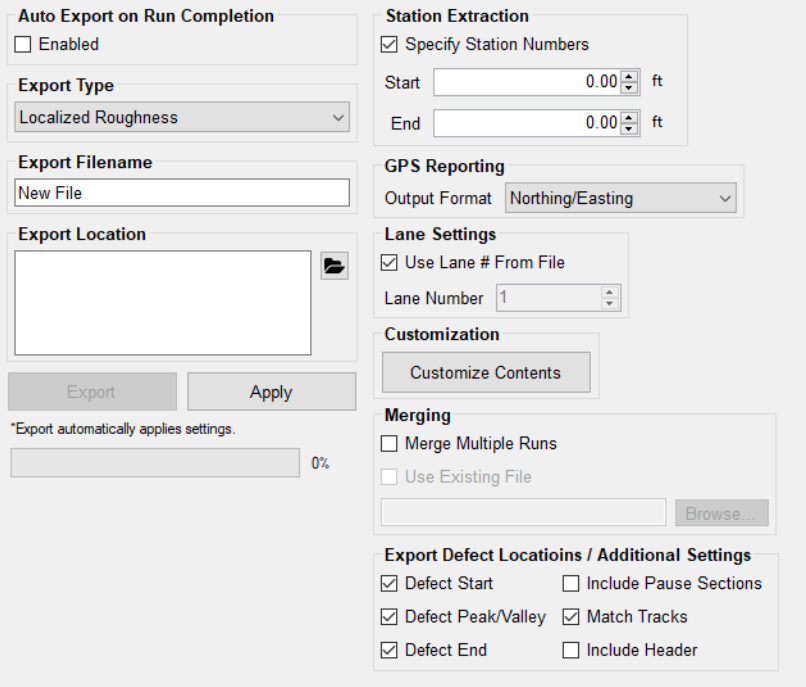


Figure 81. The Localized Roughness export options window

Specify Station Numbers

If the user desires to only export a section of the collection, select this check box and enter the start and end stationing of the soon to be exported section. If the specify station numbers is not selected, the entire collection will be exported.

GPS Reporting

To choose the type of GPS format used in the export, select Northing/Easting, Decimal Degrees, or NMEA Format from the drop-down list.

Lane Settings

The user may change the lane number that is currently in the collection file by selecting this check box and entering the correct lane number. To change the lane number, deselect the check box and change the lane number in the input location.

Customization

The user may add, move and remove columns from the Excel spreadsheet format. To do this, open the "Customize Contents" window and use the arrow keys. Move up and move down to change the order of the included columns. The columns types are at the top of the "Columns in File" side the left-most columns in the exported Excel file.

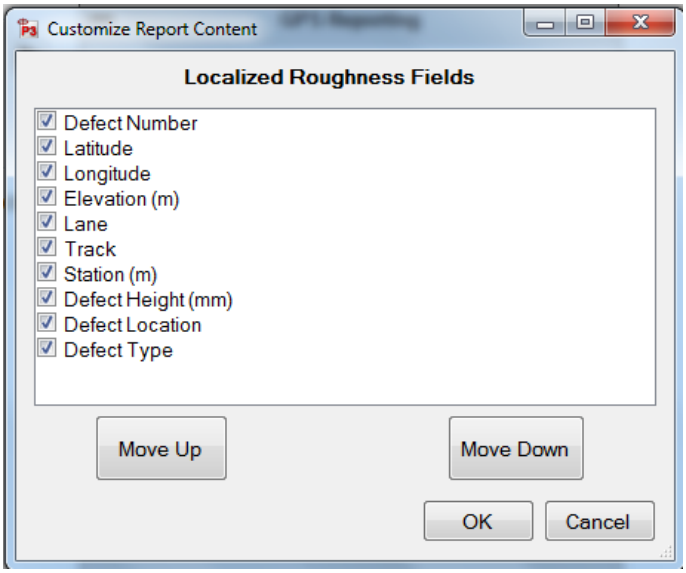


Figure 82: The Customize Window

Merging

The ´Merge Multiple Runs´ check box allows the user to include multiple collection runs in the spreadsheet. Runs that are saved in a separate file can be opened and exported alongside the current file by selecting "Use Existing File" and browsing to enter the location of the file.

Export Defect Locations

Use the check boxes to select whether the program will export the start, peak and end of the defect in the spreadsheet. The user will have the option to match tracks 1 and 2, include the paused sections, and include the header information. When paused sections are included the defects within the paused sections will be listed.

ProFAA Export

ProFAA is the format used for the Federal Aviation Administration (FAA) profiling program. This is the program that uses the Boeing Bump test method.

The user can enable high and low pass filters, change the start and end stationing, including the pauses and exclude specific tracks from the exported data.

Exporting raw data will force the data through a linear regression filter and have the data begin and end at zero elevation. The Run Up and Run out data can be included by selecting the check box.

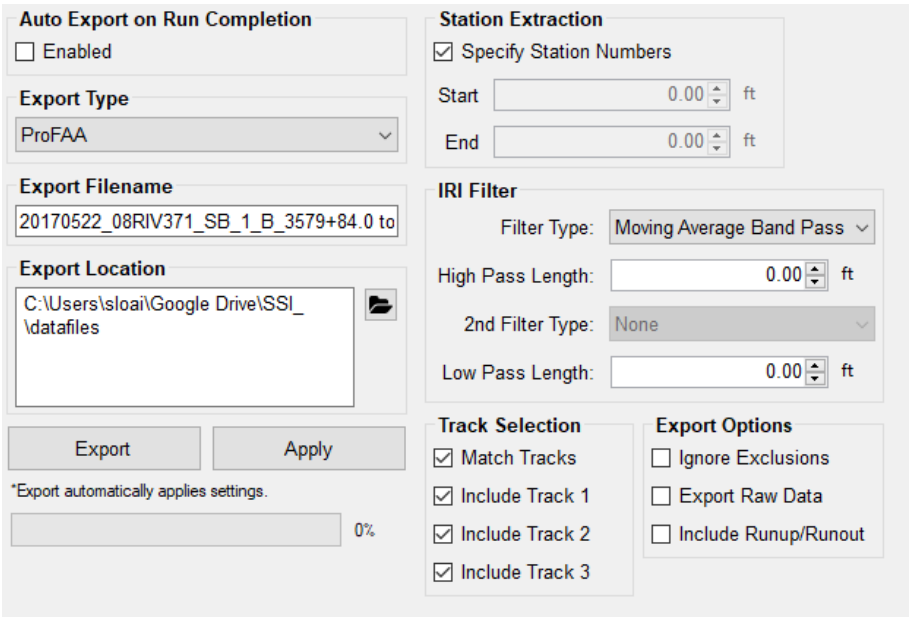


Figure 83: ProFAA window

RMS Export

The RMS export is a normalization of the profile data. RMS removes the influences of long wavelengths and grades while focusing on the amplitudes of the wavelengths in the profile. The RMS output does not show the frequency of these amplitudes in the profile, only that they exist. Set the RMS base length for continuous RMS and the sampling/segment interval.

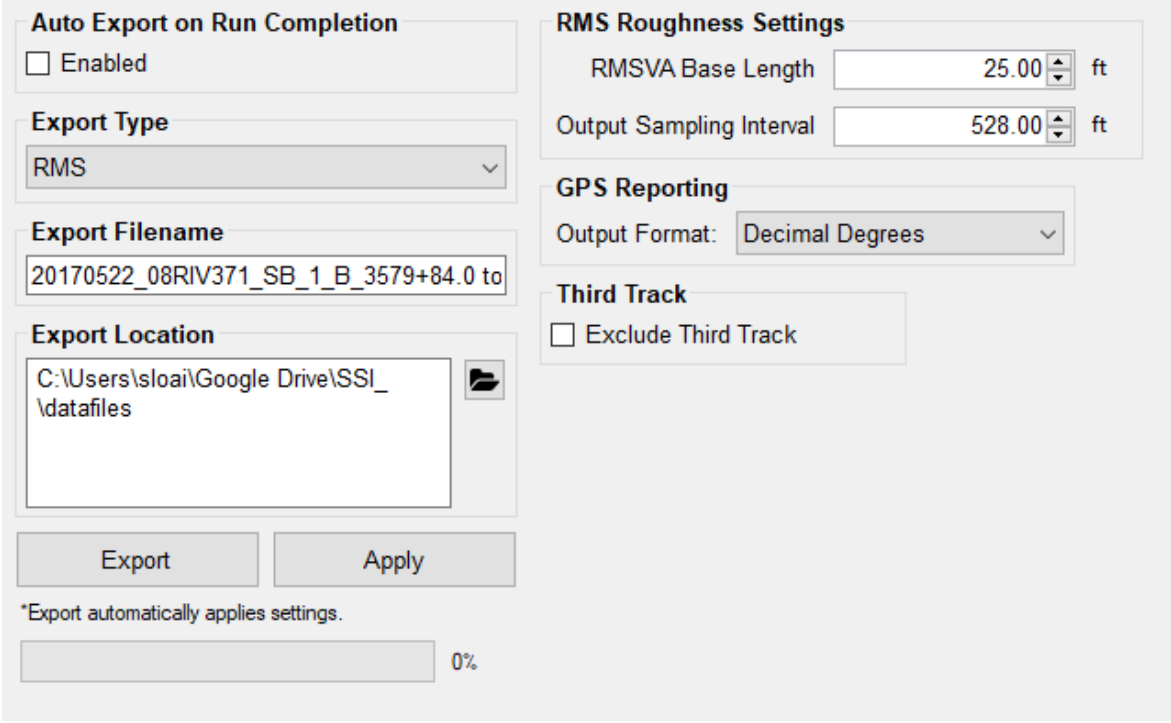


Figure 84: RMS export settings

GIS Export

The GIS export will create shape files for the segments, localized roughness, events, and track path for the profile. These files will be organized into their own folder entitled GIS Files under the destination folder.

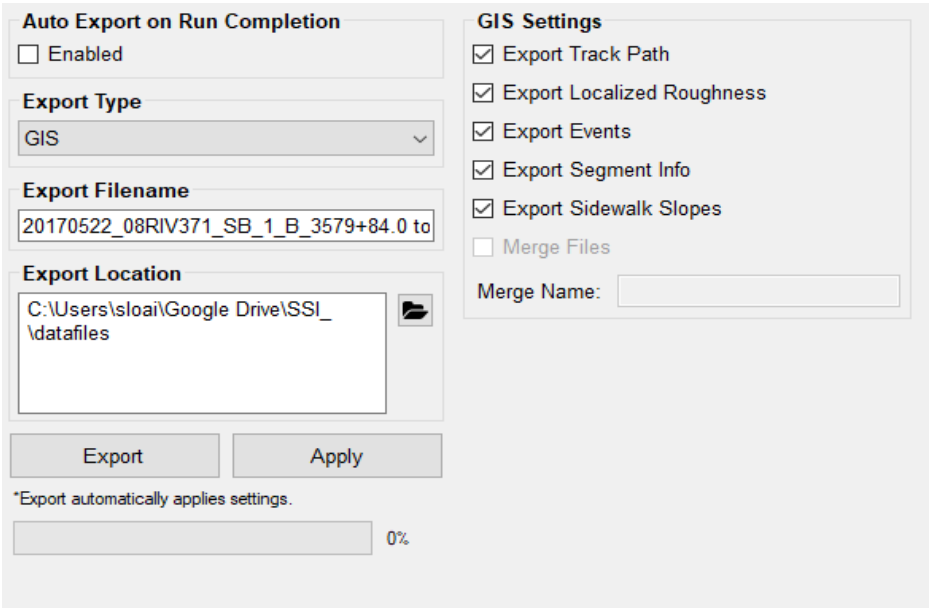


Figure 85: GIS export settings

Exporting Raw Data

The user can export raw elevation data, GPS data and GPS height data. The settings can be changed to export certain GPS string formats. It is recommended to use the Linear Regression Removal Filter to set the raw elevations along the null line. Otherwise there can be drift in the trace and give inaccurate elevation data.

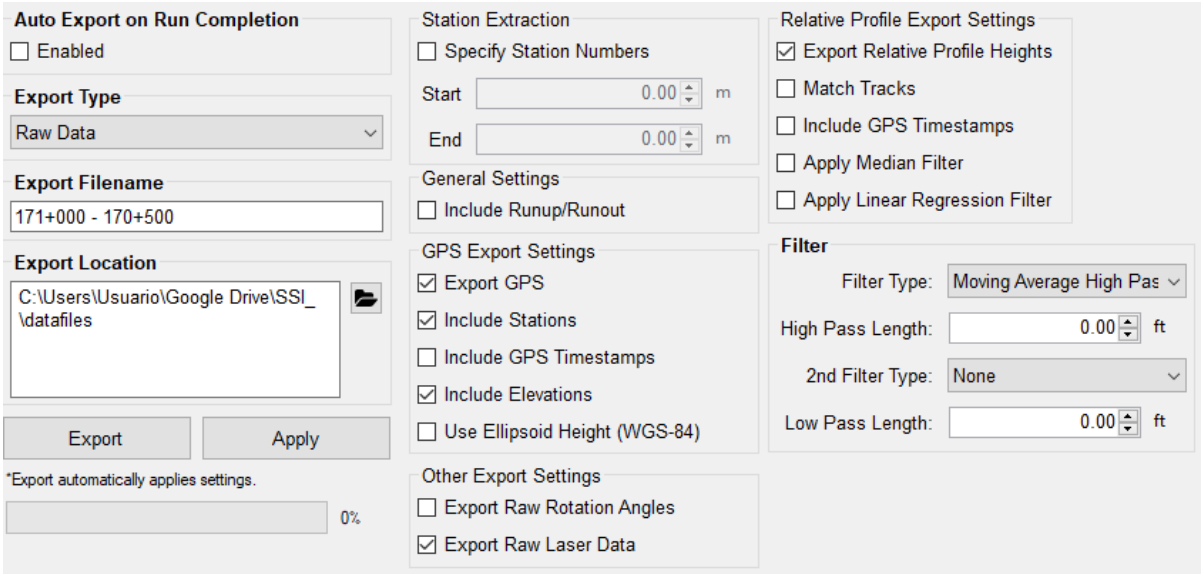


Figure 86: Exporting Raw Data Settings

General Settings

Configuration

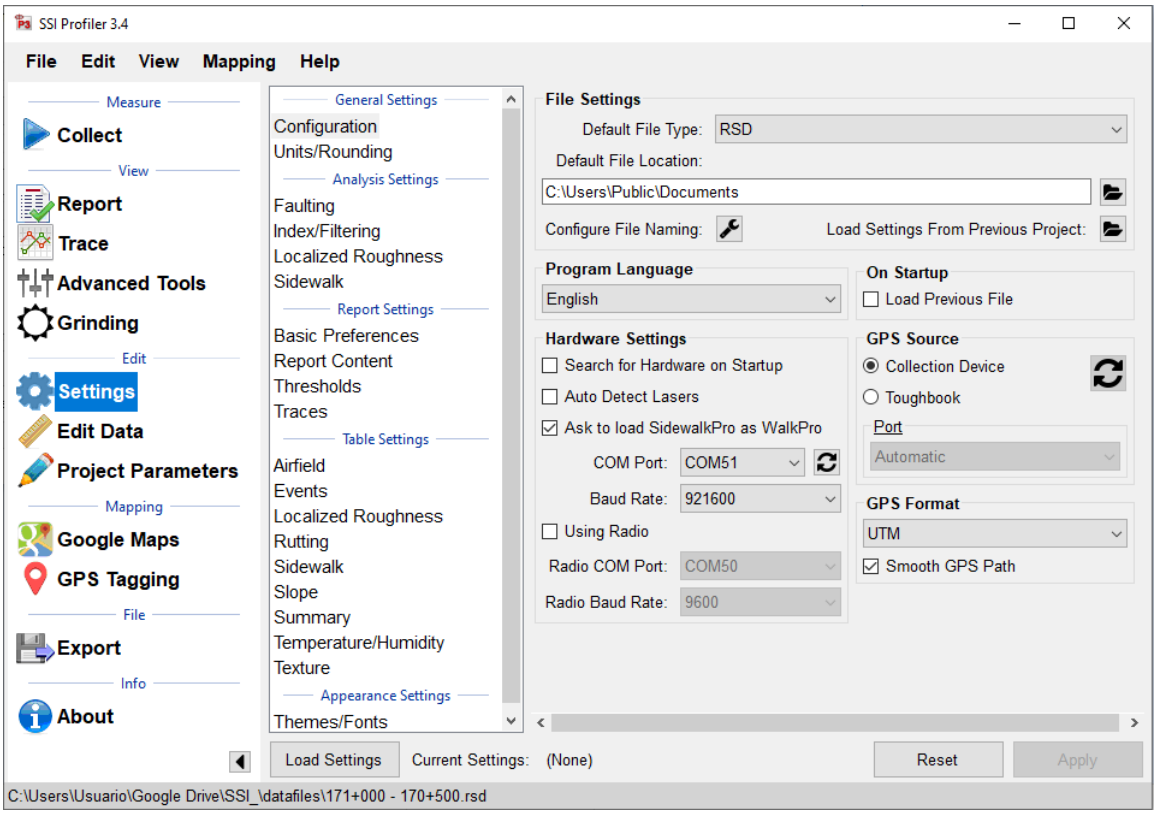


Figure 87. Configuration window under General Settings

File Settings

Default File Type (RSD, RHD)

The drop-down menu can be used to select the type of file opened in Profiler V3. Both RHD and RSD files can be imported into the program at any time. The default file type is the file format that will be used automatically when files are opened. ***Profiler V3 only saves in the RSD format.***

Default File Location

The default file location is the folder on the computer or external device that Profiler will search for the default file type. This folder can be changed through the Browse icon. If a location is used to open a file, the program will use this location to open files for future attempts. This feature saves time opening files since the program opens directly to the file location. Select **Apply**.

Default File Name

The file name can be chosen to have a name based on parameters of the program or by using a pre-loaded template. The parameters can be chosen from the list of (multiple can be chosen): Contractor, Country, Tester, etc. When a template is selected there will be a preview at the bottom of the window. Select OK and Apply to set this configuration as the default file name.

Creating a New Template

Create a New Template by selecting the "New Template" icon on the right side of the window. Select the template's name to rename it and append parameters to it. ***The template will be used as long as it is selected when OK is selected at the bottom right corner when exiting the Default File Name tool.***

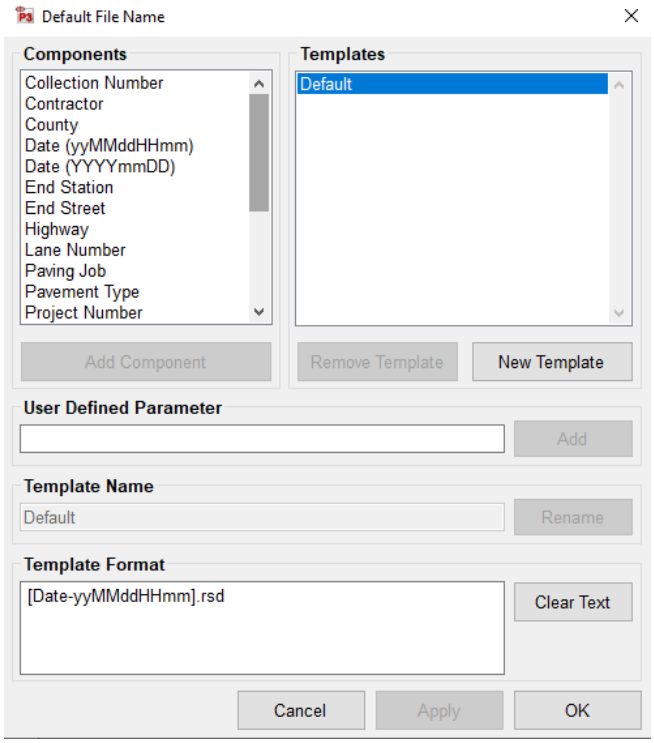


Figure 88. Custom file naming convention

User Defined Parameter

To create parameters that are specific to the job, type a new parameter name into the User Defined Parameter text box and select "Add User Defined Parameter." The bracketed variable will appear in the filename preview. To add information to the user defined parameter, open Project Parameters and the User Defined Tab. The name of the parameter will be under the Key column. Under the Value column, enter the information that is needed in the filename.

Changing the Template Name

The template's name can be changed by changing the characters under Template Name. Once a change is made, the Rename icon will be available. Select OK or Apply to save the changes.

Adding Parameters to the Template

When adding parameters to the template they will only be added to the right end of the template, as seen in the naming preview. **Select *Apply* after changes are made to the template**.

On Startup

Load Previous File on Startup

If this box is selected in figure 85, the file that was open when profiler closed last will be reopened when the program is started. A report of this file will be generated when the program is opened.

Load Previous File's Settings

The user may choose a previous file to save time if entering the same analysis parameters or project parameters under "Settings." To load a previous file's setting's, choose the file under General Settings ***or*** start a new file and choose one of the three options.

Use Last File's Parameters

This option will use the last file's settings under the localized roughness and project parameters.

Choose from a Previous File (Browse)

When this option is chosen a window explorer window will appear and the user may select a file that is saved on the computer to import the saved file's parameters under analysis and project parameters.

Set File Parameters after Collection

By choosing this option the user will not import a previously collected file but will instead manually set the parameters after the collection has finished.

Automatically Refresh Reports

The reports will automatically refresh when the operator navigates to the report window from another tab. When the user makes a change of report type within the report window, the refresh button will have to be selected manually.

Data Collection Hardware

Search for Hardware on Startup

If this option is selected the program will search for hardware and, if available, will connect to it upon opening the program.

Disconnect Hardware When Changing Tabs

If this feature is checked the program will disconnect from the hardware when the operator leaves the collect tab.

Report Generation

Generate Reports in Color

If the reports are generated in color, the defect types will be more visible. On the trace reports dips will appear be highlighted blue and bumps will be highlighted red.

Include the Footer

If the footer is included, the file name and the page number will be printed at the bottom of each page for the report. Select the check box to apply this feature.

Do not include the footer while printing with a Printrex 422.

Enable Animations

When enable animations is selected, the windows within Profiler V3 will slide across the screen whenever the operator moves from one section to another (Reports to Collect). This feature does not affect the functionality of the program, but adds an aesthetic behavior when changing windows.

Formatting

Font Settings

The report font can be changed by selecting the Font Settings icon under formatting. This allows the user to make the size of the font smaller or larger. The image scaling allows the user to print off less pages by increasing the scaling factor. The window that appears can also change the font to a strike-through or an underline.

Image Scaling

The default for the image scaling is 100%. When image scaling is set to a percentage greater than 100%, it acts the same way as the zoom function. The size of the traces within the reports will increase.

Profiler Software Update

Profiler V3 will check the internet connection by attempting to connect to the website listed under this location. If the internet connection is found, the updates will be available for download from the SSI server.

Program Language

Choose between English, Spanish (North/Central America) and, Spanish (South America)

Analysis Parameters (Ride Values)

Profiling Units

English

Selecting English units sets the segment length to 528 feet. English units use inches for the height of the defects, counts for roughness settings, and feet for scallop width and filter lengths. After every change of units, select apply in the lower right corner to save.

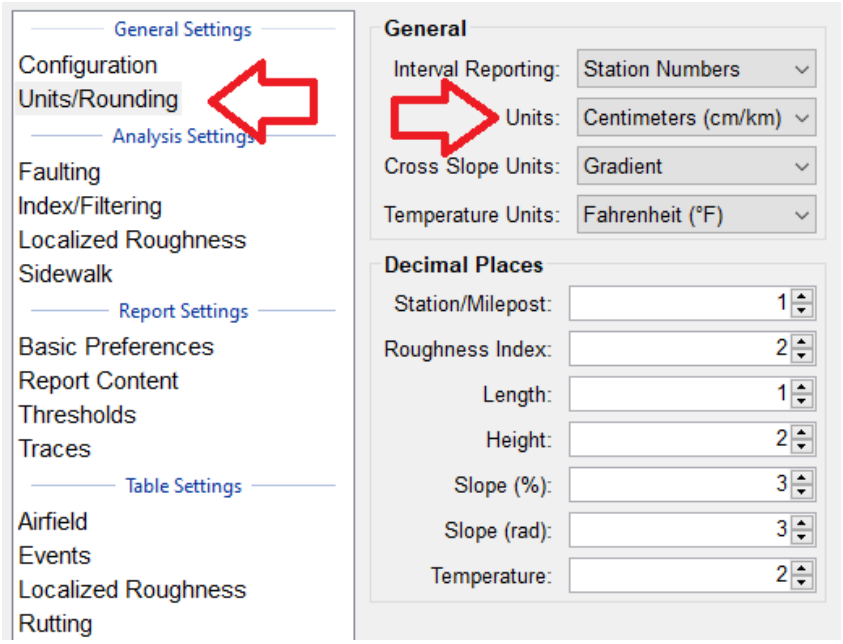


Figure 89. Units and rounding section of the General Settings

Metric Meters

In Metric Meters units, the blanking band, scallop height and scallop resolution are all in cms. The rest of the measurements for scallop width and filter lengths are in meters. The Metric Meters and Metric Centimeters settings have the same units of centimeters for height, and meters for length for all sections of defects and roughness. After every adjustment of units, select apply.

Metric Centimeters

Selecting Metric Centimeters units, the blanking band, scallop height and scallop resolution are all in centimeters. The rest of the measurements for scallop width and filter lengths are in meters. The Metric Meters and Metric Centimeters settings have the same units of centimeters for height,

and meters for length, for all sections of defects and roughness. After every adjustment of units, select apply in the lower right corner to save changes.

Metric Millimeters

Selecting Metric Millimeters units, the blanking band, scallop height and scallop resolution are all in millimeters. The rest of the measurements for scallop width and filter lengths are in meters. After every adjustment of units, select apply in the lower right corner to save changes.

Interval Reporting and Temperature Units

The operator can choose between Station numbers and Miles Posts for Interval Reporting and choose between Fahrenheit, Celsius, Kelvin, and Rankine for Temperature Units.

Decimal Places

The operator can choose how many decimal places he wants reported to his final value of: Stationing/MilePost, Roughness Index, Length, Height, Slope(%), Slope(rad), Temperature.

Shortcut Bar

The Shortcut Bar is located at the left side of the main window. The shortcut bar is used to navigate around the profiler program without using the menu bar.

The shortcut bar can be hidden by selecting the arrow at the bottom of the window. The direction that the arrow is pointing is the direction that the shortcut bar will move. It will either become hidden or reappear.

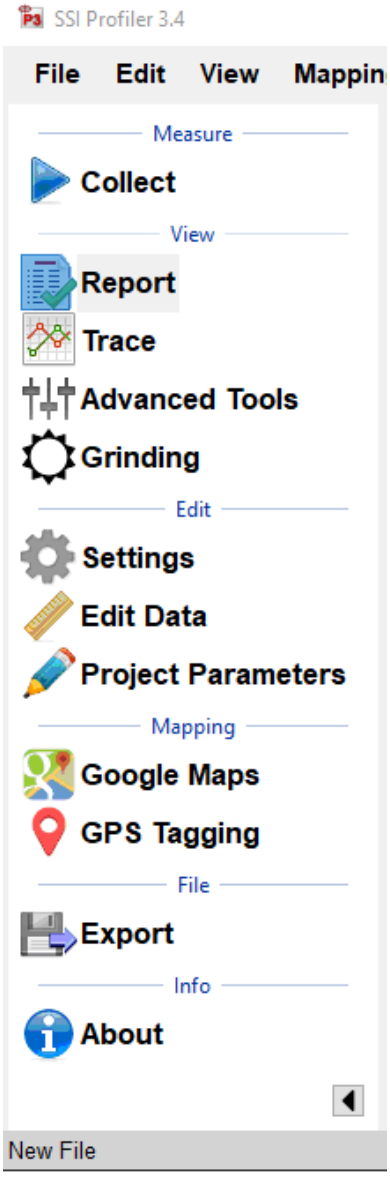


Figure 90. Shortcut bar with all the frequently used windows

Edit Data

Note: Any edit to the data will be described in the report header under File Modifications.

The edit data feature allows the user to adjust the starting station, insert pauses, or add events. All of this can be done in post processing, after a collection has been completed.

Edit Run

Open the Edit Data feature in the shortcut bar (Look for the ruler icon). Under Edit Run Information Tab, the user can adjust starting station, Lane, Track, and Station Equations. If the data was collected in the wrong station direction, the operator can change to Station Direction to Up or Down or use the 'Reverse Data' button.

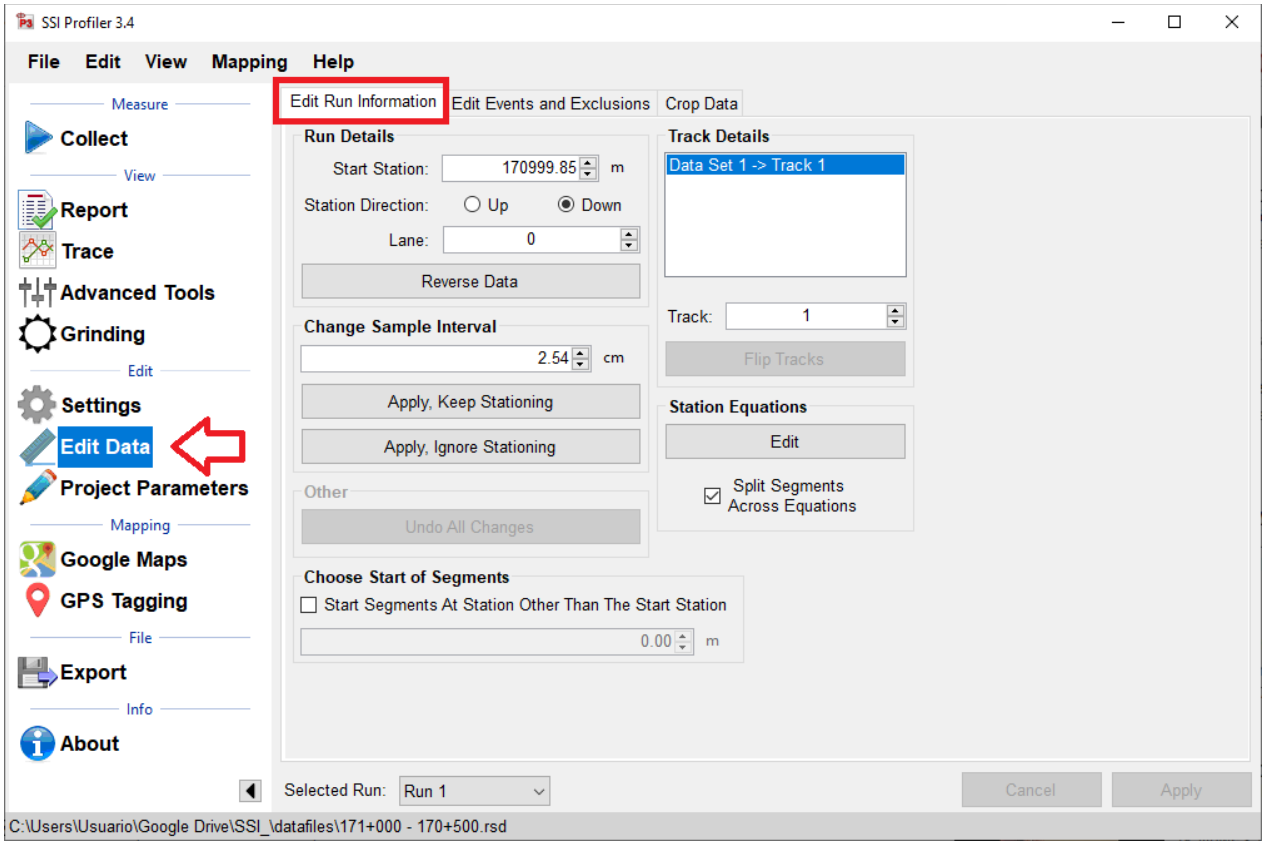


Figure 91. The Edit Data Options

Edit Segments and Exclusions

This feature allows the user to add and edit events and exclusions (sometimes called pauses) to the collection or to ignore a certain distance of collected data at the beginning or end of the run.

The Resulting Events and Exclusions list shows the type of event and exclusion and its start and end station. To edit or add events and exclusions, press the "Edit" button on the lower left corner of the window.

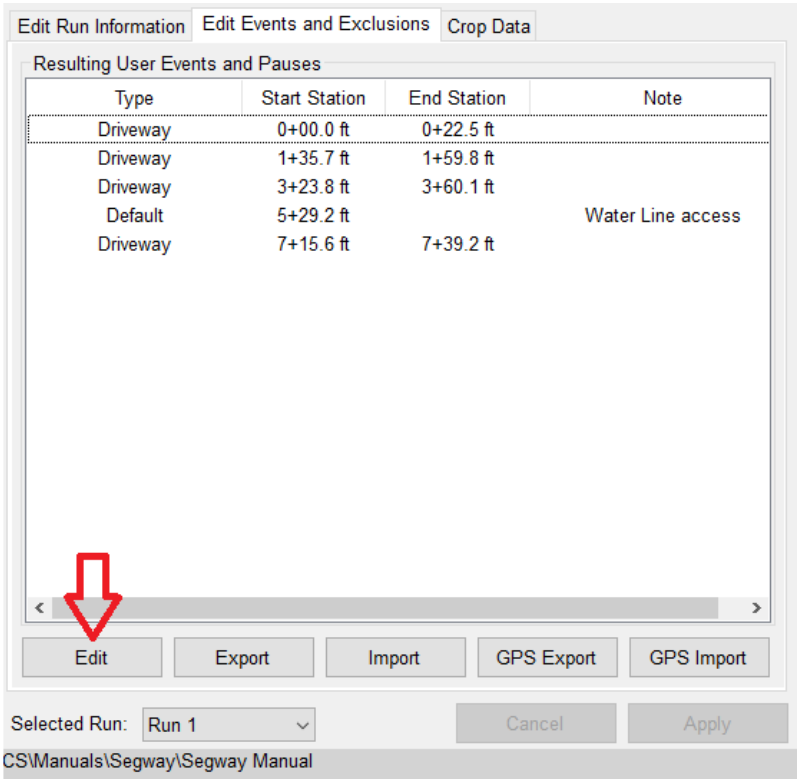


Figure 92. Table of current Event and Exclusions.

Edit or Add Exclusion/Event

1. Select the exclusion or event to be edited in the left column list. It is selected when the blue bar is highlighted the Pause/Event title.
2. Check the Enable checkbox.
3. Change the Type of Exclusion/Event.
4. Change the Start and End Station.
5. Add a Front and Rear buffer
6. Add a group Buffer.
7. Select the Apply button

Note: If the event/exclusion is to be deleted, select the* Delete *button to remove it from the list.

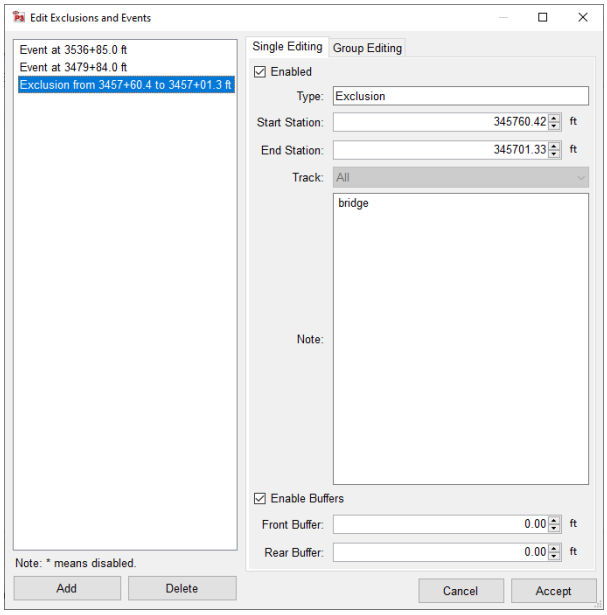


Figure 93. Edit events/exclusions window

Add a Exclusion/Event

1. Select the 'Add' button under the Exclusion/Event list in fige 86 above.
2. Select Exclusion or Event
3. Enable Exclusion/Event information
4. Choose Type, Start Station and End Station
5. Add notes and/or buffers
6. Select the 'Add' button

Exclusion Definition

During an exclusion, height data is omitted but distance is still collected. The height values are not used in the calculation of localized roughness or ride values.

Start Station

The Start Station in the stationing where the pause is to begin.

End Station

The End Station is the stationing where the pause will stop, and collection will resume.

Track

Select from the dropdown menu which tracks you wish to apply the Event or Exclusion to.

Note

To explain the reason for the pause/event or the location, enter the information in the pause notes. This information will appear in the track notes of the trace reports. See figure 93.

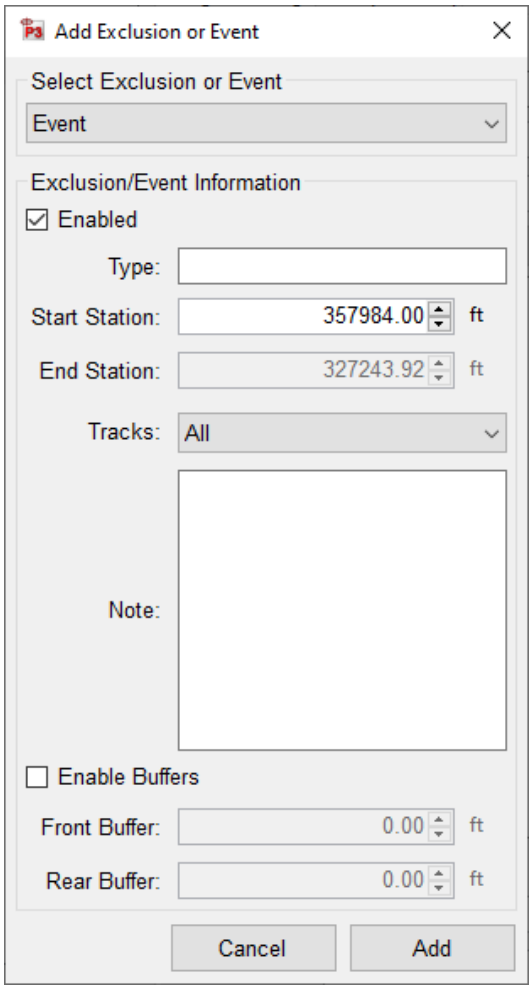


Figure 94. Add Pause/Event window

Pause/Event Buffers

Choose the Exclusión/Event Front and Rear Buffers. The units can be changed by simply clicking on the unit icon to the right of the buffer and a dropdown list will appear. Select Add when finished.

Crop Data

The Crop Data tool allows the user to trim the collections before analysis and reporting. If any changes are made to the file, the information that was changed will be described in the report header under File Modifications. To crop the collection, change the distances for the run up and/or run out distances, and select **Apply**. Change the distance units and height units of the graph by clicking on the units icon and selecting from the drop down menu. The graph can also be seen in the Pan or Zoom mode with an option to apply on either the x axis, y axis or both.

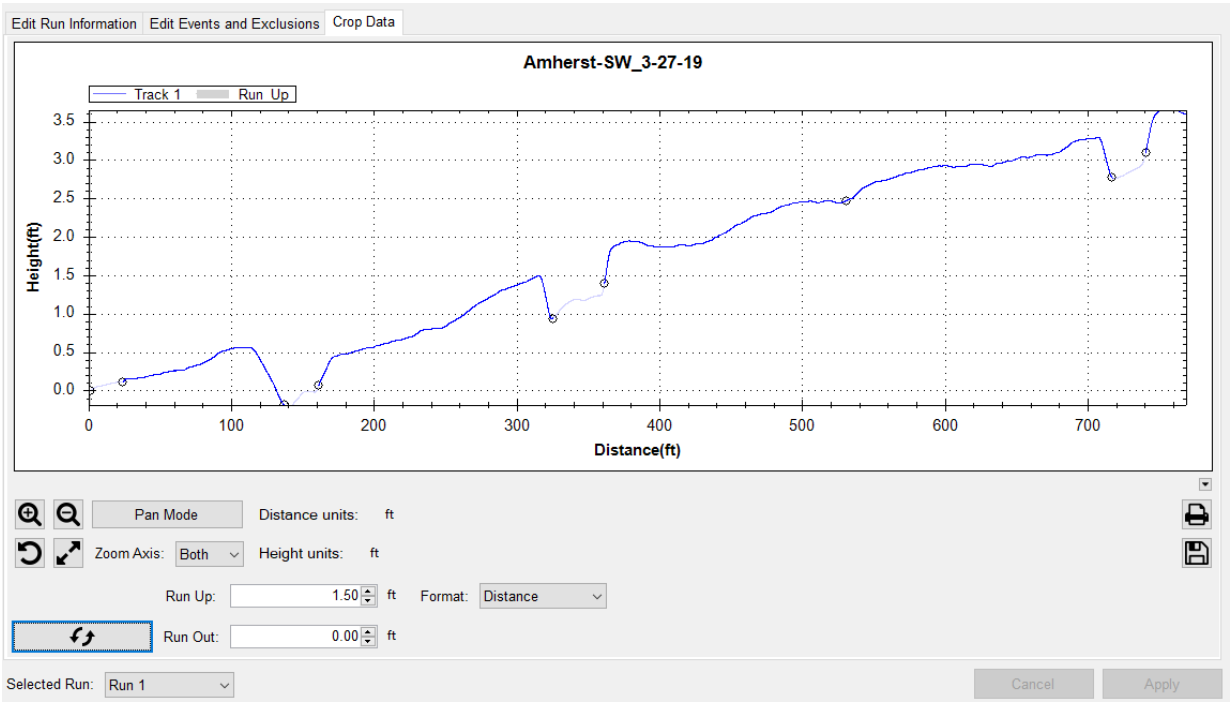


Figure 95. Crop Data Tool

Project Parameters

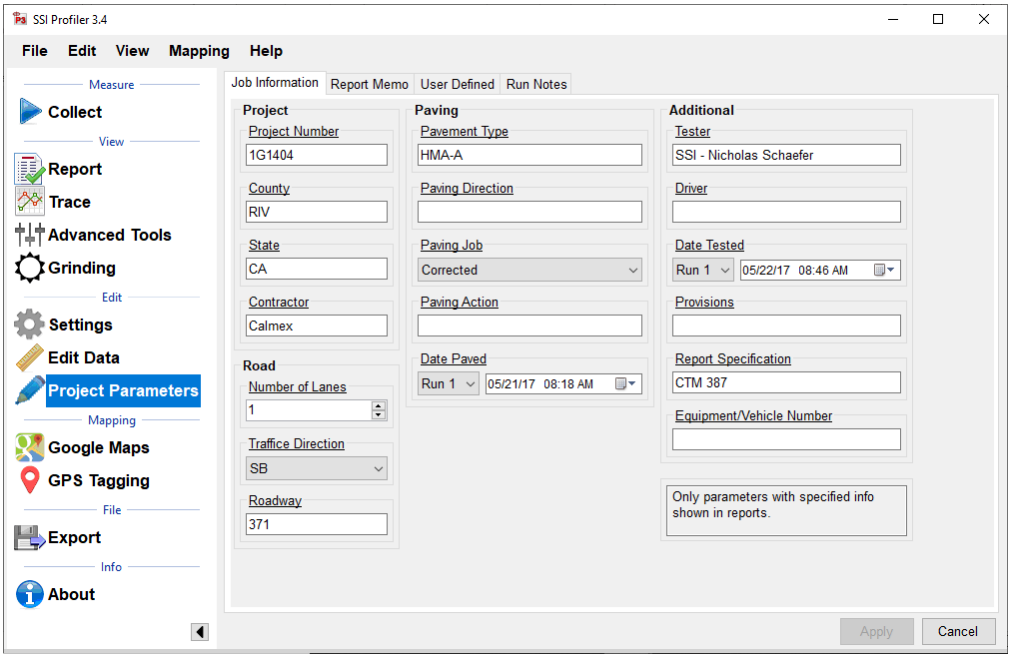


Figure 96. Project Parameters on the Job Information tab

The Project Parameters section is the location where the job information is entered. This information appears on the header of the reports and the exported excel templates. Before leaving the Project Parameters window, always select 'Apply' if changes were made.

Job Information

The job information tab specific criteria listed below are descriptive information about the project. Review the contract to enter the required information into the sections listed below. These sections can be edited at any time within Profiler V3.

Project

Project Number

The Project Number is unique to each project. This is to be determined by the State, Federal DOT or by the contractor. This information will be listed in the project contract.

County

This location is reserved to list the county where the profiling is taking place.

State

The state in which the profiling is taking place and the job is located.

Contractor

This section is for the name of the paving company or for the company operating the profiler.

Road

Traffic Direction

The traffic direction of the lane to be profiled.

Number of Lanes

The number of lanes of the project. This section can be changed by inputting values directly or by using the arrow keys. Traditionally, the number of lanes is the number of lanes travelling in the same direction for main line freeways. Use a classification system that can be understood during post-collection analysis.

Paving

Pavement Type

Input the type of pavement here. Enter pavement types such as Cold–in–Place Asphalt, HMA, JPCP, CRCP, Open Grade etc.

Paving Direction

Enter the direction of the paver when placing the pavement.

Paving Job

Specify the type of paving job, either corrected or original.

Paving Action

Under paving action list any further information about the paving process.

Additional

Tester

The individual operating the profiling equipment over the pavement surface.

Provisions/Weather

The weather at the time of profiling the pavement. Such as: Cold, Hot, Overcast, Morning, Afternoon, Evening, etc.

Report Memo

Report Memo is a section available for inputting large amounts of text to be saved along with the data file. Anything from reminders to stationing can be inputted into the Report Memo and not influence the data.

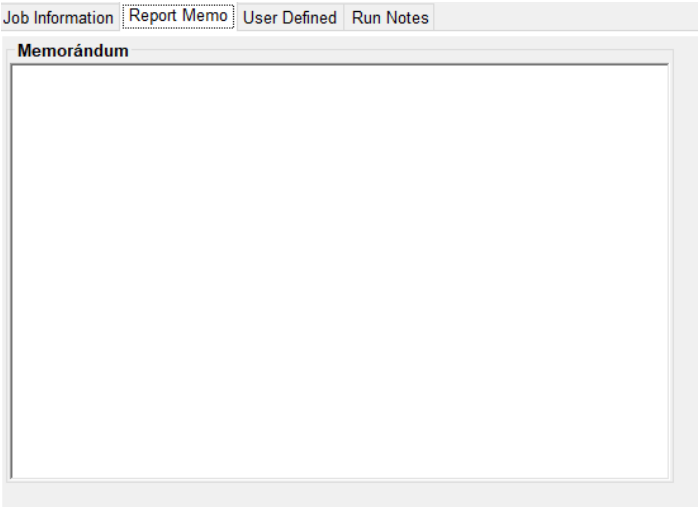


Figure 97: Report Memo window

User Defined

Additional parameters can be stored in the data file as desired by the operator. Consult the contract for any additional user defined parameters that may be required for the profile data files. Add new parameters by selecting 'Add' at the bottom of the window. The parameters are entered by double-left clicking on the 'Key' column and typing in the required information.

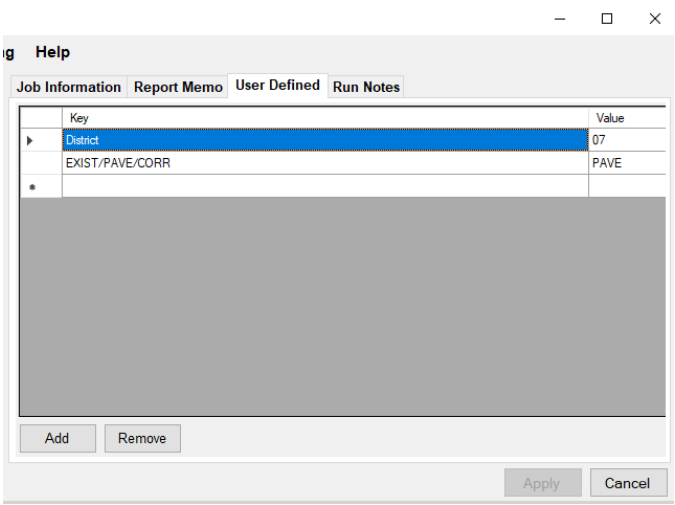


Figure 98. The user defined

Run Notes

The Run Notes lets the user add specific notes to the run indicating whatever useful knowledge the operator wishes to associate and save with the file and run. This can include road and weather conditions. Press 'Apply' to save the changes.

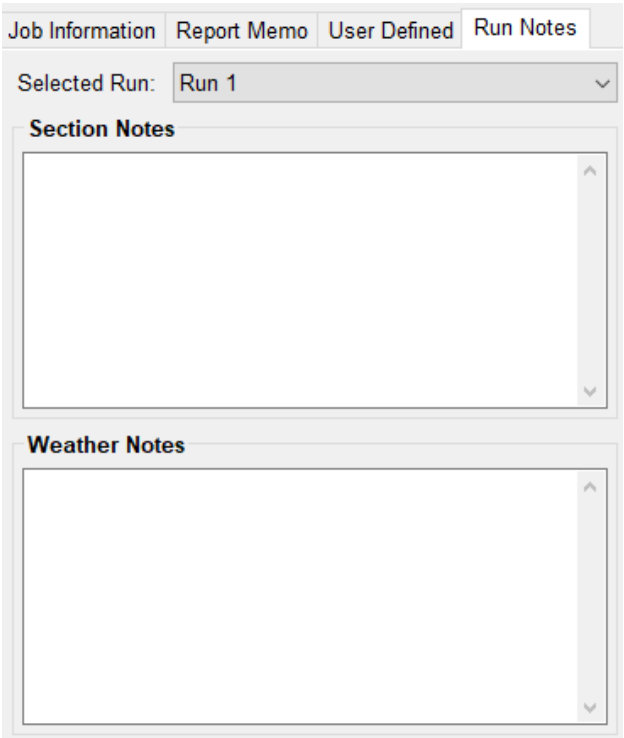


Figure 99. The Run Notes window.

Settings

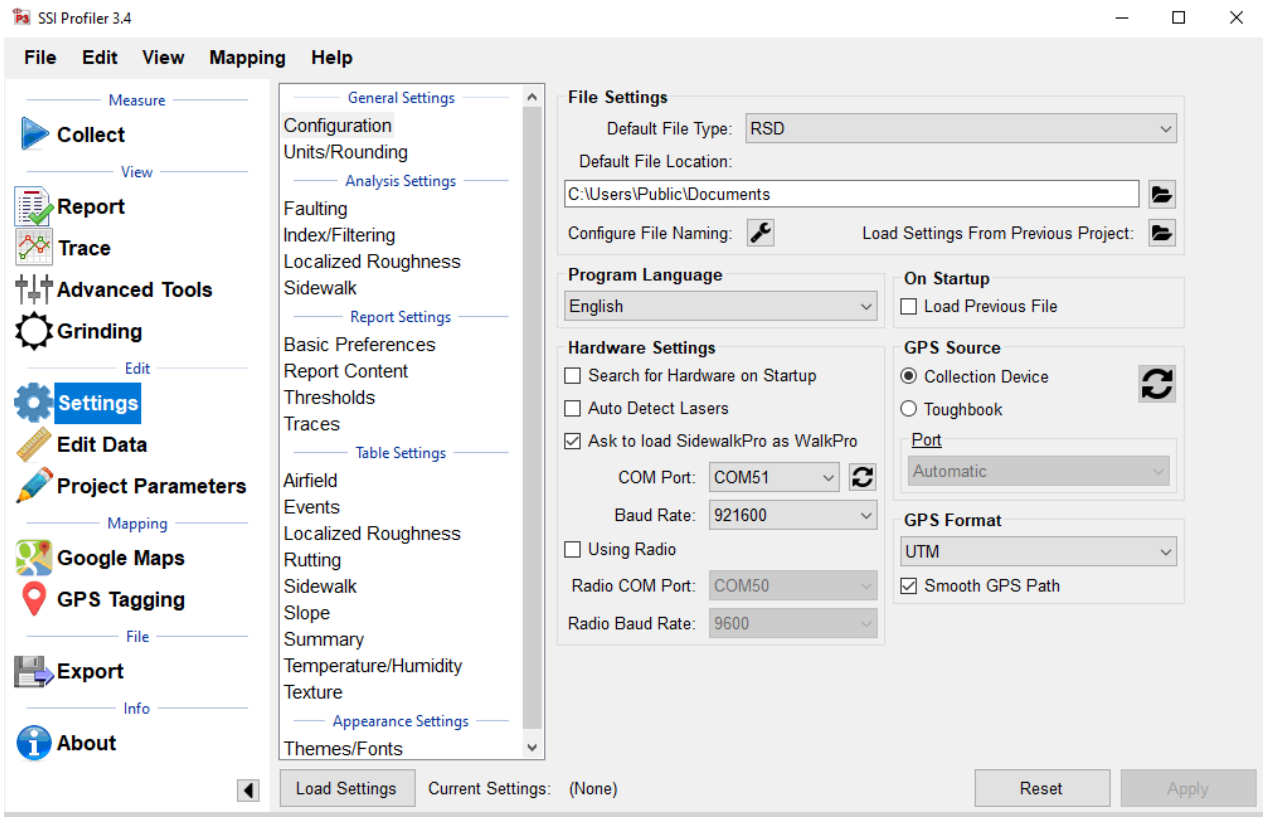


Figure 100. The settings window

Default File Type

Use the default RSD file type for collections and analysis on the Profiler V3 software. The RHD file type option is for working with older versions of collections and may apply only to files collected with Profiler V2 systems.

Default File Location

The default file location shows the folder under your computer where collection files will be saved. The folder icon to the right of the location box (see figure above) opens a Windows Explorer window where the operator can choose and or create the folder where the files will be saved. SSI recommends being clear and orderly when choosing where to save. Example: C:\Users\SSI Profiler\Collection Files\Kansas\Manhattan-Ft. Riley I-70 Project

Load Settings from Previous Project

If the operator is collecting and saving different files for the same project, Choose the Load Setting form Previous Project folder icon (see figure above). The icon will open a Window Explorer window where the operator can choose an already collected and saved collection to import all the previous setting without having to fill them in a second time.

Configure File Naming

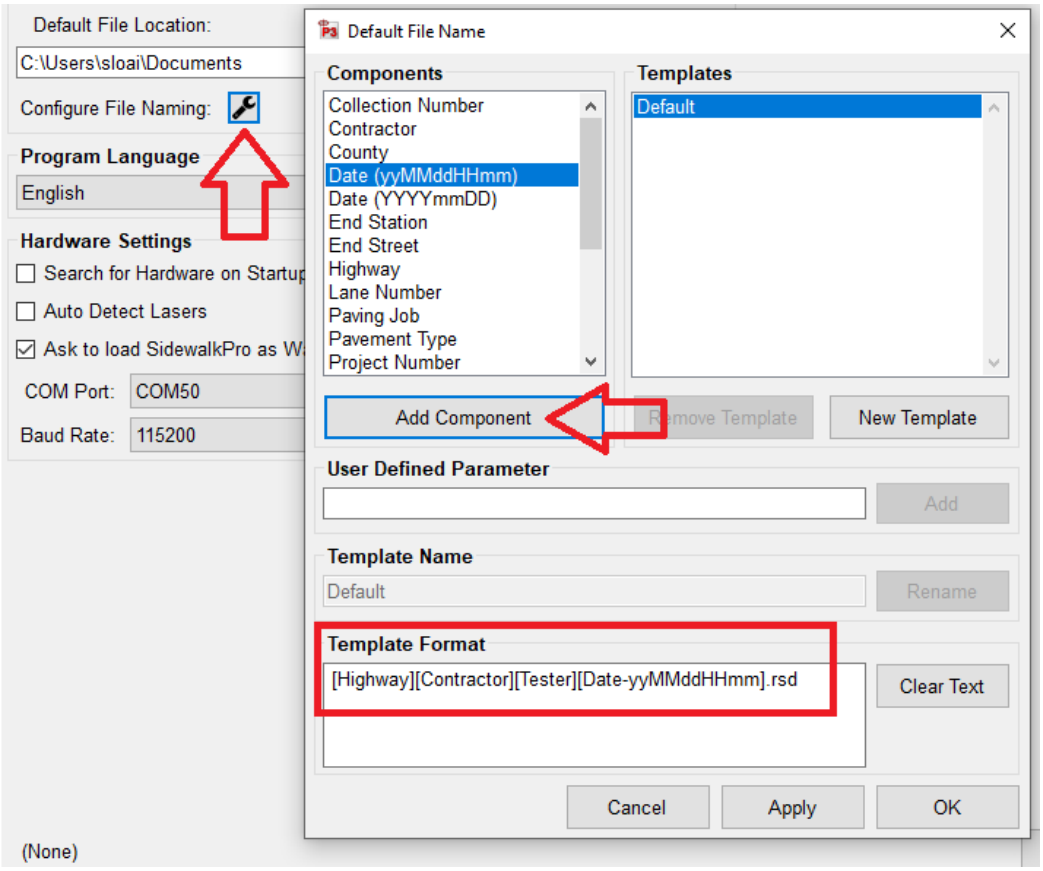


Figure 101. The Configure File Naming window option

In order to simplify and help the organization of collection files, SSI recommends using the Configure File Naming option by clicking on the wrench icon (See figure). This function allows the software to automatically name the collection files. Choose from the Components list and press Add Component. The resulting file name will automatically include the desired job parameters helping future identification and improving data organization. The example in figure 98 include Highway, Contractor, tester and Date for the file name nomenclature.

Program Language

Pick between English, Spanish North/Central America, and Spanish South America. The program Profiler V3 must be restarted for the changes to take effect. English is the default language.

On Start Up and Hardware Settings

Under On Start Up (see figure 100 above), Choose the Load Previous File check box to automatically load and open the previous file the operator was working on. This is useful when finishing a particular unfinished run. SSI recommends saving separate collections in different files and only appending to an existing file when necessary. The Hardware Setting allows the operator to automatically activate various hardware settings. See figure 100 above.

GPS Source and GPS Format

Choose the GPS Source the operator wishes to use during collection, the port to be used, and the format (UTM or the degrees variations). See figure 100 above.

Units and Rounding

Choose the profile index units to be calculated during the collection of data. Typical units used in the United State of America and Great Briton are English (in-mi) Units. Typical units in most other countries are one of the 4 metric options.

Also choose the Interval reporting and the Temperature Units.

Below Choose the Decimal Places3 to be used when rounding off the result values.

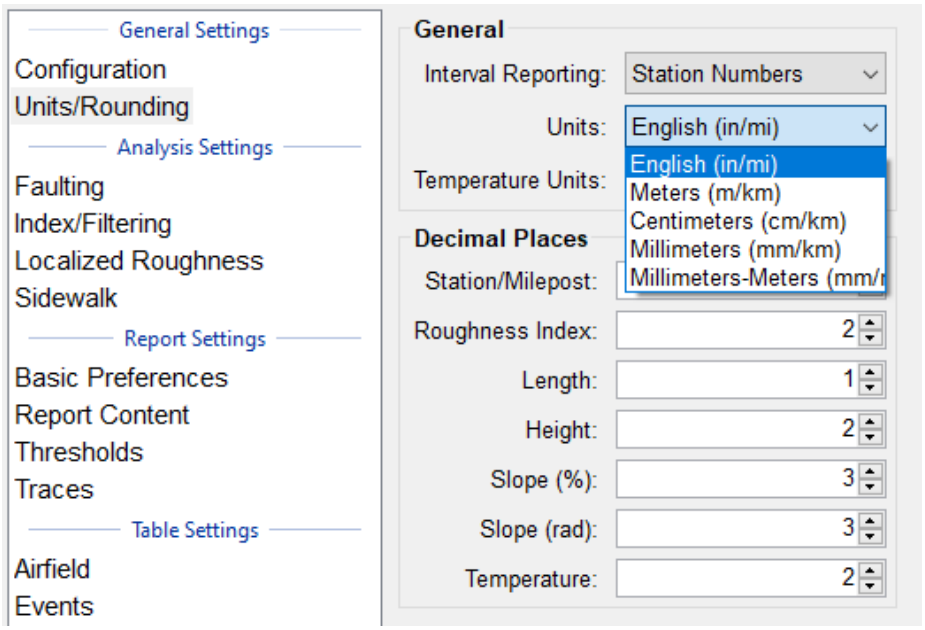


Figure 102. Units and value Rounding under General Settings

Analysis Settings

Profile Index, Segment Length and Filtering

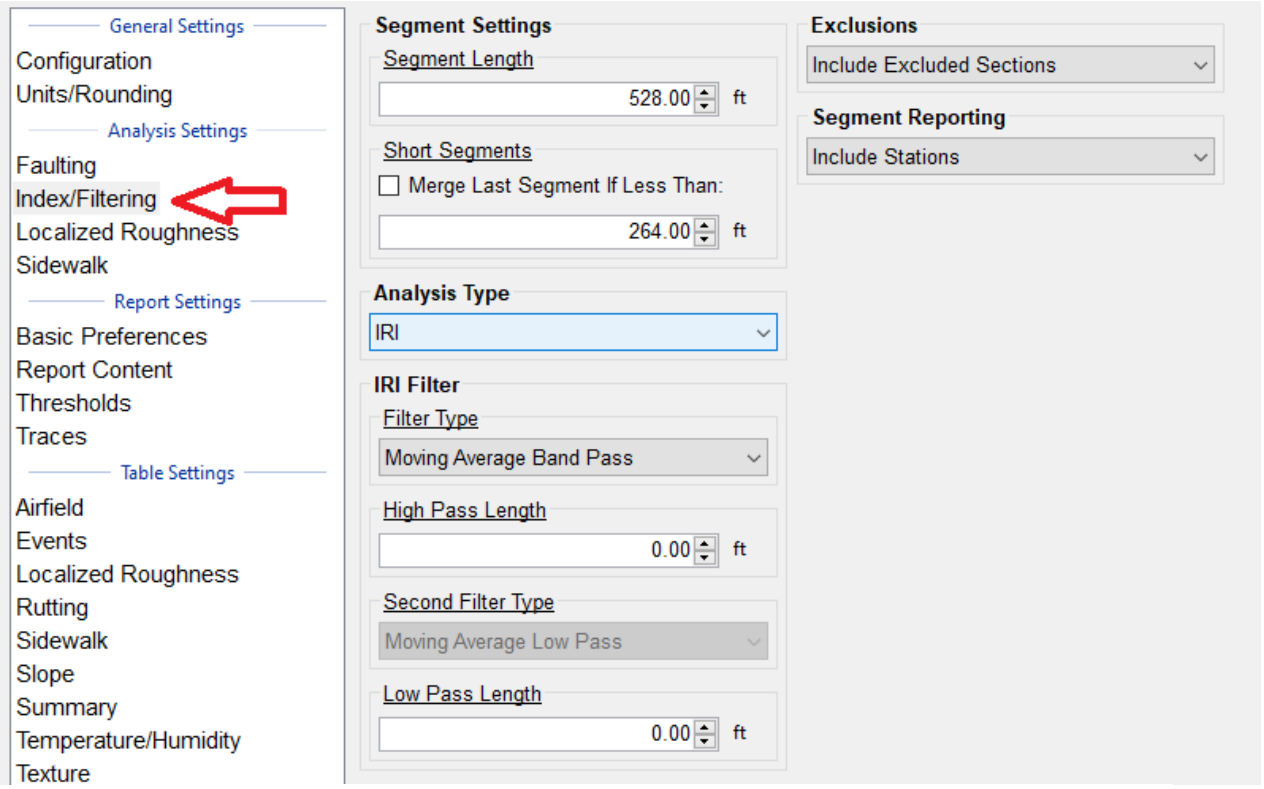


Figure 103. The Index and Filtering options under Analysis Settings

Segment Settings

Segment Length

Segment length is the interval of profiling that is used to calculate ride values. Traditionally the distance used for segment length is one-tenth of a mile, or 528 feet (160 meters). This section is adjusted by using the arrow keys or double-left clicking in the box to type the segment length.

Short Segments (Merge Last Segment if Less Than)

If the last segment is shorter than the segment length, it can be merged into the segment before it. This will prevent large ride values from short distances. Only use if your specification does not require a specific segment length for pay incentives. The last segment length will be changed if this feature is used.

Exclusions

Ignore Excluded Sections

When 'Ignore Excluded Sections' is selected, the excluded sections created during collection or through the Segment Adjustment window will not be included in the report or the calculation of the ride values.

Include Excluded Sections

When Include Excluded Sections is selected, the excluded sections are included with the actual collection when calculating the ride values. The report will show the excluded sections in the segment summary and the trace view.

Excluded Sections Only

When ´Excluded Sections Only´ is selected from the drop-down menu, only the excluded sections created during collection or through the Segment Adjustment Window will be displayed in reports and used to calculate ride values and counts for roughness.

Ignore Exclusions, Keep Stationing

When 'Ignore Exclusions, Keep Stationing' is selected, the excluded sections created during collection or through the Segment Adjustment window will not be included in the report or the calculation of the ride values, but the Stationing will remain constant.

Analysis Type

IRI

The International Roughness Index is a universal ride index for concrete and asphalt roads around the world. The profile is analyzed using a quarter-car simulation that is weighted towards the frequencies of body and vehicle bounce; the most uncomfortable riding conditions.

To calculate IRI in Profiler V3, select IRI from the drop-down menu, then adjust the filter settings if necessary according to the contract specifications. View the report under the Report Tab to observe IRI.

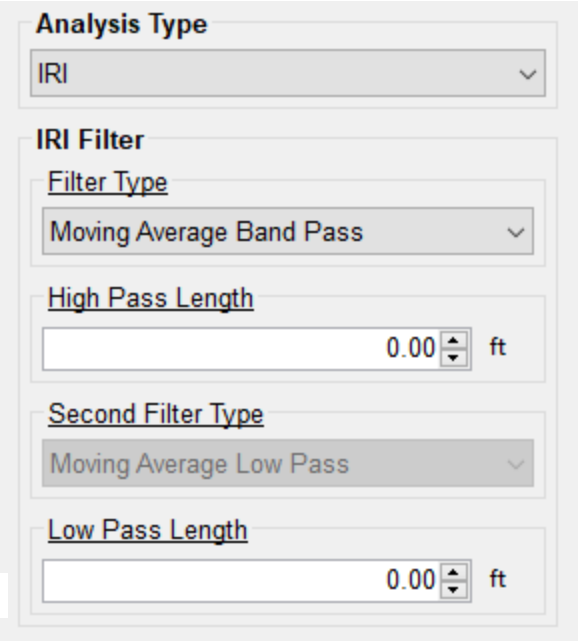


Figure 104. IRI Analysis type options.

PRI

The Profile Ride Index is a simple calculation to classify the smoothness of a road profile against other roads. The formula for this calculation is:

English Units:

$5280\ ft \times (Total\ Roughness\ in\ inches\ in\ Segment)/(Segment\ Length\ [ft])$

Metric Units:

$1000\ m \times (Total\ Roughness\ in\ m,\ cm,\ or\ mm\ in\ segment)/(Segment\ Length\ [m])$

To calculate the PRI in Profiler V3, select PRI from the Analysis Type drop down menu. Once the settings are correct, select Apply and then view a report to observe the PRI ride values.

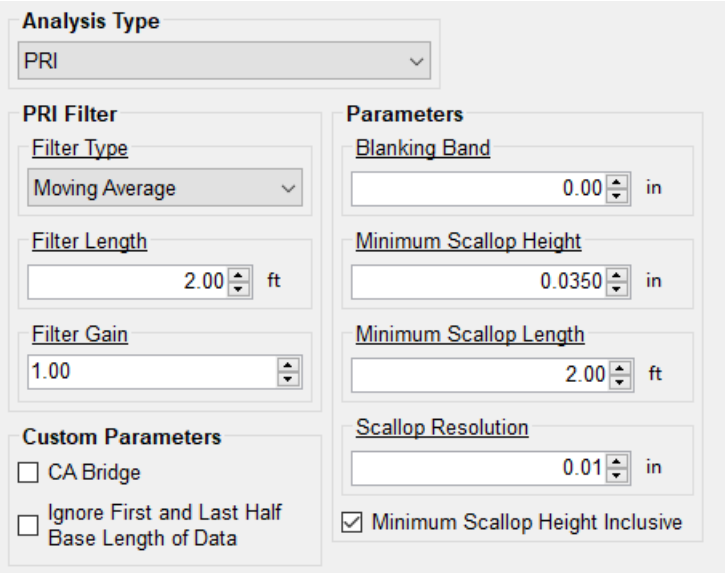


Figure 105. The PRI analysis type options.

PRI Parameters

Note that the PRI Parameters are only for the calculation of the Profile Ride Index (PRI). Blanking Band, and Scallops have no connection to the manner in which defects are found. For defect settings, see *Localized Roughness*.

Scallop Definition

Scallops are the deviations of the profile trace from the blanking band. If the trace exceeds the defect height but the minimum width of the scallop is not reached, the deviation is not included as a defect. Although defects are not included in Ride Values, if the deviation still exceeds the defect height parameter, it adds to counts for roughness.

Blanking Band

The blanking band is a null area that classifies the height of all sections of the trace within its borders as zero. Therefore, a trace that remains within the borders of the blanking band would have zero counts for roughness and a PRI of zero.

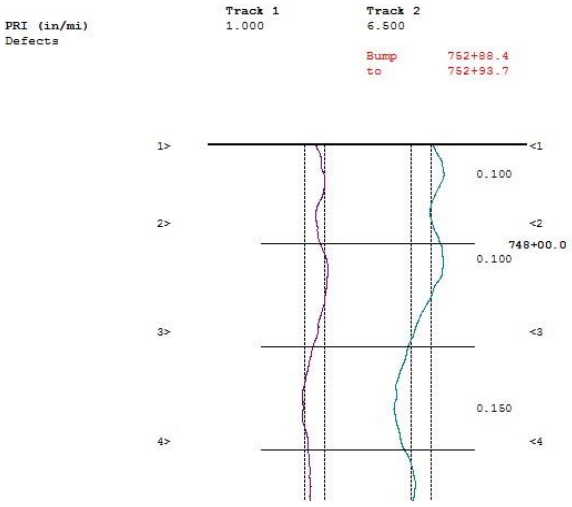


Figure 106. An example of the blanking band in the trace report.

Minimum Scallop Height

The minimum scallop height is the minimum deviation height from the blanking band or null line. Frequently, the value for minimum scallop height is 0.035 or 0.9mm, which is the default value for the Profiler V3 program.

Minimum Scallop Width

The minimum scallop width is traditionally 2 feet (0.61 meters). Review the Department of Transportation
smoothness specification that pertains to the project. The minimum scallop distance is the minimum longitudinal length (the direction of traffic) that is used to find the deviations of the profile off of the null line or blanking band. The setting of 2 feet or 0.61 meters is the default setting for Profiler V3.

Scallop Resolution

The scallop resolution is the accuracy of the height measurement. Current equipment is accurate to 0.01 inches, the default value for Profiler V3 software. A resolution of one-hundredth of an inch means that the scallop heights will always be rounded to the hundredth decimal. Consult the recent smoothness specification released by the overseeing agency to confirm the scallop resolution value.

Reset File Settings

Selecting this icon brings all values in Settings to their default program values.

Minimum Scallop Height Inclusive

When this box is selected, the minimum scallop height will be included as a scallop. Meaning, if the minimum scallop height is 0.035, 0.035 will be the minimum instead of 0.0351.

HRI

The Half Car Ride Index (HRI) is found by applying IRI to an average of two profiles. HRI uses a half car simulation, unlike IRI which uses a quarter car simulation. To calculate the HRI in Profiler V3, select HRI from the Analysis Type drop down menu and verify the settings of filter length based on the project specifications. Once the filters are correct, select **Apply** to save the settings. To view the calculated HRI, view one of the reports under
View>Report.

RN

The Ride Number (RN) can be calculated in Profiler V3 by selecting RN from the Analysis Type drop down menu and verifying the settings of filter length based on the project specifications. Once the filters are correct, select Apply to save the settings. To view the calculated RN values, view one of the reports under View>Report.

RMS Roughness

The RMS roughness is a ride value method calculated by profile height over a base length of 25 feet. This is how RMS roughness gets inches as it´s units. The RMS Roughness report gives a depiction of the amplitude and wavelength but does not necessarily give the frequency that this amplitude and wavelength occurs. The output is similar to a PSD plot.

Analysis Parameters: Filters

High Pass Filter

The High Pass Filter will remove any trend in the data that is less than the chosen length. The length can be selected by typing the value in the box or by using the arrows to adjust the input.

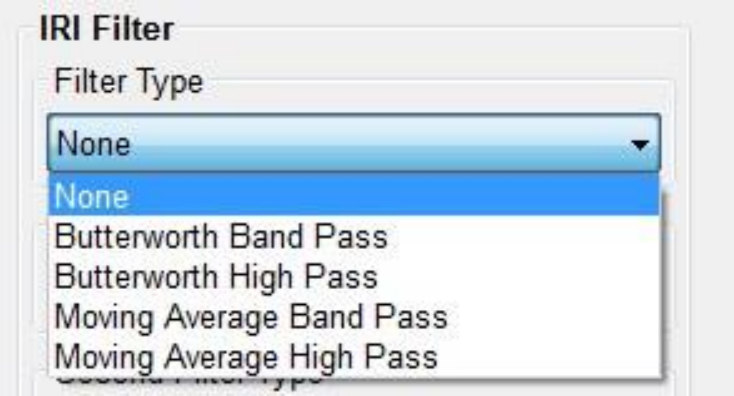


Figure 107. The filters within the IRI analysis parameter window

Low Pass Filter – The Low Pass Filter will remove any trend in the data greater than the chosen length. The length can be selected by typing the value in the box or by using the arrows to adjust the input.

PRI Filter

Type Moving Average

A length of 2.0 feet can be chosen for the Moving Average Filter, depending on the contract specification. The use of the moving average filter was initially used by the Kansas Department of Transportation (see Report No. K-TRAN: KSU-9302 "An Automated System for Determination of Pavement Profile Index and Location of Bumps for Grinding from the Profilograph Traces.)

Butterworth

The third order Butterworth filter has a default length of 2.0 feet. The Butterworth filter is not required for updated profiling specifications. The Butterworth filter was used for the original automated Profilograph systems.

Available Filters:

Moving Average High Pass Filter

Moving Average Band Pass Filter

Butterworth High Pass Filter

Butterworth Band Pass Filter

Filter Gain—1.00

The filter gain is only used for necessary adjustments while comparing different profiling systems. The filter gain does not need to be used in normal profiling environments. When comparing high speed profiling systems to other Profilograph systems, the filter gain may be used to change the output of the data files. A filter gain setting of 1.00 does not affect the collected data. For typical profiling, use the default setting of 1.

Localized Roughness

Localized roughness refers to the bumps and dips that occur over a determined distance.

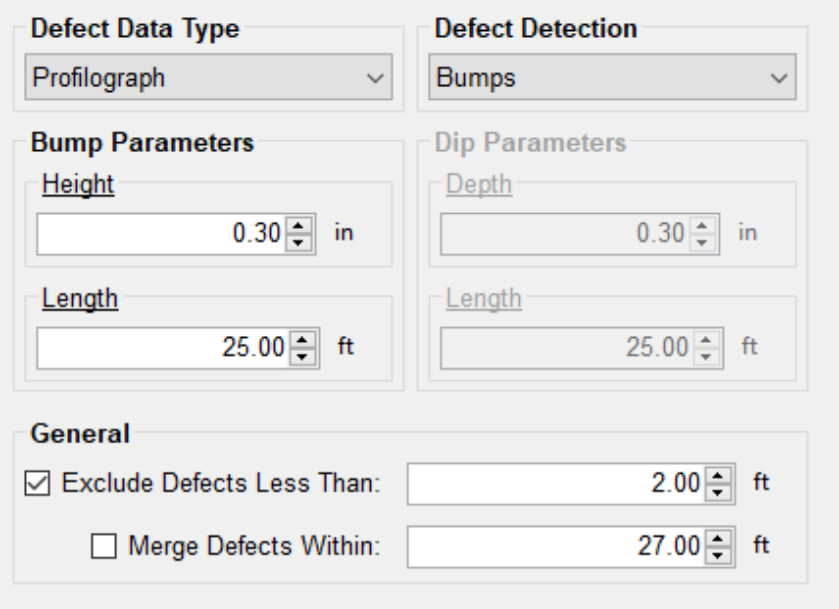


Figure 108. Profilograph Localized Roughness Bumps and Dips

Defect Detection

The operator may choose the mode of defect detection in Profiler V3. The options to choose from are Bumps, Dips, Both, and None. To select the type, use the drop down menu labeled Defect Detection. ***No filters are associated with localized roughness***. "Both" is selected by default.

If only one defect type is chosen, be sure to change the correct settings. Do not change the dip parameters instead of the bump parameters by mistake. The report section of Profiler V3 can be used to review the settings and traces of the collection.

Bump Parameters Height

Bump height is the maximum distance that a profile may deviate within the width of the bump. The width of the bump is the length of a Profilograph, or 25 feet (7.62 meters). A typical value for bump height is 0.3 inches. When the settings are changed for the bump parameters, always select **Apply** to save changes.

Width

The width of a bump is based on the length of a Profilograph; 25 feet or 7.62 meters. This is the default value for the Profiler software.

Dip Parameters

Depth

The depth of a dip is the maximum distance a profile trace may deviate within the width of the dip (25 ft or 7.62 m). The default value for dip height is 0.4 inches or 10.2 millimeters. When the settings are changed for the dip parameters, always select **Apply** to save changes.

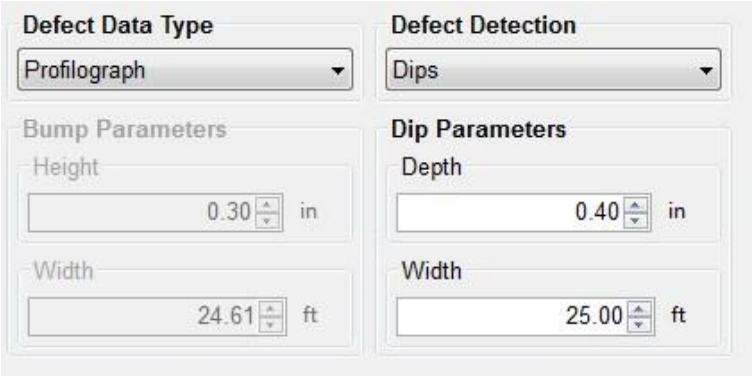


Figure 109. Reporting only dips

Width

The defect width is based on the length of the original SSI-Cox profilograph (25ft), as the system couldn't physically measure widths greater than itself. 25 ft or 7.62m is the default value for the Profiler

Localized Roughness/Defect Data Type

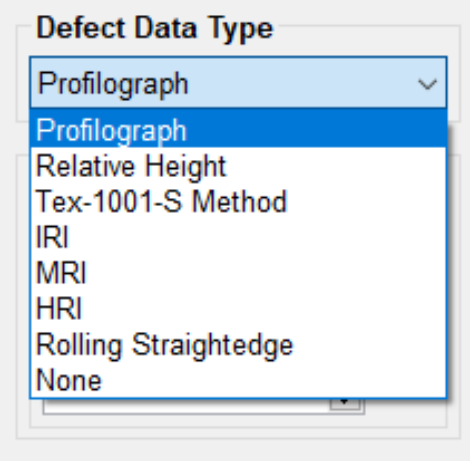


Figure 110. Defect detection types

Profilograph

The Profilograph defect data type is the most common method used to find defects. The settings are the same as described above in Analysis Parameters, defect detection, bump parameters and dip parameters.

Relative Height

Relative Height defect data type finds the defects of the profiled surface through the local differences in the trace. The settings required to be inputted within the Localized Roughness tab of the Settings Window are the bump and/or dip parameters.

Texas-1001-S Method

The Texas 1001-S Method is used mainly by the Texas DOT for profiling with inertial profilers. The procedures and information for this test method can be found on the Texas DOT website; a direct link is below.

ftp://ftp.dot.state.tx.us/pub/txdot-info/cst/TMS/1000-S_series/pdfs/spe1001.pdf

The Texas-1001-S method detects localized roughness (defects) of the profiled surface by applying the base length and the threshold values saved in the Settings Window.

IRI

When IRI Defect Data type is selected, the IRI calculation will be used to find the road's defects (localized roughness) of the profiled surface. If this setting is selected the IRI ride value will not be shown in the summary. To list the IRI ride values on the reports, select the analysis type to be IRI in the Analysis Parameters tab. The ride interval is set (usually to 25 feet, in English units) and is used as a sliding guide across the profile. When the summation of the profile's IRI exceeds the threshold, the entire continuous length which exceeds the threshold will be an area of localized roughness.

General in Localized Roughness

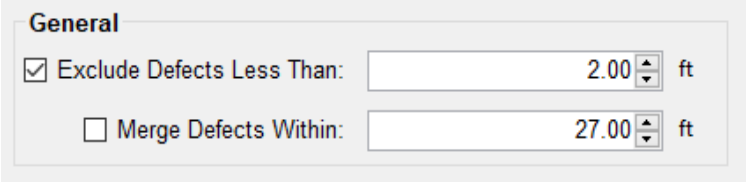


Figure 111. General Option in Localized Roughness

Merge Defects within:

The operator is able to merge multiple defects into one defect to eliminate high frequency grinding patterns. The action of merging defects does not affect the ride values or the defect heights. Merging adjusts the start and end stationing of two defects into one length. The default value of the merge defects tool is 5 feet. To use this feature, select the check box next to "Merge Defects Within."

Exclude Defects Less Than

The operator can choose to exclude defects that are smaller than a certain threshold.

Faulting

Faulting options are found under Analysis Settings. Choose the Detection Method, the Nominal Spacing and the Window size.

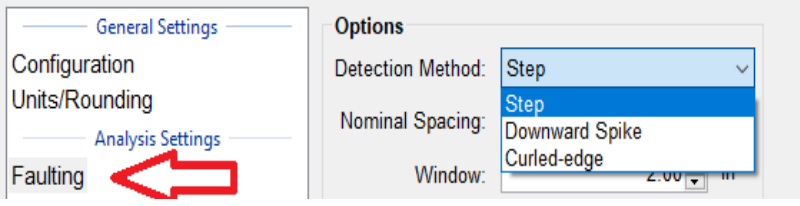


Figure 112. Faulting Options under Analysis Settings

Report Settings

Basic Preferences

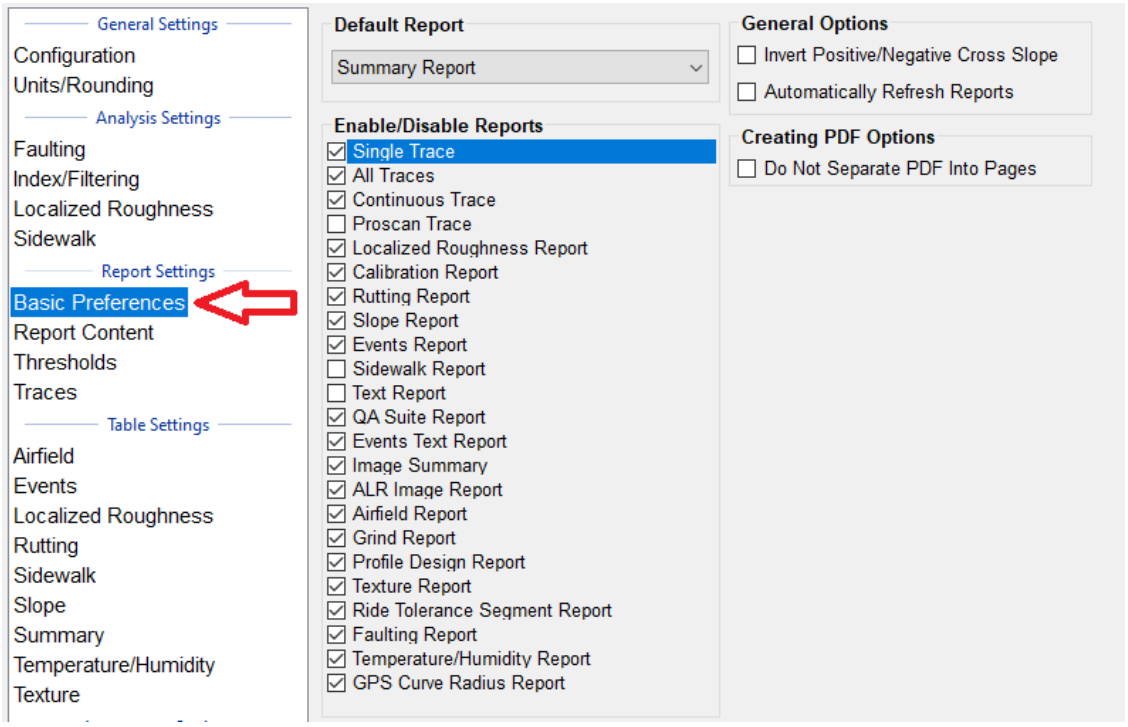


Figure 113. Basic Preferences under Report Settings

Enable/Disable Reports

This feature allows the user to select the type of reports that appear in the drop-down menu. To have a report not be displayed in the drop-down menu, deselect the check box. These reports will be reflected in the 'Default Report' dropdown menu above and also in the Reports Section of Profiler V3.

Report Content

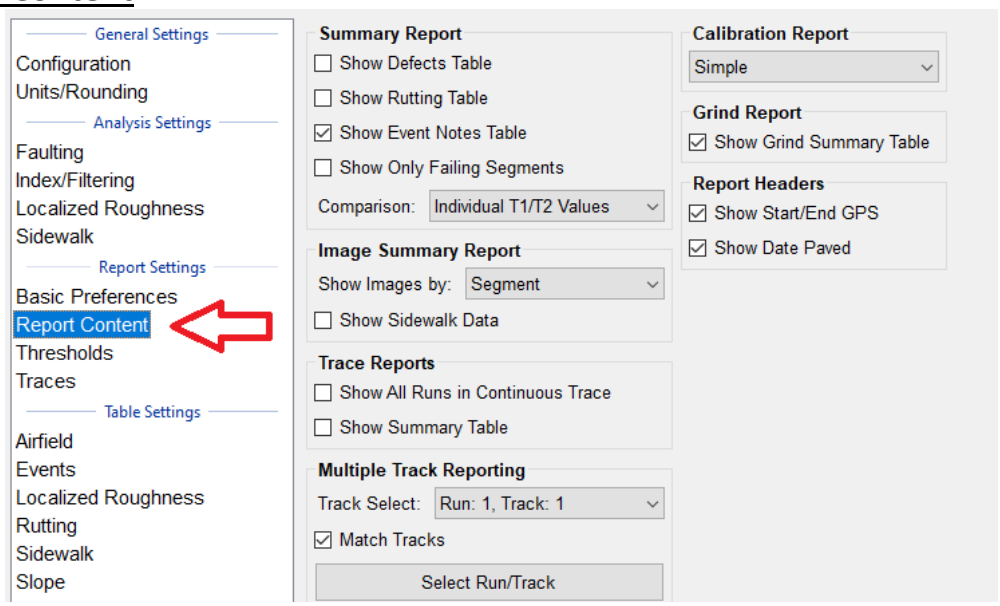


Figure 114. Report Content Under Report Settings

Summary Report

Choose which parameters to show in the Summary Report by clicking on the checkbox next to the following options: Show Defects Table, Show Rutting Table, Show Event Notes Table, Show Only Failing Segments. Below, the operator can choose whether to show Individual track 1 and track 2 Values or an Average for track 1 and track 2 values.

Image Summary Report

This section of the Report Content Tab allows for the operator to choose how to show the images collected (applicable to systems with a camera). The images can be shown by Run, Segment, Image or All. To configure for sidewalk data, check the "Use Sidewalk Data" box.

Trace Reports

Choose to Show All Runs in a Continuous Trace and/or show the summary table by clicking on the checkboxes next to each option. Track 1 will always be the left driverside laser (Wheelpath).

Calibration Reports

Simple Calibration Report

The simple report contains information about the software version and the calibration summary. The included calibrations are the accelerometer calibration constants, distance calibration counts, and inclinometer calibration settings.

Extended Calibration Report

The extended report has the calibration and the verification data from the last verification procedures. The verifications for the inclinometer, height sensor, and the bounce test are all included along with the calibrations for the accelerometer, inclinometer, and distance encoder.

Grind Report and Report Header

Choose to show the Grind Report Summary Table and choose the Report Header Options.

Multiple Track Reporting/Track Select

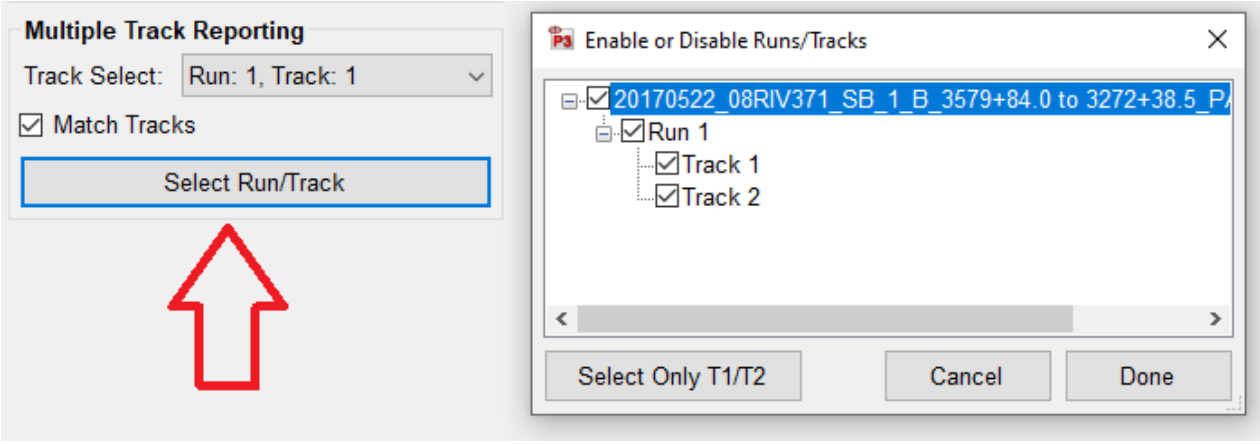


Figure 115. The Multiple Track Reporting tool

Track Select is the tool that is used to select the track which will to be shown in the reports. From the drop-down menu, select a single track based on the label of [Run: Number, Track: Number].

When Match Tracks is not selected, the reports will only show one trace. The selected run in the drop-down menu will be the only run shown in the Reports of Single Trace, Continuous Trace, and All Traces.
To plot multiple or all tracks that are saved within the file, select Match Tracks. See below for information on Match Tracks. When Match Tracks is selected, the run shown on the collapsed Track Select drop down menu will be on the left side of the trace in the report. The figure above will have Run 1, Track 1 on the left side trace report.
To report specific runs and tracks, select the "Select Runs" under Multiple Track Reporting. Here the user can select certain tracks or runs that will be included in the reports, localized roughness and ride value calculations.

Match Tracks
When the Match Tracks check box is selected, all of the tracks associated with the file will be displayed in the reports of Single Trace, Continuous Trace, and All Traces.
With Profilograph profiles for the Profilograph, there are only two-wheel paths, while with some High-Speed Profiling Systems there have three traces. When dealing with multiple traces, the Track Select can change the order in which the tracks are displayed in the reports. The track that is selected in the drop-down menu within "Track Select" will be the trace that is on the left side of the report of the single trace, continuous trace and all traces plots. In order to save changes made to the Multiple Trace Reporting Section, always select **Apply**.

Thresholds

Ride Index
The operator can choose the Over and Under thresholds limits for the ride index. Segment values over the Over limit will appear in red in the report for easy identification. Values under the Under limit will appear in blue in the report.

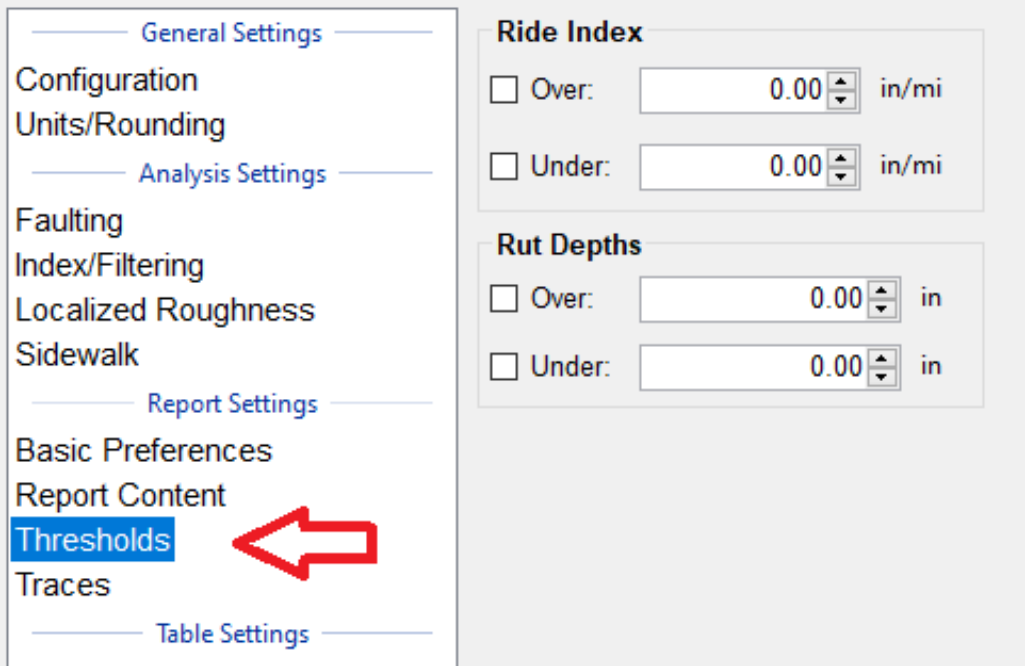


Figure 116. Threshold options under Report Settings

Rut Depths
For laser systems with a center laser, the operator can choose over and under limits for the RUT depth.

Traces

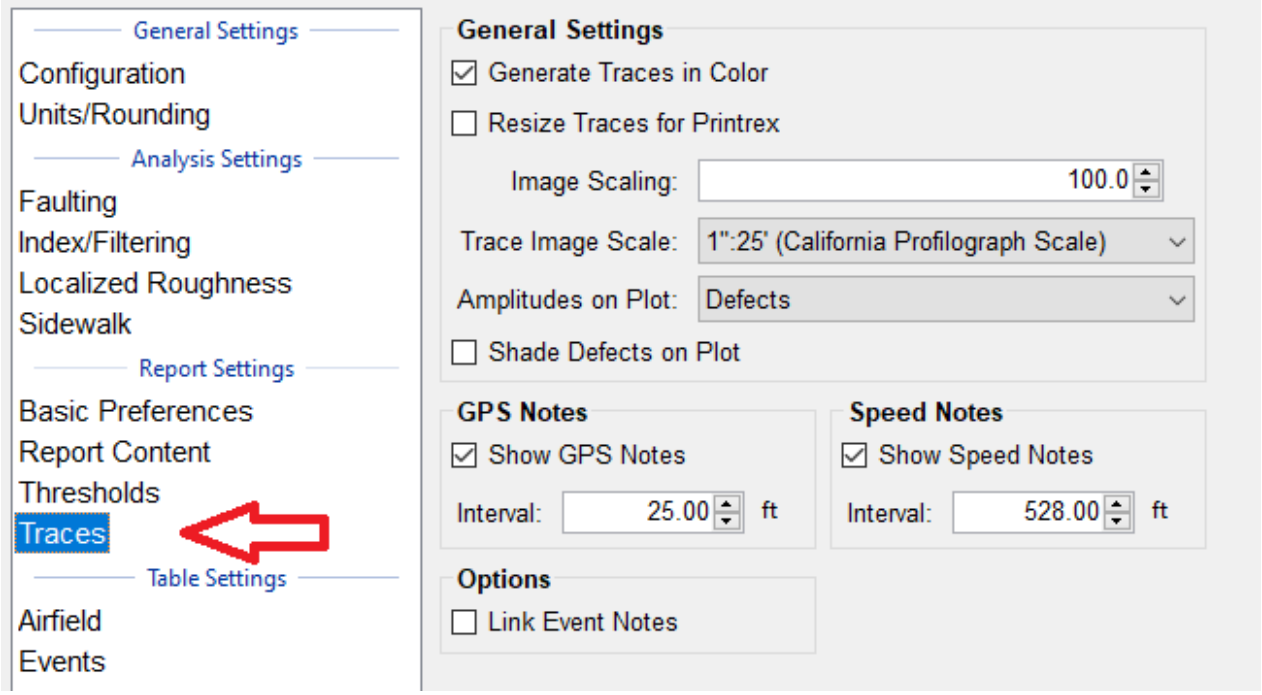


Figure 117. The Traces options under Report Settings

General Trace Settings

The operator can choose to generate the traces in color and resize traces for the Printex Thermal printer. Image Scaling can also be changed along with the Trace Image Scale.

Amplitudes on Plot

The operator has the option of showing the amplitudes for either the scallops or the defects on the plot. When comparing the reports to the SSI spreadsheet defects templates, the operators should choose to show only the defect heights. Scallops are the deviations of the trace outside of the centerline or blanking band in PRI analysis. The defect heights will also be shown when scallops are selected, however there will be more labels on the deviations.

Note Reporting

GPS Notes

To have the GPS notes included in the trace report, select this box. If this box is not selected, the GPS notes will not be shown at the bottom of the report.

Speed Notes

To have the speed notes included in the printed report, the check box to the left of "Report Speed Notes" should be selected. To change the interval which the notes are reported, select the "Customize Reporting Intervals" icon. If changes are made, select **Apply**.

Customize Reporting Intervals (GPS/Speed Notes)

The reporting intervals are the distances traveled while collecting data to between a GPS and or the Speed note on the report. A new note will be shown each time the distance of the interval is traveled.

Tables Settings

Select content and options for all the different tables available. Certain tables like Rutting, Sidewalk, Slope, and Texture are specific to the profiling system. For example, the Rutting table only applies to laser systems with a center laser. The Slope table only applies to systems with IMUs including some laser systems and the CS8600 system. The Sidewalk table only applies to Sidewalk systems. The Texture table only applies to systems with texture capabilities.

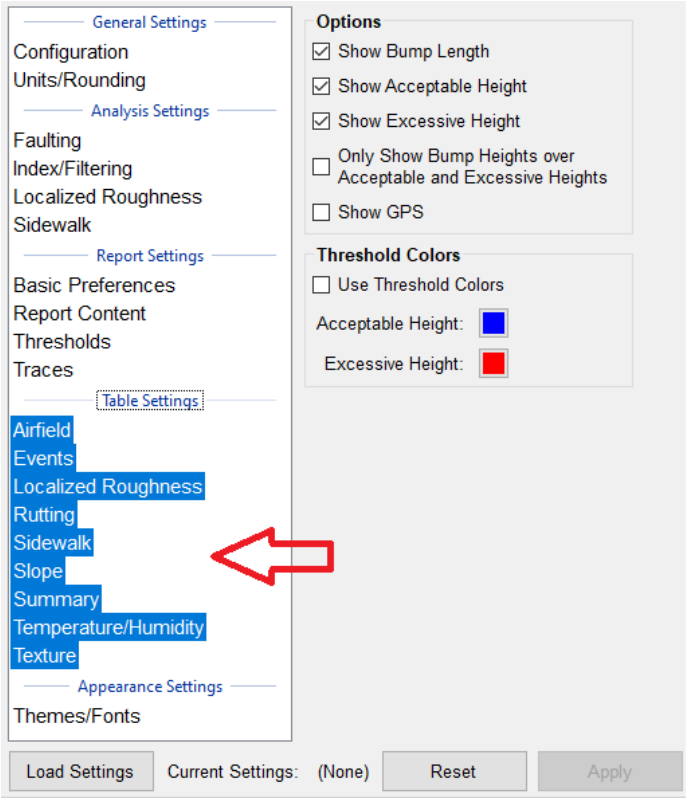


Figure 118.The Table options in Report Settings.

Appearance Settings

Themes/Fonts

Profiler V3 lets the operator choose between two different Reports Themes: Classic (default) and Light. The Font can also be changed along with the Threshold Colors and the Defect Colors.

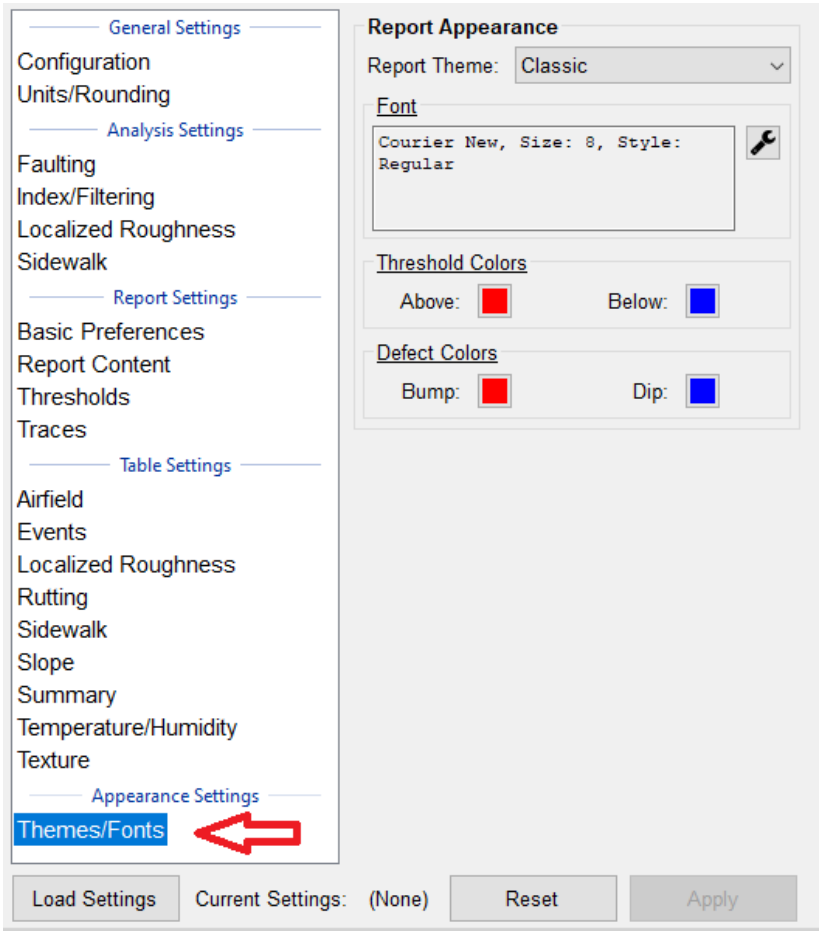


Figure 119. Themes and Fonts option under Appearance settings.

View

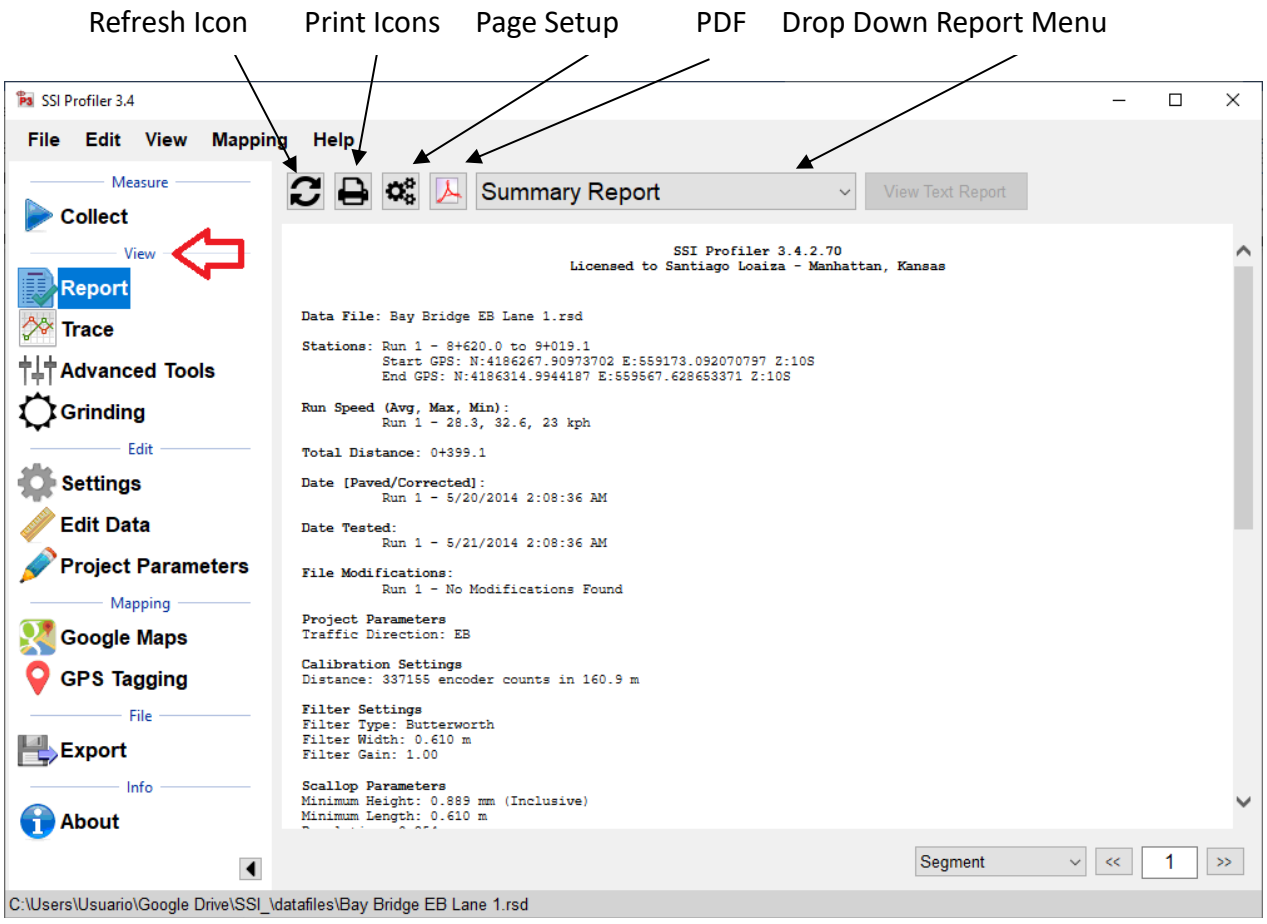


Figure 120. Summary header for single trace report

Report

Refresh

It is required to refresh the Report window whenever a change is made to the Project Parameters, Settings, or Report Options. The refresh icon is located at the top left of the Report window. Select the refresh button and verify that the information is accurate before printing. Automatically Refresh may be selected in Tracks/Segments settings window. With this selected, reports will automatically refresh when changes are made.

Print

To print a report select the print icon in the Report window or select CTRL+P on the keyboard. The print window will appear. Within the window, select the printer to be used and verify that the printer settings are correct. When 'Print' is selected, the document will be sent to the printer.

If more printing options are needed, select the 'Preferences' icon. This icon will open a window that is printer specific that contains information about the orientation, paper size, and image quality.

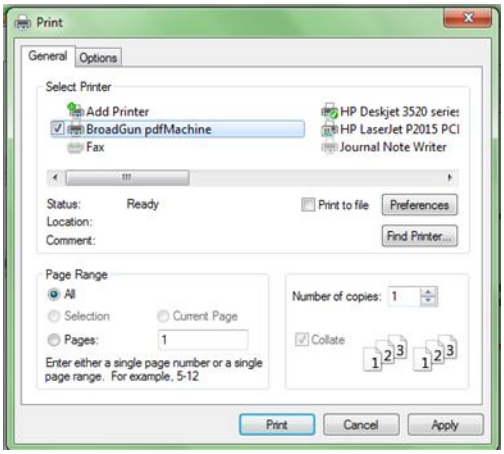


Figure 121. Printing Options

To PDF

The Adobe Symbol between the Printer symbol and the report type will print the current report to PDF format if a PDF printer is installed. Contact SSI support if you are having issues with your PDF printer.

Report Options

The Report Options available in Profiler V3 are Summary Report, Single Trace, All Traces, Continuous Trace, Proscan Trace, Localized Roughness Report, Calibration Report, Rutting Report, Slope Report, Events Report, Sidewalk Report, Text Report, QA Suite Report, Events Text Report, Image Summary, ALR Image Report, Airfield Report, Grind Report, Profile Design Report, Texture Report.

Reports containing Sidewalk data are "Sidewalk Report", "Image Summary Report", and "Texture Report".

The most commonly used reports are the Summary Report, Single Trace, Continuous Trace, and Calibration report. All these reports have the defect locations, localized roughness and information entered in the project parameters.

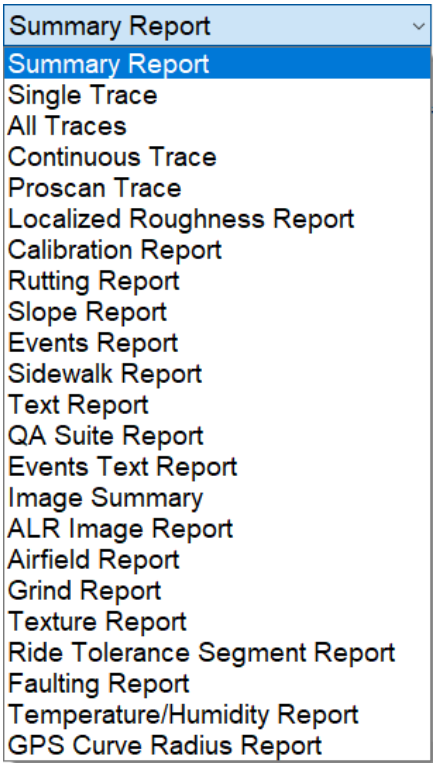


Figure 122. Drop-down menu for the report options

Jump to

Using the arrows in the lower right had side of the screen, the operator can jump from Segment to Segment, Defect, to Defect, Event to Event, Run to Run, and Image to Image. Each parameter function with the appropriate report.

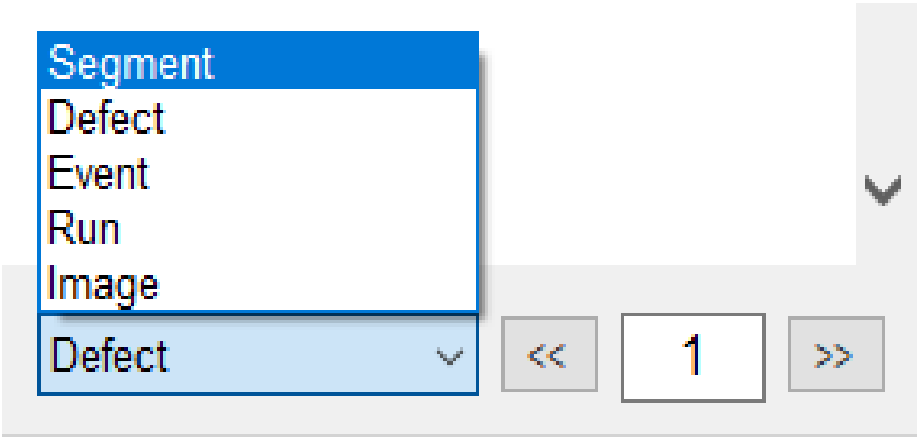


Figure 123. The Jump to navigator

Collect

To collect data the operator should select the Collect Icon when the hardware is attached. Once the hardware is found, the data collection may begin. See the Collection section of this manual for procedures to perform prior and during a collection.

Trace

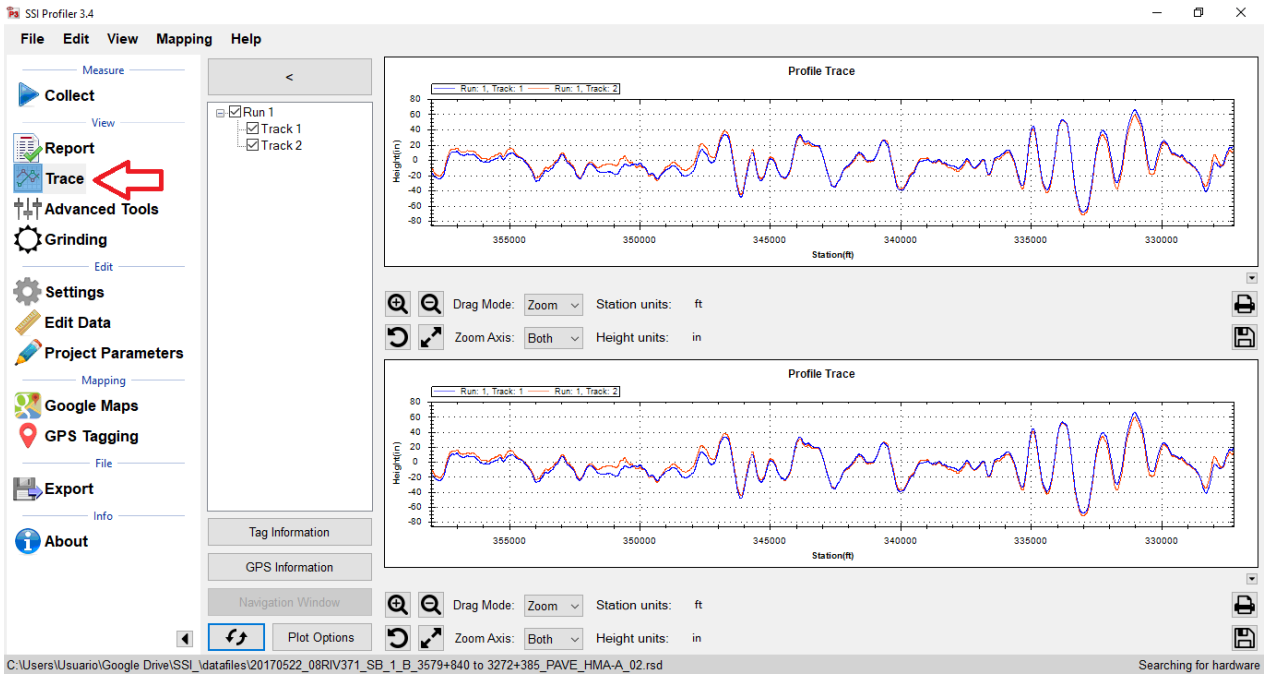


Figure 124: An example of the profile trace

Choosing Tracks for Plotting

To choose tracks for plotting in the trace window, select the check box next to the desired tracks. Once all the necessary tracks are checked, select the refresh icon to view the tracks within the plot.

Whenever a change is made by deselecting a track or checking a new track, select the refresh icon to have it appear in the trace. *If the refresh icon is not selected, the trace will not update and changes will not be shown.* Review the legend to verify that all the selected tracks are shown in the plot.

Refresh

It is required to refresh the Trace window whenever a change is made to the track selections. The refresh icon is located at the bottom left of the Trace window. Select the refresh button and verify that the trace is accurate before a print is made.

Plot Options

Plotter Data Type

The Plot Options button can be found at the bottom of the trace window next to the refresh button. Select between Profile, Continuous IRI, MRI and HRI, Median Profile, Segmented Bar IRI, Brids Eye View, Continuous IRI vs Speed, Rolling Straight Edge, Cross Slope, Running Slope and Rutting Depth.

Settings

Use the checkboxes to select the available options to be applied to the final graph.

Localized Roughness

Select the 'Display Defects' checkbox to show Bumps and/or Dips according to the previously chosen Localized Roughness Settings. Select the 'Display Defect Peak Value' to show the max height of the bumps/dips.

GPS Lock-On

Select the 'Display Current Location' checkbox to indicate GPS position. Select the 'Enable Navigation' checkbox This feature will display a vertical line at the vehicle's current GPS location. This vertical line will move through the trace as the vehicle moves.

Rendering Mode

Under the Rendering Mode section the operator can choose the type of rendering to increase the speed or increase the quality when refreshing the graph. When using the high quality rendering, the time it takes to refresh will be longer, however the resolution of the trace will be optimum.

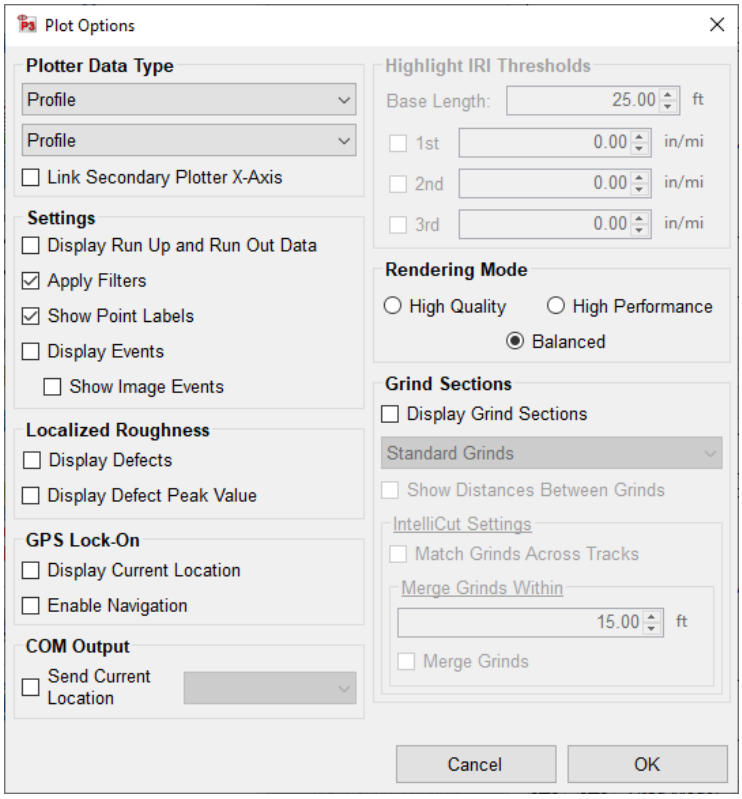


Figure 125. The plotter options window.

Grind Sections

Select the 'Display Grind Section' and then select 'Show Distance Between Grinds' for complete grind information.

COM Output

Select the 'Send Current Location' to output GPS location data to another device

GPS Tag Information

The tag feature allows the user to add exclusions, events and station markers to previously collected data. The system must be connected to GPS for it to work. Use the 'Undo' and 'Undu All' buttons to eliminate any changes.

The 'Set Static Location' button will pop-up the Static Location window allowing the input of a GPS location. The window will also allow the user to select the Location Type. Choose between 'Set Station', 'Start Pause', 'Event', and 'End Pause'.

The 'Import Locations' button will allow the user to import and use previously defined GPS Locations.

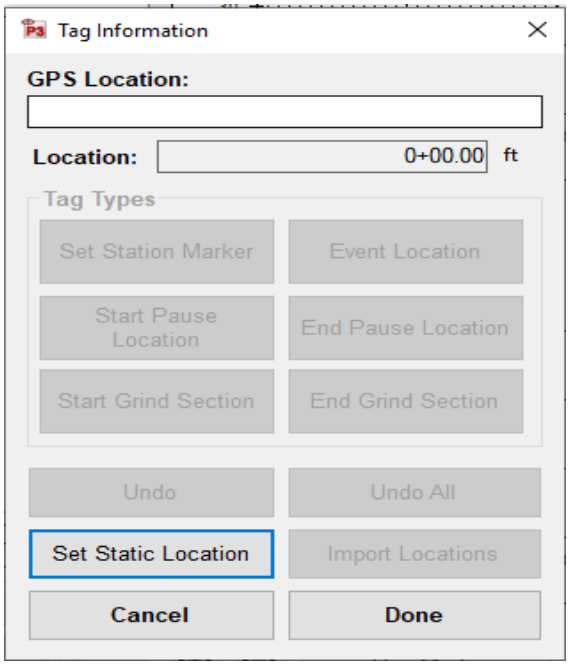


Figure 126. The GPS tag information window

Print

To print the trace, select the Print Icon in the lower right-hand corner of the window or select CTRL+P on the keyboard. The print window will appear at this time. Within the window, select the printer to be used and verify that the printer settings are correct. When 'Print' is selected, the document will be sent to the printer.
If more printing options are needed, select the 'Preferences' icon. This icon will open a window that is printer specific containing information about the orientation, paper size, and image quality.

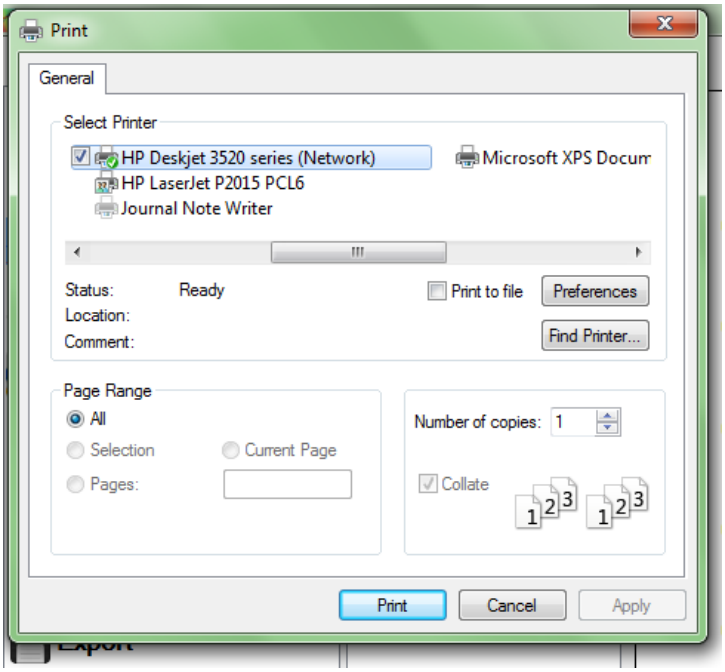


Figure 127. Print window after print icon pressed

Save

Click on the Save icon in the lower right-hand corner of the trace window. When the Save icon is selected, the user is able to save the trace as an image in png, gif, jpeg, tiff, and bmp format. The image can be saved on the operating computer or on a connected external device.

Zoom

To zoom in the trace window, verify that the Pan/Zoom Mode icon displays 'Pan Mode.' To zoom in on the plot, left click and hold while dragging the cursor over the area to be blown up. While dragging the cursor, a dotted box will appear. This dotted box contains the area of the plot that will be blown up, by being fit to the size of the plot window.

Zoom Previous Icon

When Zoom Previous is selected, the last 'zoom in' action is undone.

Zoom Fit Icon

To return to the original aspect ratio, also known as the home view, select Zoom Fit.

Pan/Zoom Mode Icon

The Pan/Zoom Mode icon has two functions. When Pan Mode is displayed, the cursor may be used to zoom in on the plot. To zoom in on the plot, hold down the left mouse button and move the cursor over the plot area to be blown up. The dashed box contains the area that will be enlarged.
When Zoom Mode is displayed, the operator may use the cursor to pan across the plot area. The pan mode allows the user to navigate through the plot area without changing the aspect ratio, or zooming out.

Units for Height and Station

The units for height (y-axis) and stationing (x-axis) can be changed by left clicking upon the current units and selecting the necessary units from the dialogue box that appears. The units available are mils, inches, feet, yard, miles, millimeters, centimeters, meters, and kilometers. The units scale the plot area.

GPS Editing and Tagging

The operator can use the GPS signal to edit the start and stop locations of the collections and add events to the collection.

Advanced Tools

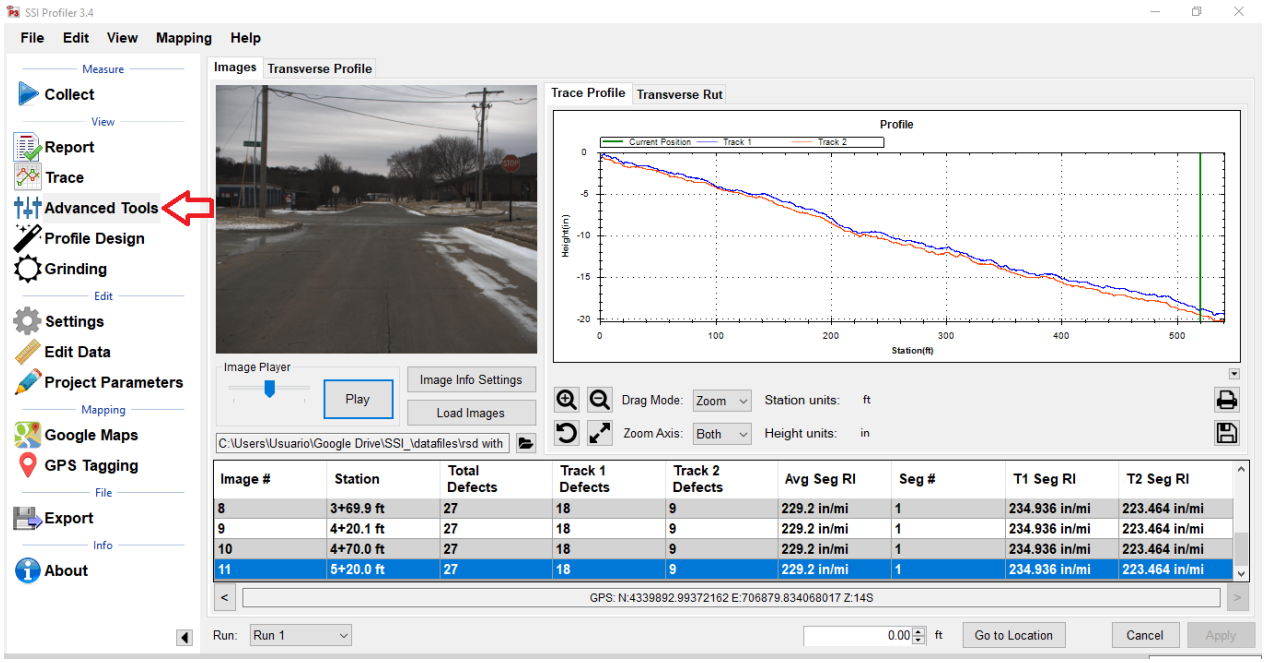


Figure 128. Advanced Tools Images window with an image loaded

Images Window

If there is already a direction path, press the 'Load Images' button above the folder icon. If there is no address, click on the folder icon to browse and select the image folder. Once the ´Load Images´ button is selected, the software will load the images found in the directory listed below the button. The default folder address is where they are initially saved after collection. If the directory where they were initially saved is changed and software closed, the next time Profiler 3 is opened the address box will say ´Image directory not found´ and the folder will have to be found manually by pressing the folder icon. **Displayed content can be modified by right clicking on the header row.**

For CS8600 systems Image #, Station, Seg Cross Slope, Instantaneous Cross Slope, Seg Running Slope, Instantaneous Running Slope, and Level Change can be viewed. Seg Cross/Running Slope computes the average slope over the "Segment Length" which can be configured in Settings>Index/Filtering. Instantaneous Cross/Running Slope displays the slope reading at the station the image was taken plus/minus image offset.

Press the ´Image Info Settings´ button to select the Filter options in the Filter Image Information window. See figure 129. In addition to the options shown in the window, the operator can click on the table parameters to perform multiple filtering options to show only certain characteristics of the collection. The data can be filtered by station, defects or ride value. The software automatically enters the minimum and maximum values for each of these three fields. The units of these parameters can be changed by selecting the current units to enable to drop down menu to choose new units. After the operator has changed the parameters according to the range desired, select “Filter”. The images will reorganize and the new images will not be reverted until the parameters are changed to the original setting (“Reset”).

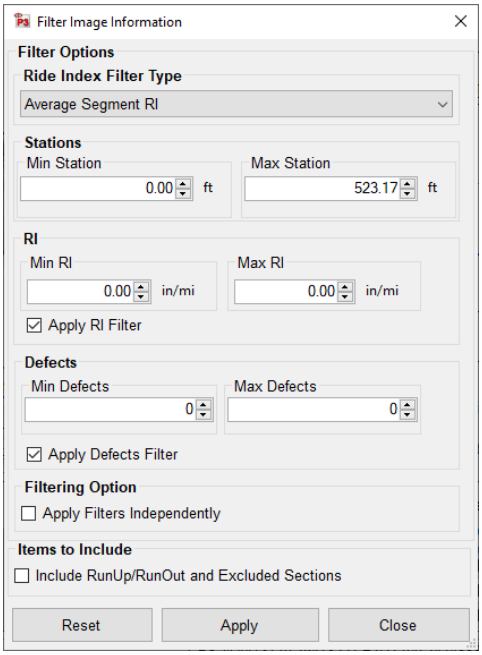


Figure 129. Filter Image Information window

The information in the table below the image will be populated as long as the location is not in the run-up distance and there is sufficient data. If the system was not a full lane width 5-laser system the rutting depths will read ‘N/A’.

The arrow keys on the computer’s keyboard can be used to advance the images. There will be a lag using the computer’s keyboard until the images are populated from the files. After the images are loaded the operator will be able to constantly hold the up/down arrow keys to view a slide show of the collection.

Profile Design

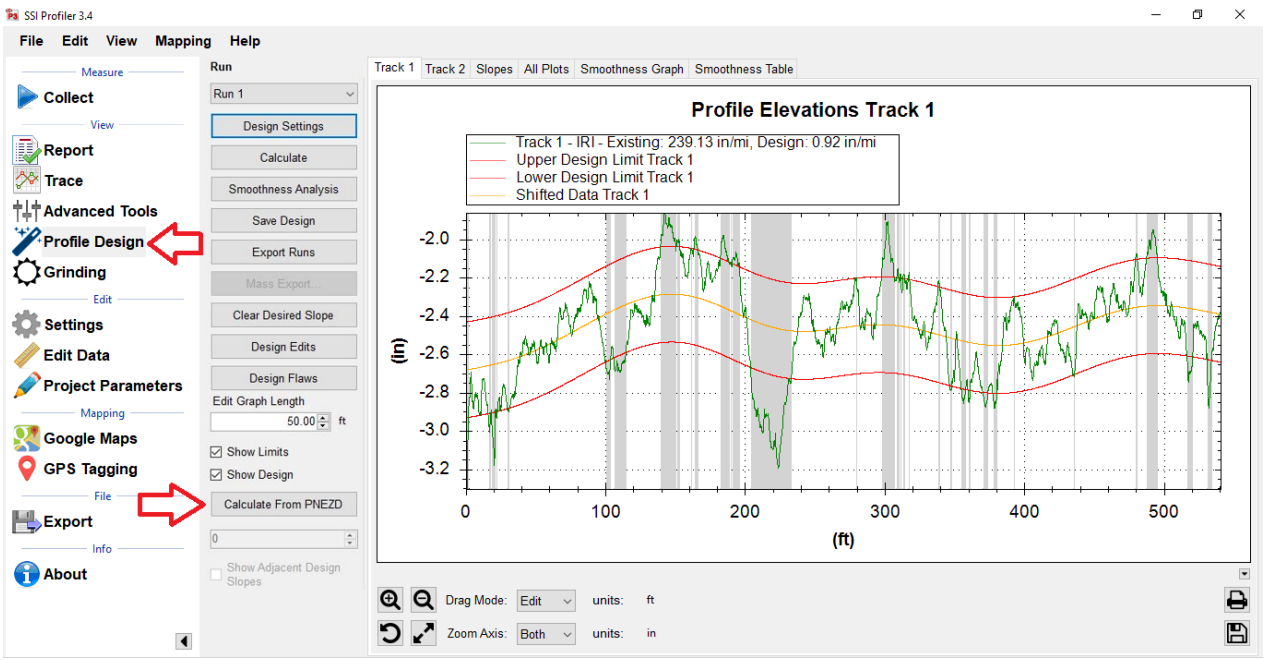


Figure 130. Profile Design window and graph after Calculate Button has been pressed.

Profiler V3 Profile Design is a tool used to create designs for optimized smoothness to be used for variable depth machine control. Profile Design takes user specified min/max depths and cross-slope tolerances to calculate an optimum design for the roadway. It can load in RSD data profiles and cross-slopes or 3D PNEZD longitudinal profile lines and will export to design depth csv tables or 3D PNEZD formats.

Load PNEZD data

3D PNEZD lines can be imported instead of using track profiles from an RSD file. Press the 'Calculate from PNEZD' button signaled at in the figure above. Once the multiple files are selected from the browse window, it will ask for the coordinate system and units that the files are in. Below figureSee below.

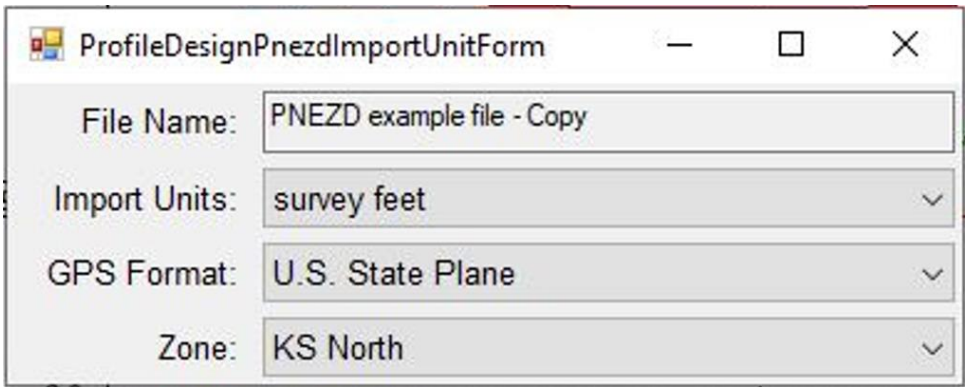


Figure 131. PNEZD Import Window

For each file, it will ask for the units and coordinate system that the file is in. Once set, click the "X" for the window to proceed to the next file. Once all files have been gone through, it will show the files in a list allowing you to order them from left to right for your design. This can be done by selecting the line and changing which file you want for that line from the dropdown. See 132.

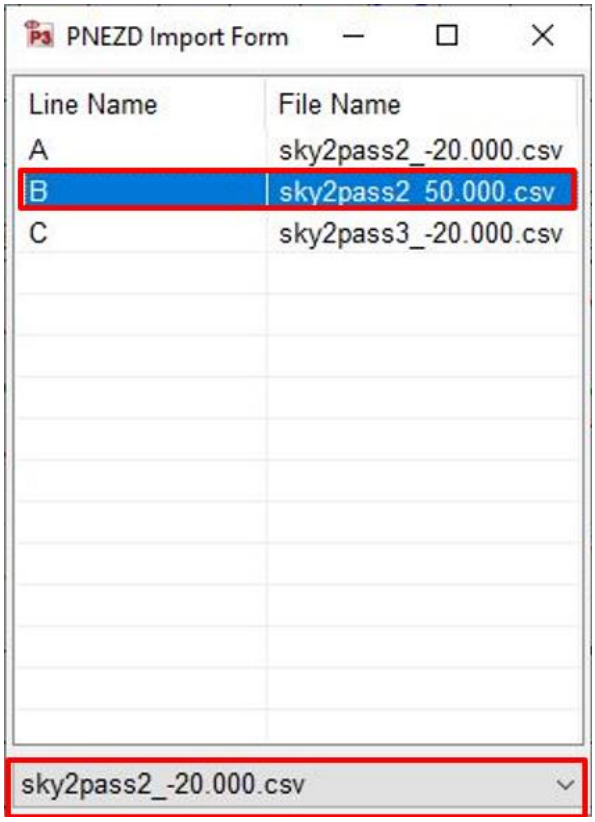


Figure 132. PNEZD line/file ordering

Design Settings

Press the ´Design Settings´ button and choose the Design Type (Milling, Grinding, or Paving). The parameters will change from ¨Fill¨ to ¨Cut¨ depending on the Design Type selection. After selecting the desired Settings and the Export Settings, press ´Done´ for each window and proceed to press the ´Calculate´ button (if you don't have a PNEZD file). The Profile Elevations graph will appear. The operator can choose to perform a Smoothness Analysis, Export Runs, and Clear Desired Slope.

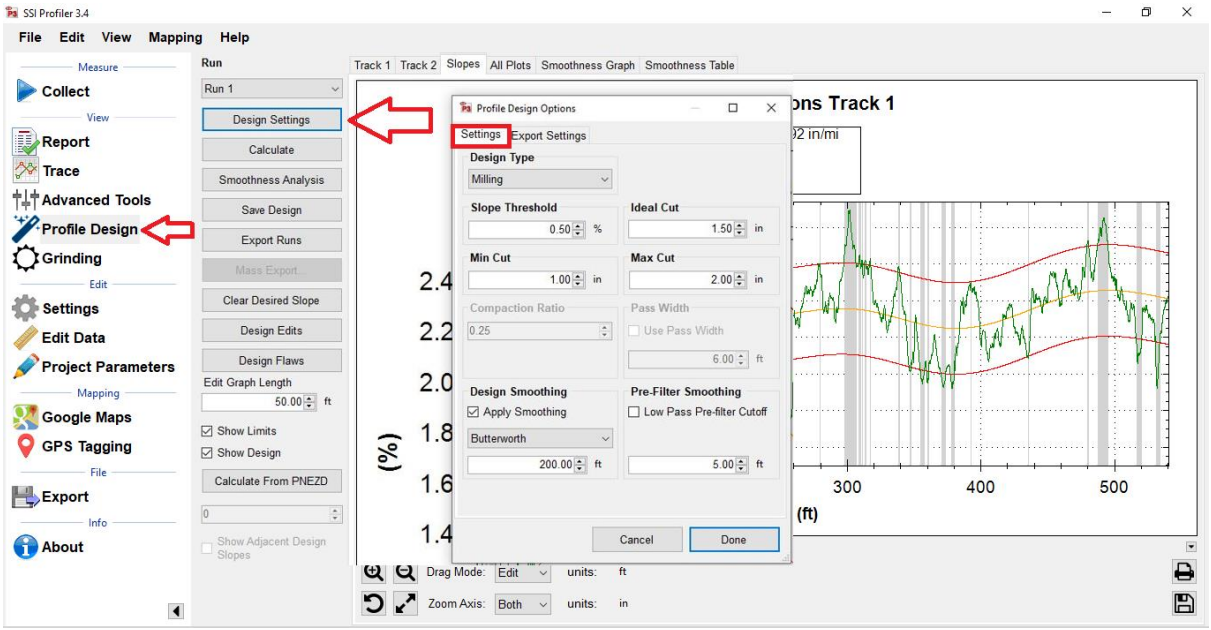


Figure 133. The Profile Design Options window under the Design Settings button

Constraints

The design settings contain some constraints that you are required to enter before you begin. First choose the threshold you would like the design slope to be within. Then enter your Min and Max Depths and Ideal Depth. The optimum ideal depth for doing designs is halfway between the min and max depths. The ideal depth is the depth that each design will be at on average throughout the entire project, so this value is what primarily controls the total volume of material being added or removed over the entire length.

Design Smoothing

The design smoothing allow the road to achieve a design with low IRI. Ideally this is set to 200ft to remove all wavelengths below 200ft (wavelengths contributing to IRI). However, in some scenarios where your min/max depth constraints are too tight, you may have to sacrifice IRI and use a lower smoothing filter to maintain a design that does not go outside of your constraints. In those cases, lengths of 25-100ft filters may help.

Pre-Filter Smoothing

The pre-filter smoothing is used to emulate a ski or other type of low-pass filtering effect on the data before analysis. For example, if machine control used a 30ft ski, use a 30ft moving average pre-filter to mimic the ski before doing the design. Essentially this pre-filter must match whatever you will be using for machine control. If using a basic yo-yo or sonic off the cutting head shroud, you would want to use a very small moving average filter such as 3-5' depending on your cutting head shroud length.

Export Settings

Click on the 'Export Settings' Tab in the Profile Design Options window. The Export Settings have options for the various file output types you wish to export after creating your design as well as units and coordinate system information.

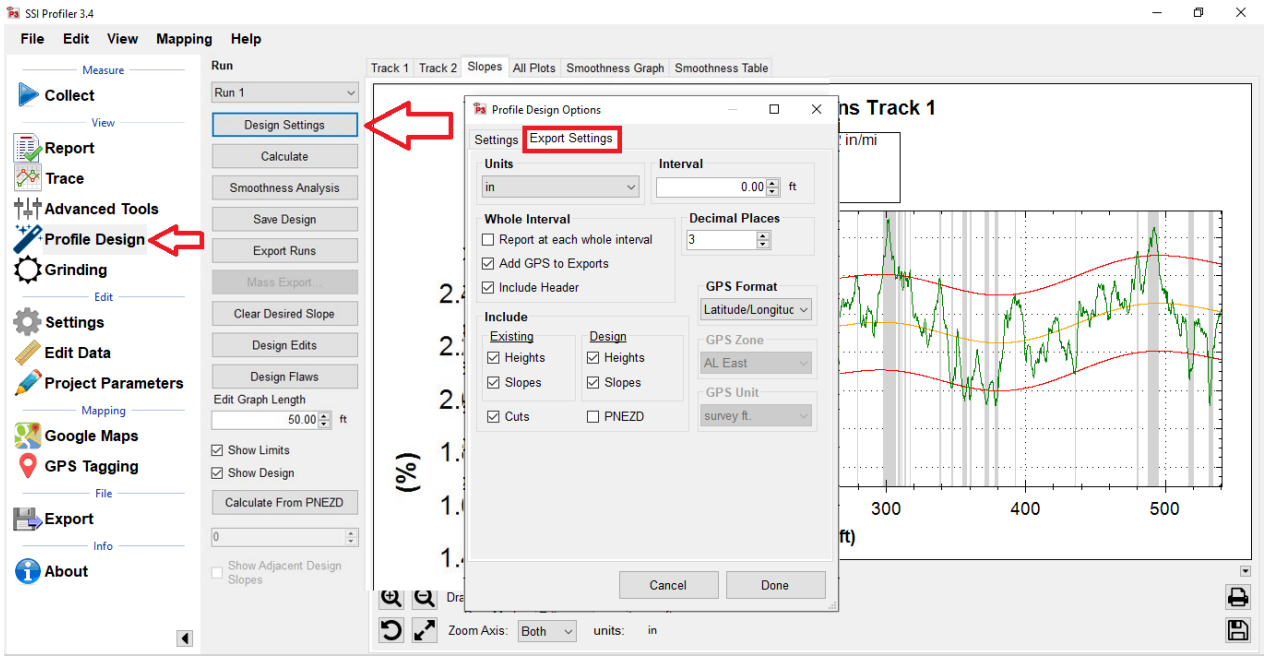


Figure 134. The Export Settings tab window in the Profile Design Options window

Plotting Tabs

At the top of the profile design module, you will see several tabs that allow you to visualize or edit your designs on different plots. Track 1 and Track 2 plots are longitudinal profiles of each track (left and right) with existing and design profiles being shown. The Slope plot shows the existing cross-slope profile of the roadway and the design cross-slope profile. All Plots shows Track 1, Track 2, and Slope all on the same window and is ideal for doing design edits. The smoothness tabs show comparisons of smoothness data before and after the design. See figure below.

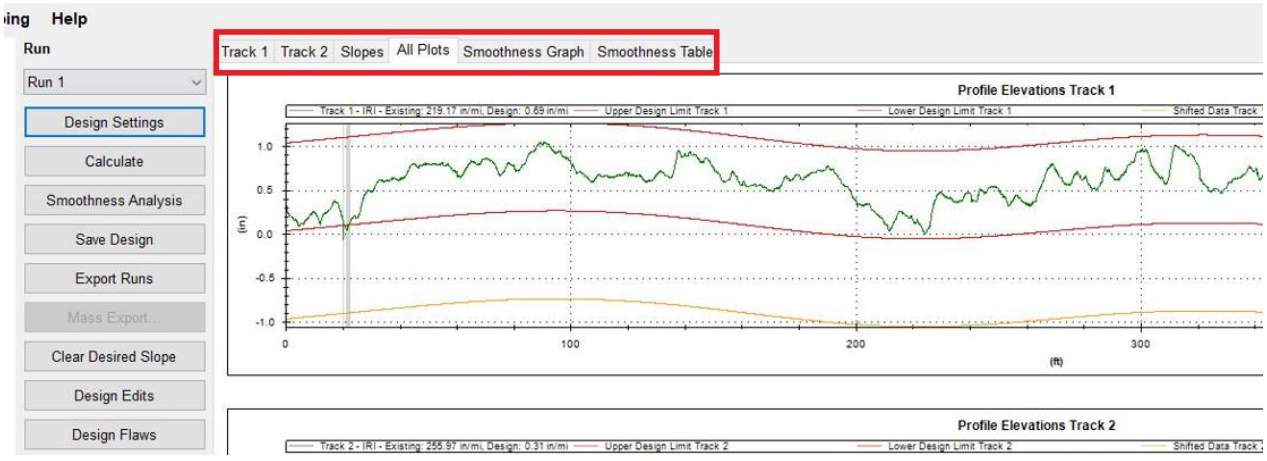


Figure 135. Plotting tabs for the Profile Design

Drawing slopes

If the user wants to make the design match a specific slope throughout the project or transition slope through curves, they can do this in the slope tab. You can change the “Drag Mode” to “Draw” using the drop-down as shown below. It is recommended that the user re-calculate the design after drawing or re-drawing their desired slope in order to know what the design will look like with the new slope applied. If you wish to start over on the drawn slopes, the “Clear Desired Slopes” button can be used to erase the user-drawn slopes.

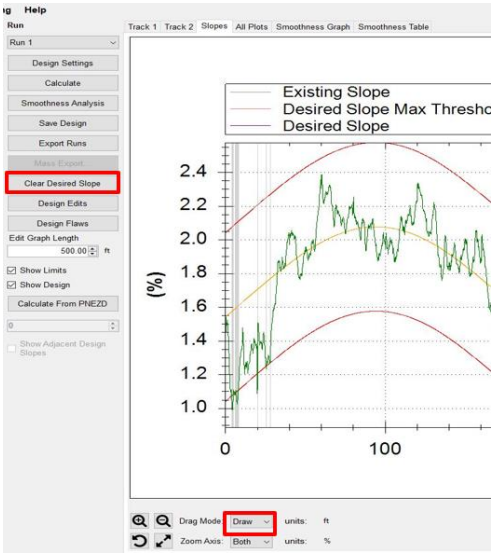


Figure 136. Slope Tab in Profile Design

Multiple Lane Designing

If you used the PNEZD option (with more than 2 lines imported) for multi-lane designing, you can toggle between lanes using the below box. Note that it is handy to draw the slopes for each lane and then “Calculate from PNEZD” again once all lanes’ slopes have been drawn. When drawing slopes, you can enable the “show adjacent design slopes” to see the previous lane’s slope profile.

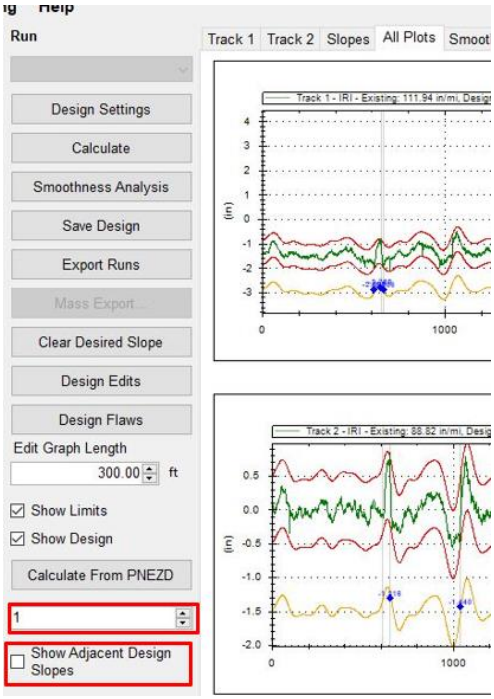


Figure 137. Multiple Lane Designing

Design Flaws

Once you have generated a starting design, you may notice that some areas of the project are out of tolerance based on your constraints and are classified as “Design Flaws”. For example, any time the design slope goes outside the user-specified tolerance, or anytime the design profiles go outside the min/max depths. These areas require the user’s attention to be fixed be either changing the design settings or manually editing the areas by hand. You can click on any design flaw and it will zoom your graphs in to that location so you can then proceed to edit your design to fix the flaw.

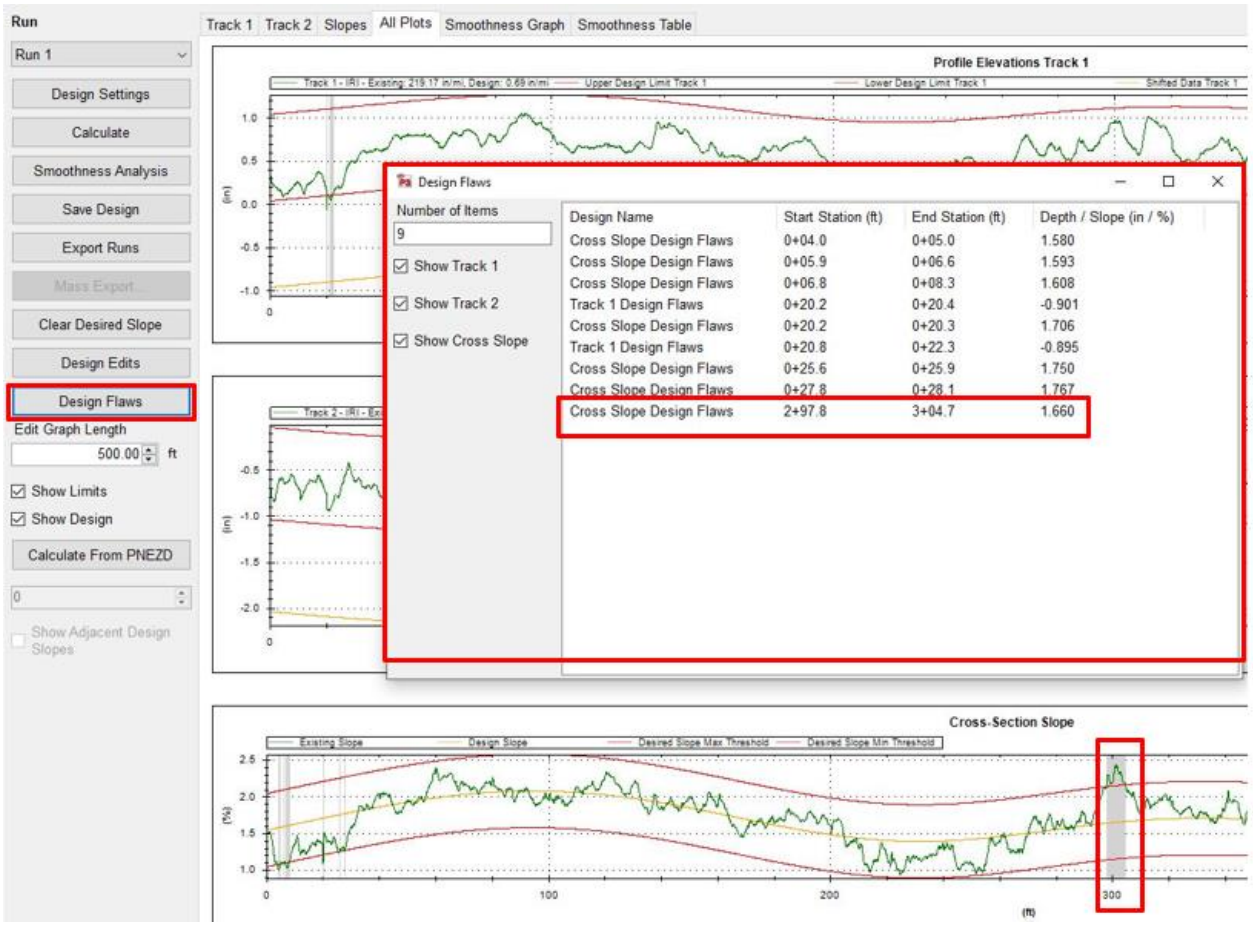


Figure 138. Design Flaws button and table

Edit Designs

Once the user is satisfied with the baseline design, they can start navigating to flaws to fix them using the manual “edit” mode. The user can begin this process by going to whatever plot they desire and selecting “edit” for the drag mode of the plot. See below. Once the Edit mode is enabled, the user can then drag the red “tolerance” lines up or down to make them fit around the green existing line. You can modify the length of which the drag affects the red line but changing the “Edit Graph Length” parameter. ***NOTE: If using multiple lanes with PNEZD files, if a shared profile line is modified, it will affect the adjacent lane’s profile (since it is the same profile line) and therefore change the adjacent lane’s slope.

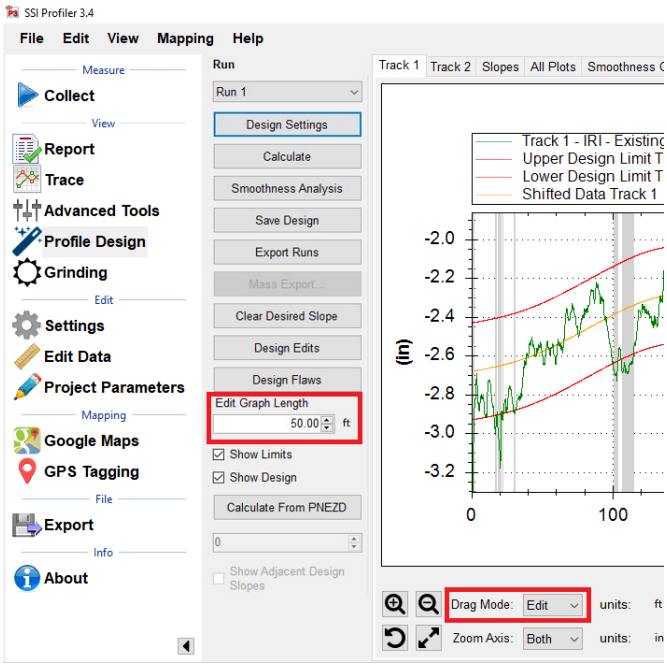


Figure 139. Edit Design in Profile Design

Design Edits Table

Any time that the baseline design has been edited by the user, a blue dot will show up where that edit was applied. These locations are also shown in the design edits window as shown below. The user can delete edits if they do not want them anymore. To quickly access this window, the user can right click on the blue dot to pull up the edit and delete it in the table.

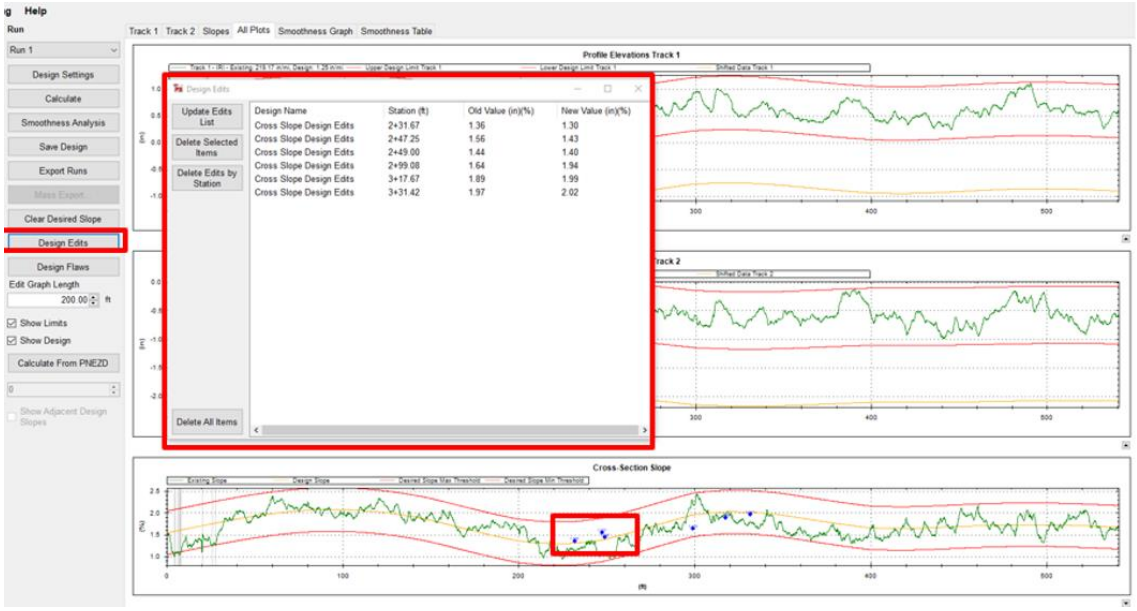


Figure 140. The edit designs table

Smoothness Analysis

Once the design has been finalized, the user can click the “smoothness analysis” button in order for the software to calculate and show the comparisons of the existing and design profiles for smoothness. The results can be found in the Smoothness Graph and Smoothness Table tabs.

Figure 141. Smoothness Graphs for Profile Design

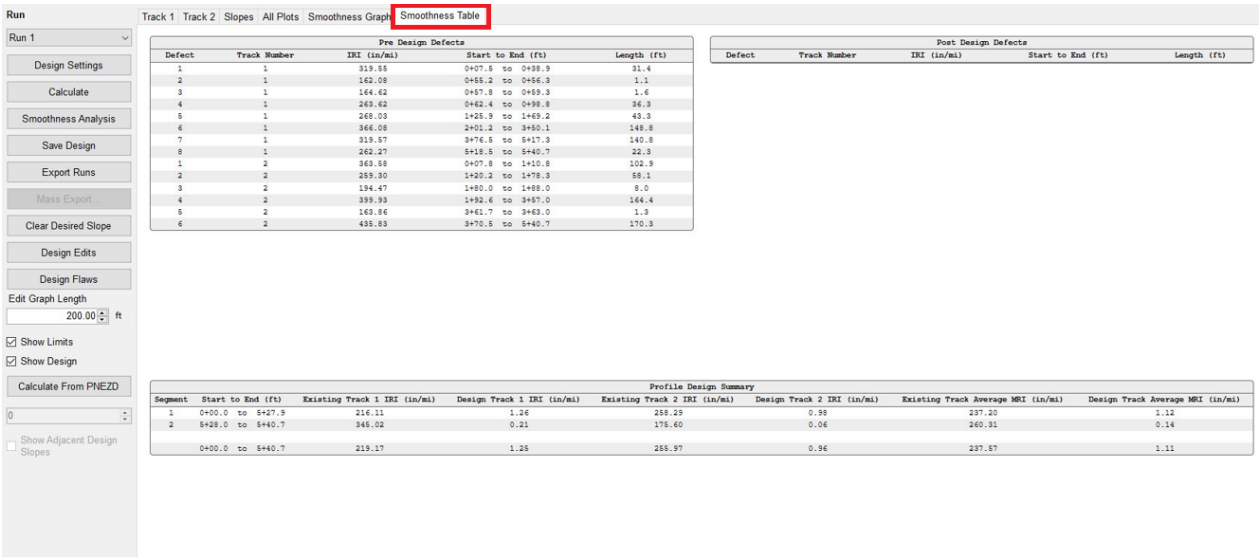


Figure 142. Smoothness Tables in Profile Design

Design export:

Once the design is finalized and the smoothness graphs/tables are approved, export the data according to the design export settings explained earlier. Use the "export runs" button.

Save Design

The design can be saved to the RSD file by clicking "Save Design" button.

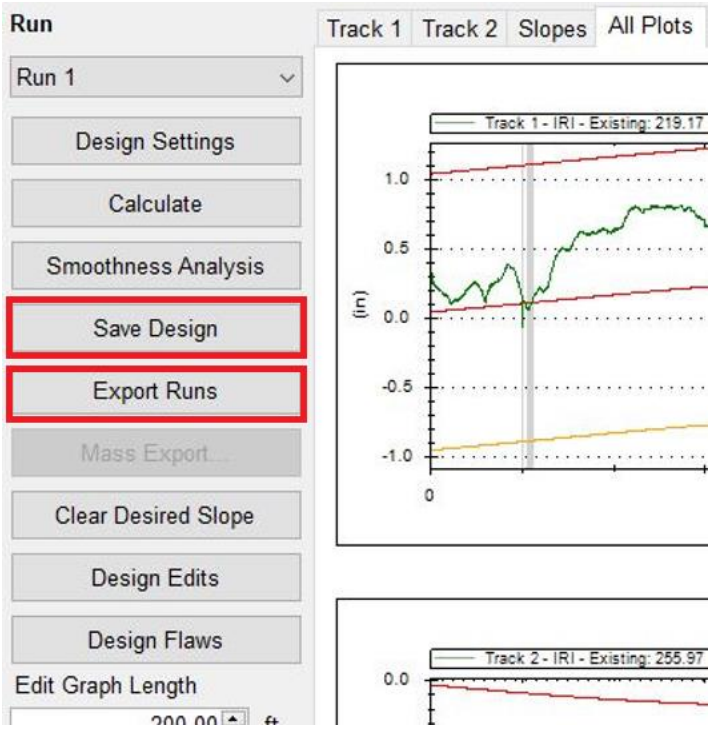


Figure 143. Save Design and Export Runs buttons in Profile Design

IntelliCut (Grinding/Milling/Paving)

IntelliCut, for grinding, milling and paving simulation is included in a deluxe license of Profiler. Go to the IntelliCut main tab and press the 'Load File' button. Buttons will be activated, and the first Grinds Location graph will appear (Grinding is the default analysis, see below for Milling and Paving). ***Navigation tolerances depend on GPS accuracy used to collect and layout roughness.***

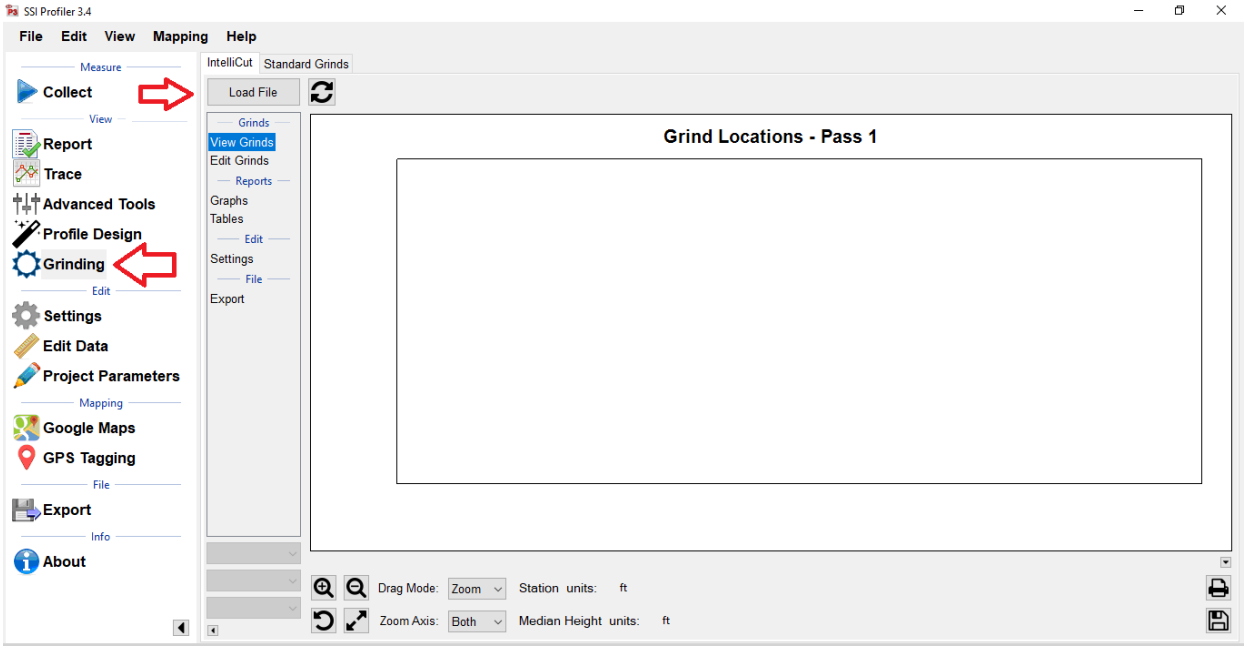


Figure 144. Press the 'Load File' button under IntelliCut main tab

Grinding

After the surface has been profiled, Grinding is typically used to eliminate ALR (Areas of Localized Roughness). These areas can be determined in SSI Profiler's Localized Roughness section. Note: Grinding ALR does not always have the best result in removing roughness because ALR can now include dips and bumps. Grinding dips takes a special procedure.

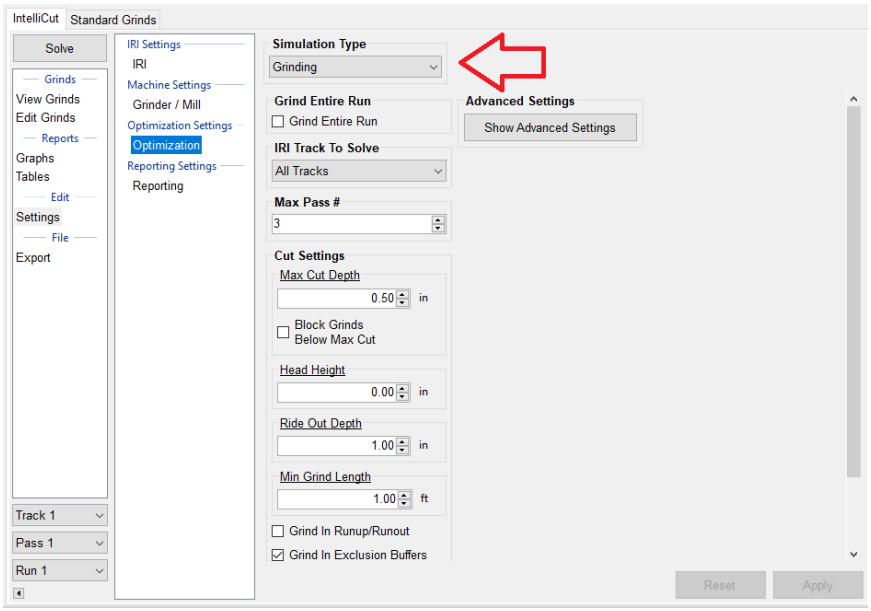


Figure 145. Grinding option in the Simulation Type dropdown menu showing Advanced Settings

Make sure that the Simulation Type is the one desired. When changing between Grinding, Milling, and Paving, or other settings, press the 'Solve' button on the upper left side of the window for the software to calculate using the new settings.

IRI Settings

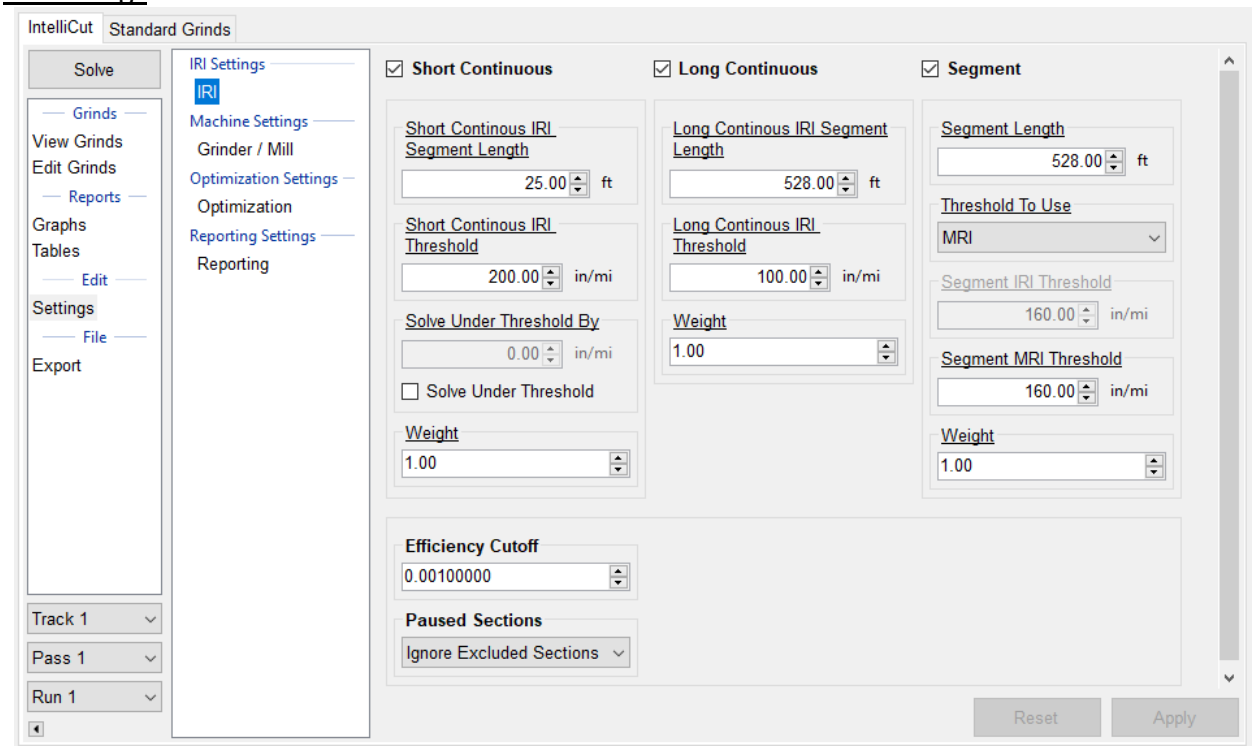


Figure 146. IRI Settings

Machine Settings

Selected the correct Machine Settings and enter the Front Wheel and Back Wheel measurements. The operator may choose from one of the preset machines in the dropdown menu under Presets: PC-9600, PC-4500, GR-390, GR-2, and G38. Press the 'Load' button afterwards.

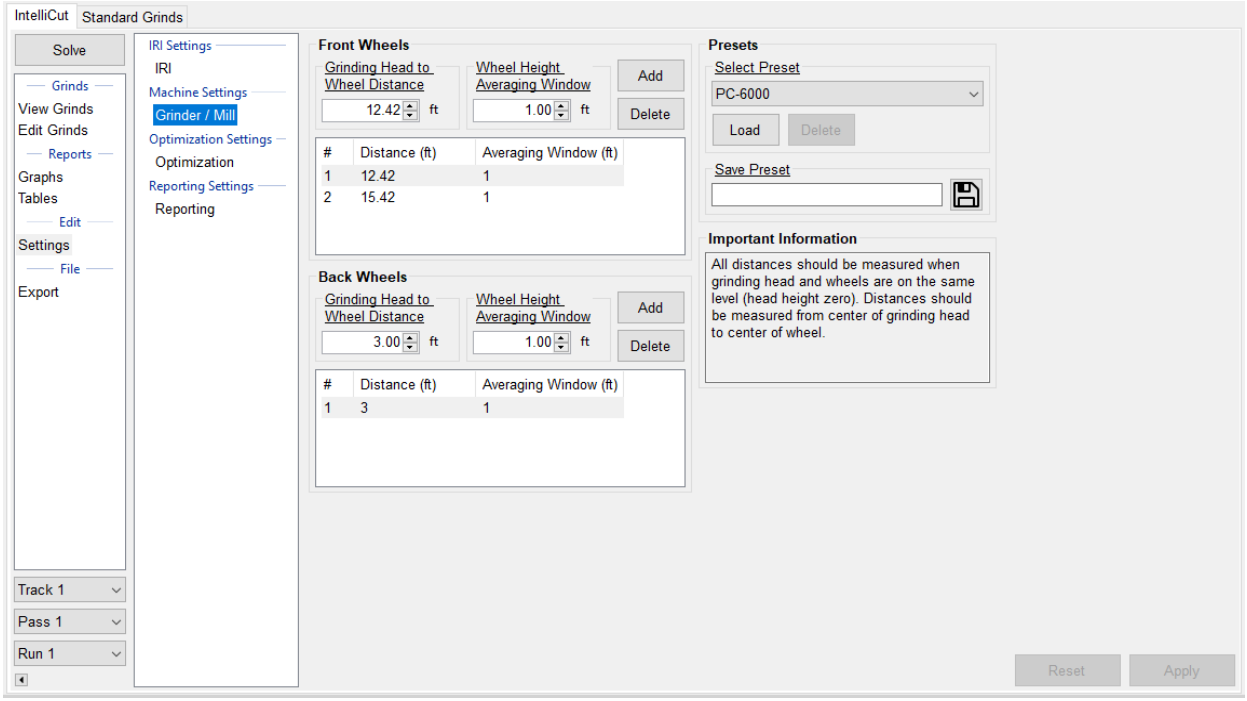


Figure 147. The Machine Settings

Reporting Setting

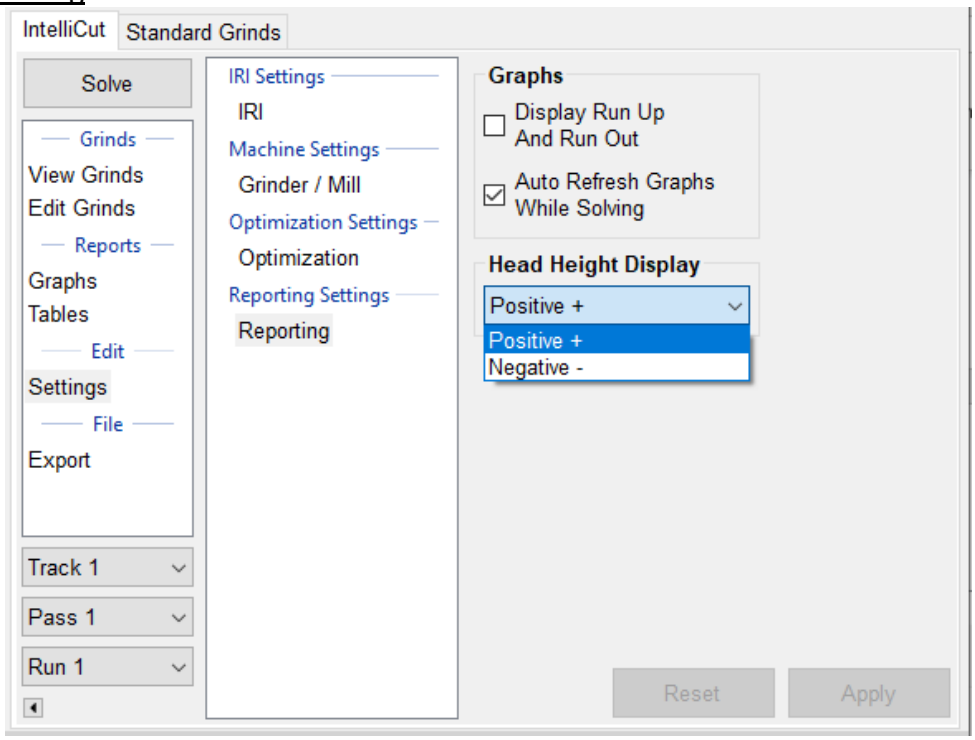


Figure 148. The Reporting Settings with Head Height Display dropdown menu

Once all settings are correct and in place, press the 'Solve' button on the upper left corner of the window. SSI software will calculate, graph the file for the according settings. See figures below.

View Grinds

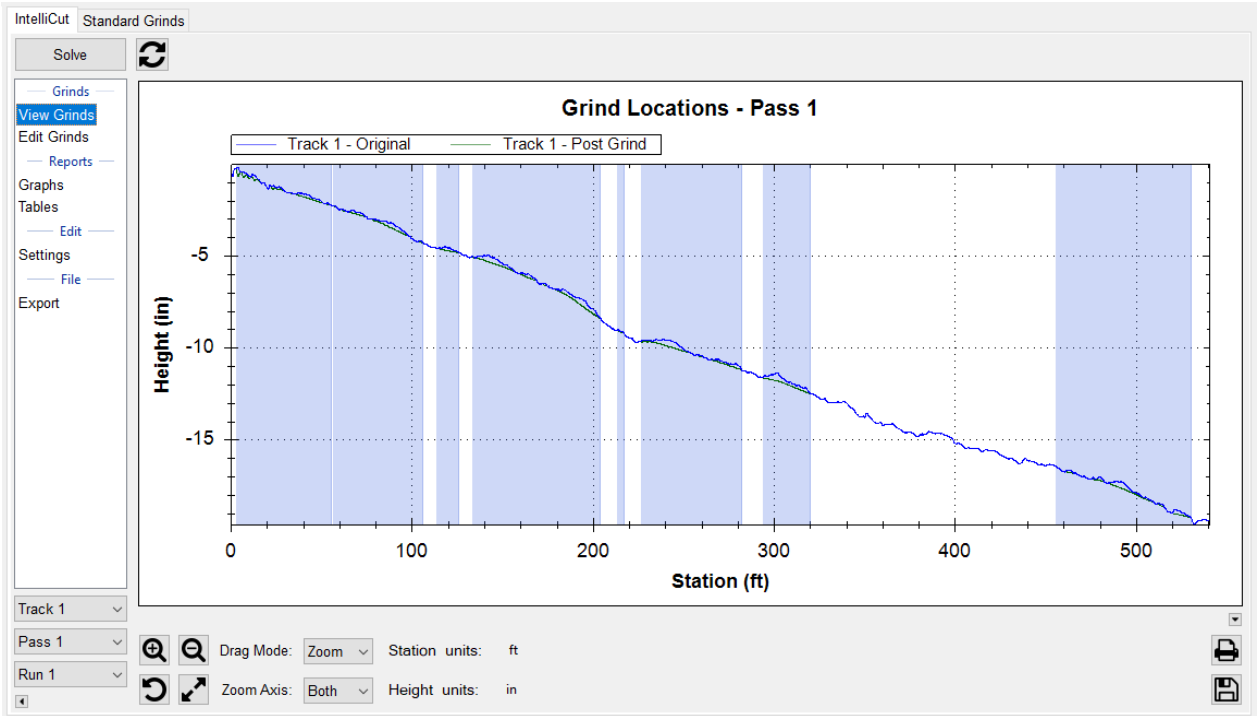


Figure 149. The View Grinds graph with the Grind Locations for pass 1

Edit Grinds

To add grinds, go to the left of the window and enter the Start Station and End Station of the grind and chose the Head Height. All units can be changed by clicking on the units icon and selecting from the dropdown menu. Press the 'Add Grind' button and the grind will be added to the main table at the center of the window. The table will have all the information of the grinds. To delete a grind select the specific grind on the table (it will be highlighted blue), and press the 'Delete Grind' button at the top of the window. To add or delete passes, simply press on the respective button on the middle lower left of the window. See the figure below.

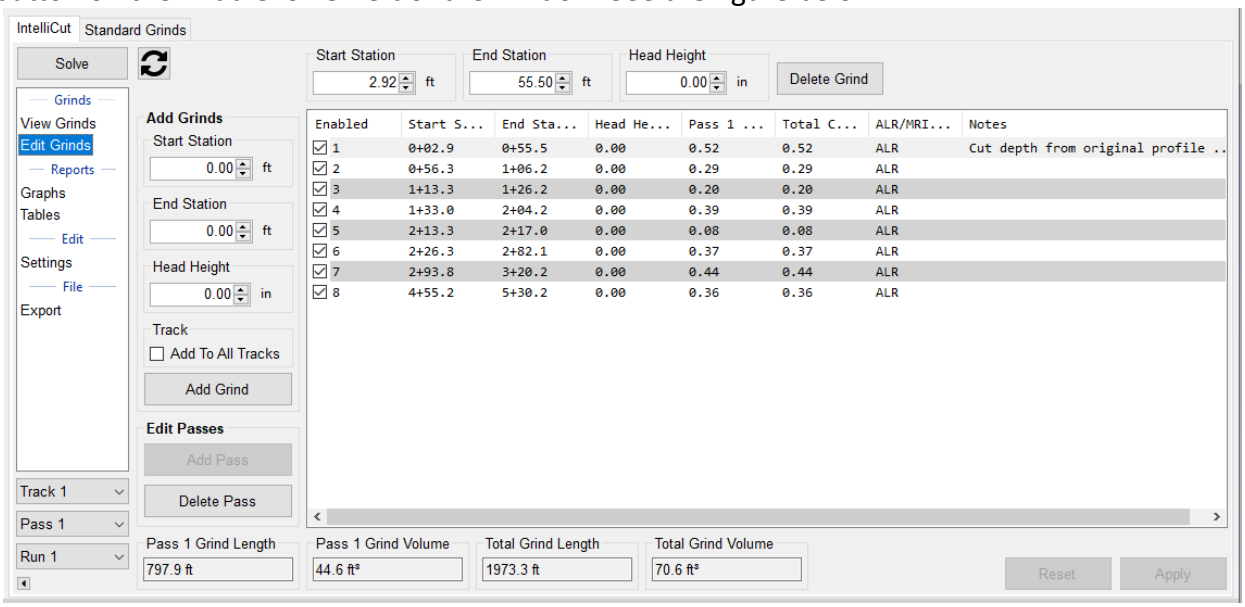


Figure 150. The Edit Grinds window with 3 grinds already added to the main table

Pre vs Post Grinding Graphs

The grey areas in both Height and IRI graphs represent the grind sections.

Figure 151. The Graph Tab with Pre vs Post Grinding Height and IRI graphs

Tables

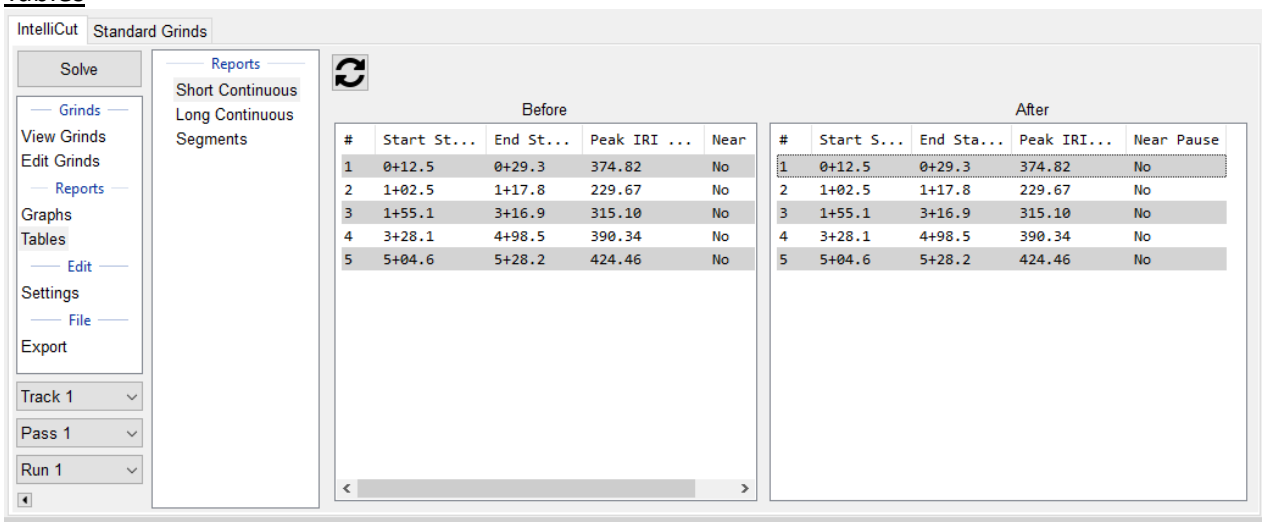


Figure 152. The short Continuous Report table in the Table tab

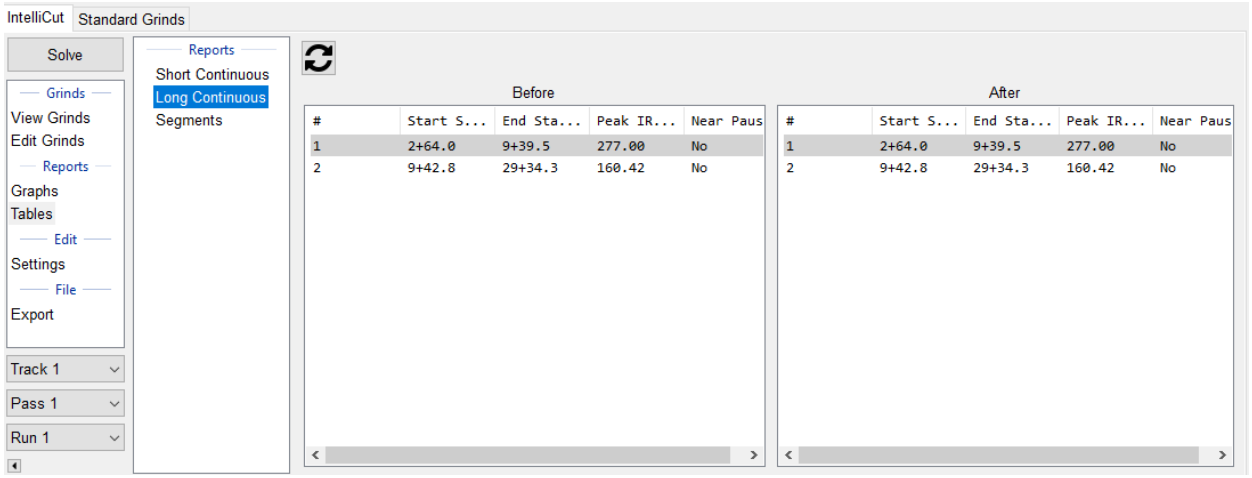


Figure 153. The Long Continuous Report table in the Table tab (From different Exp file)

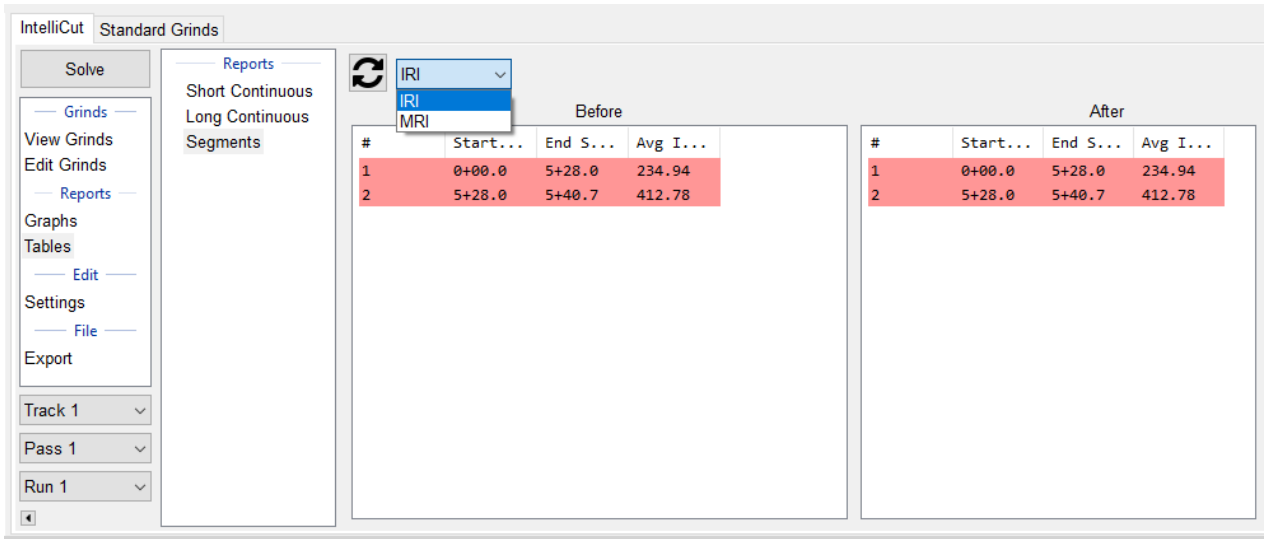


Figure 154. The Segments table report with IRI or MRI dropdown menu

Export

The operator can export a pdf document containing a summary of the Grinds report with the following graphs: Grind Locations graph for tracks 1 and 2 respectively. Short Continuous graph and tables for track 1 and 2, Long Continuous graphs and tables for track 1 and 2, and a Mixed Interval Analysis with MRI threshold.

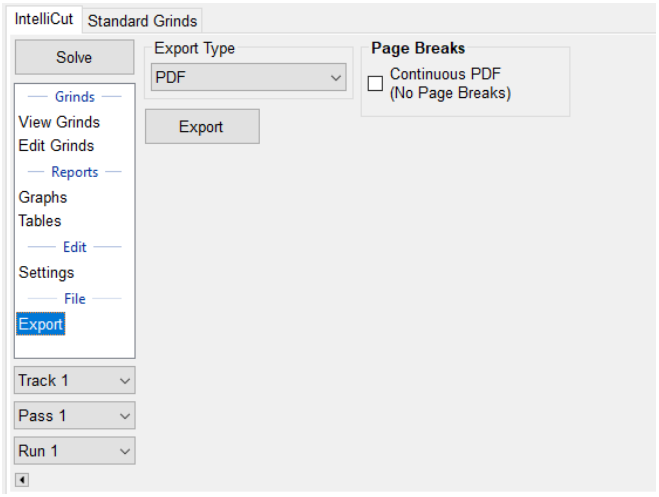


Figure 155. The Export tab options for Grinding/Milling/Paving Reports

Milling

Milling is generally used to correct the pavement before paving and achieve a better base. The operator will more likely be milling longer distances for MRI than short distances for Areas of Localized Roughness (ALR). Milling with very small cut depths can be used to fix IRI problems and for existing corrections before microsurfacing. The contractor doesn't need to correct the entire pavement length, only locations not meeting tolerances. Milling machine head height should be at a fixed 0.0 to set a minimum cut length (like a minimum grind length). The minimum cut length for milling should be much longer than the min cut length for grinding. The mill should be in the ground at least 100ft each time (goal is MRI segments, not ALR). Press the 'Solve' button on the upper left of the window once all the settings have been selected. All reports, graphs and tables will be calculated for the milling parameters.

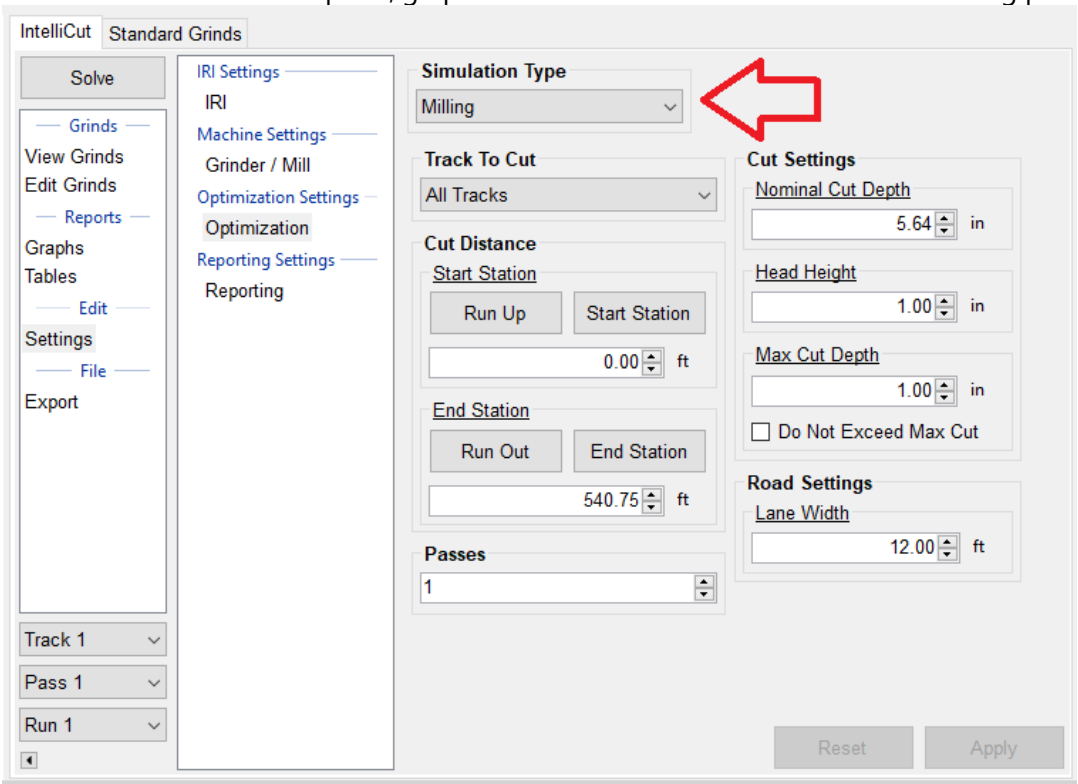


Figure 156. Milling under the Simulation Type with respective parameters

@@Here

Mapping

With a file loaded, press “Enable Overlay” to superimpose data on the map.

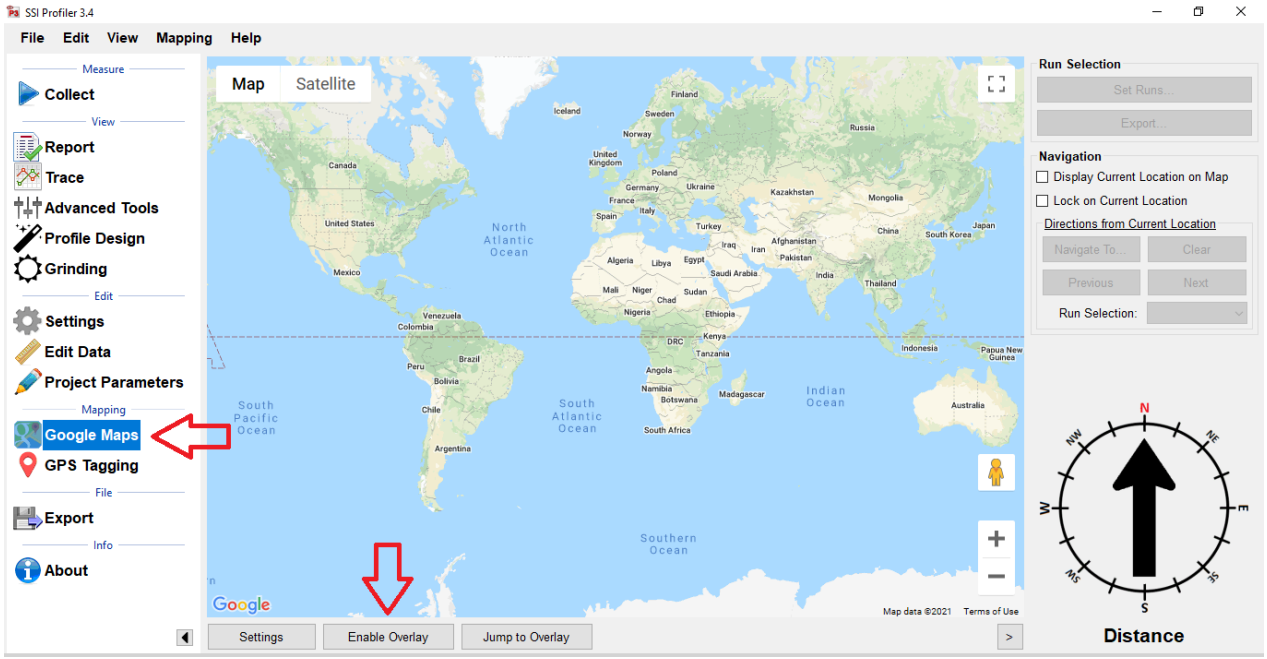


Figure 157. Google Maps Initial Screen

Google Maps allows visualization of data within SSI Profiler 3 software. The data depicted in Google Maps will be the same as exported Sidewalk GIS files. ***An internet connection is required for use of Google Maps***

“Jump to Overlay” zooms in on the loaded dataset.

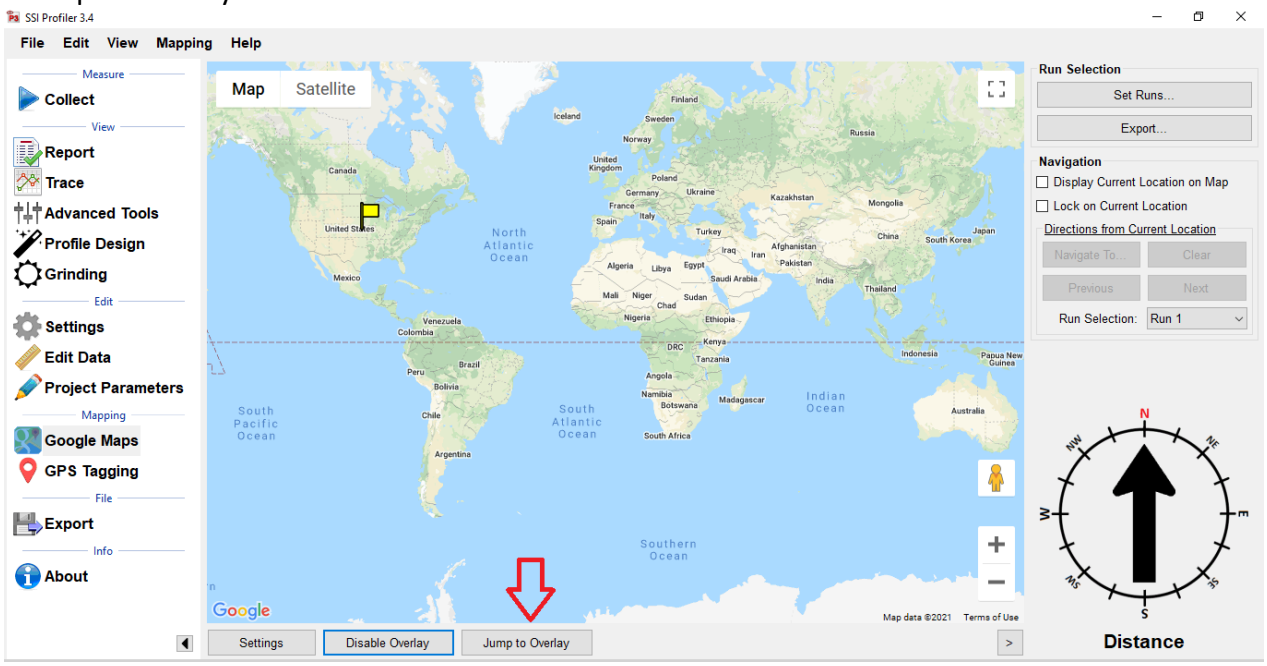


Figure 158. Google Maps Jump to Overlay

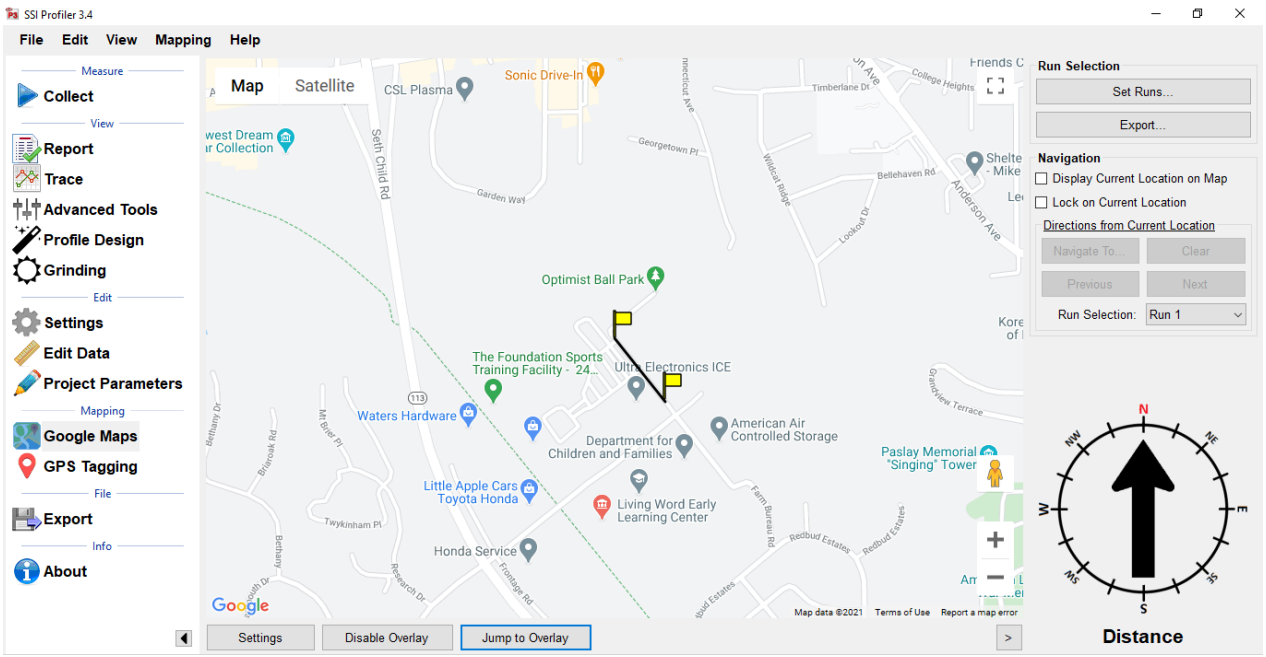


Figure 159. Jump To Overlay button has been pressed and the track has been zoomed in

Sidewalk features

The pins displayed in the figure below are sidewalk features.

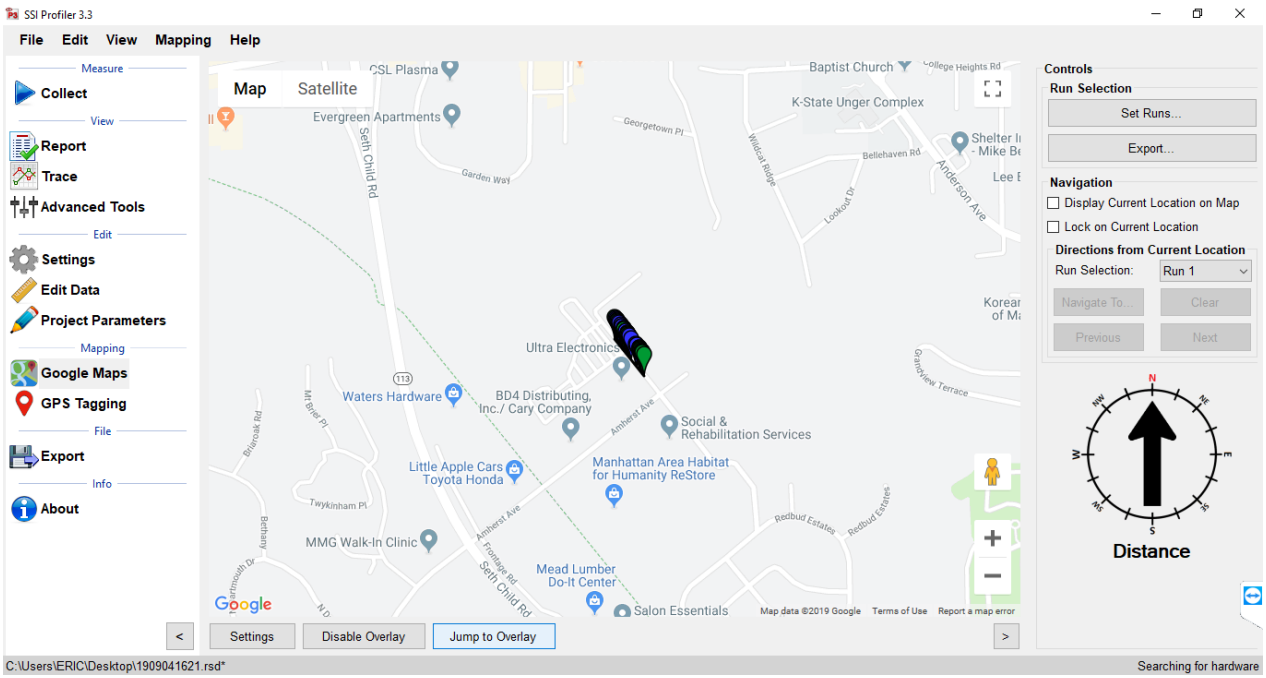


Figure 160. Google Maps after Jump to Overlay

When selected, each pin displays its relevant data. See figure below.

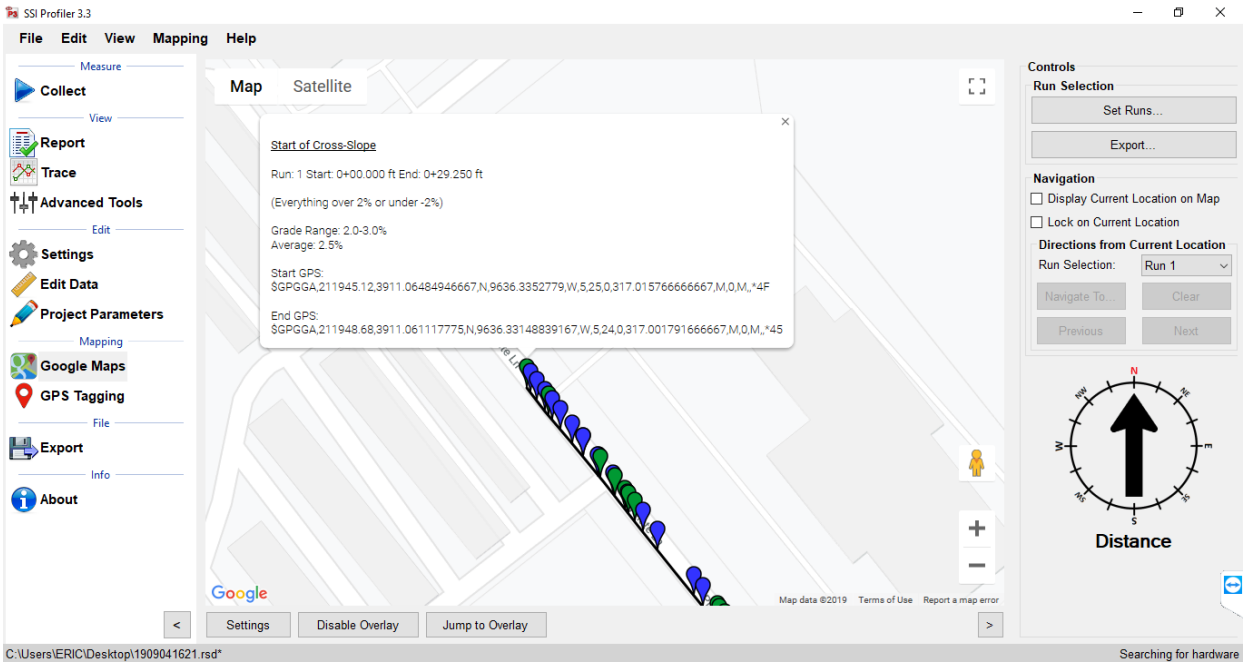


Figure 161. Google Maps Overlay zoomed in with pin clicked for information

"Settings" allows configuration of which features are displayed in Google Maps under Display Options. Path Display Type changes how the traveled path is depicted.

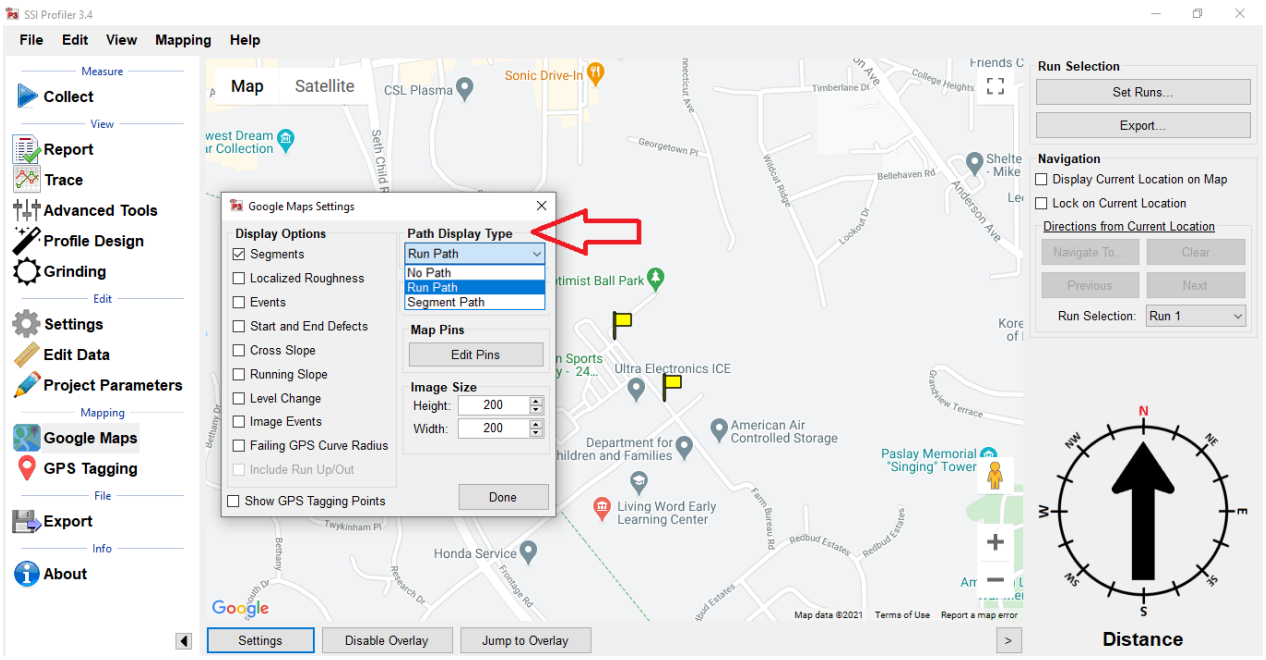


Figure 162. Google Maps Settings: Path Display Type.

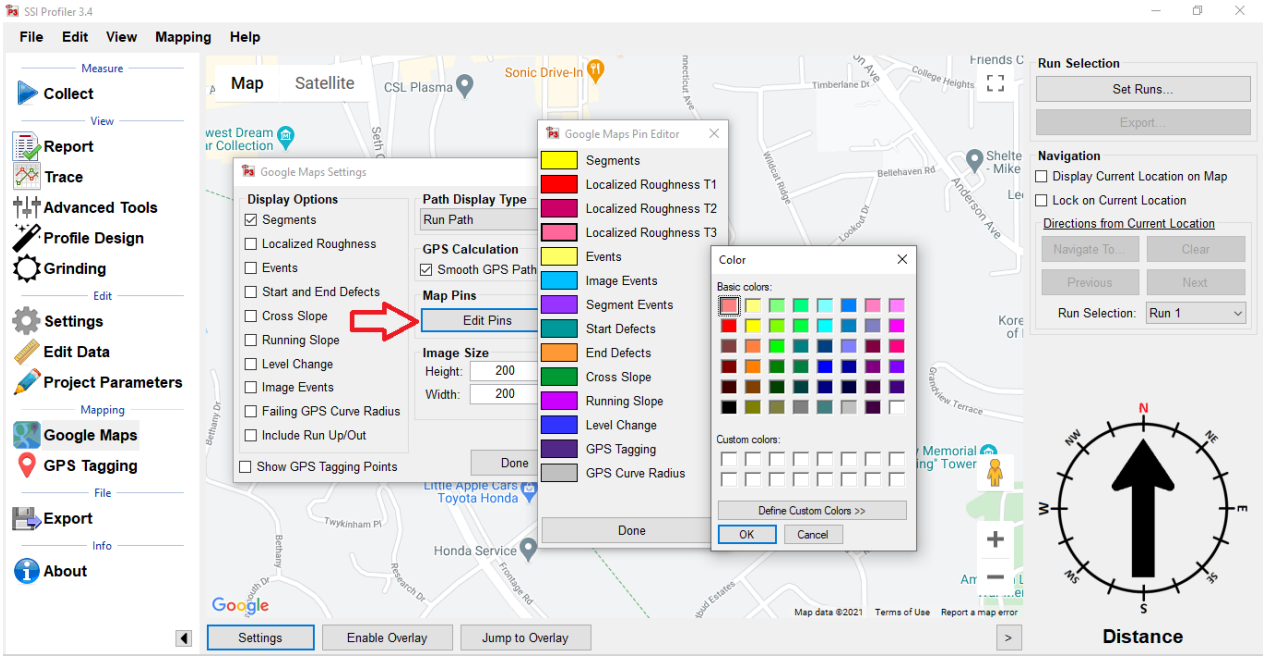


Figure 163. Google Maps Settings: Edit Pins

Data can be exported to .kml format through the Google Maps window by clicking “Export” under Run Selection in the upper right of the window. KML files can be viewed in most GIS software, for example, ESRI ArcGIS Earth and Google Earth.

Display Current Location on Map

If this check box is selected, the current location of the profiler is marked by a large green arrow in the map window. Must be connected to system with GPS to use this feature.

Lock on Current Location

If the check box for “Lock on Current Location” is selected, the location of the profiling system will remain in the center of the map window. The map will move with the GPS system in real time. Must be connected to system with GPS to use this feature.

Directions from Current Location

The V3 program will navigate to the start or end of the run and other information found during collection. Select the destination from the drop-down menu and select the calculate icon. The route will appear as a blue line from your current location to the “B” landmark.

To navigate to an Event, Pause, Segment, Image, GPS Coordinate, or Station, select the correct run number and then the “Navigate To” icon. If GPS is connected the program will ask the user where to be navigated to. Once the location is selected Profiler will direct the device to the location.

Note: GPS must be connected to use Google Maps Navigation

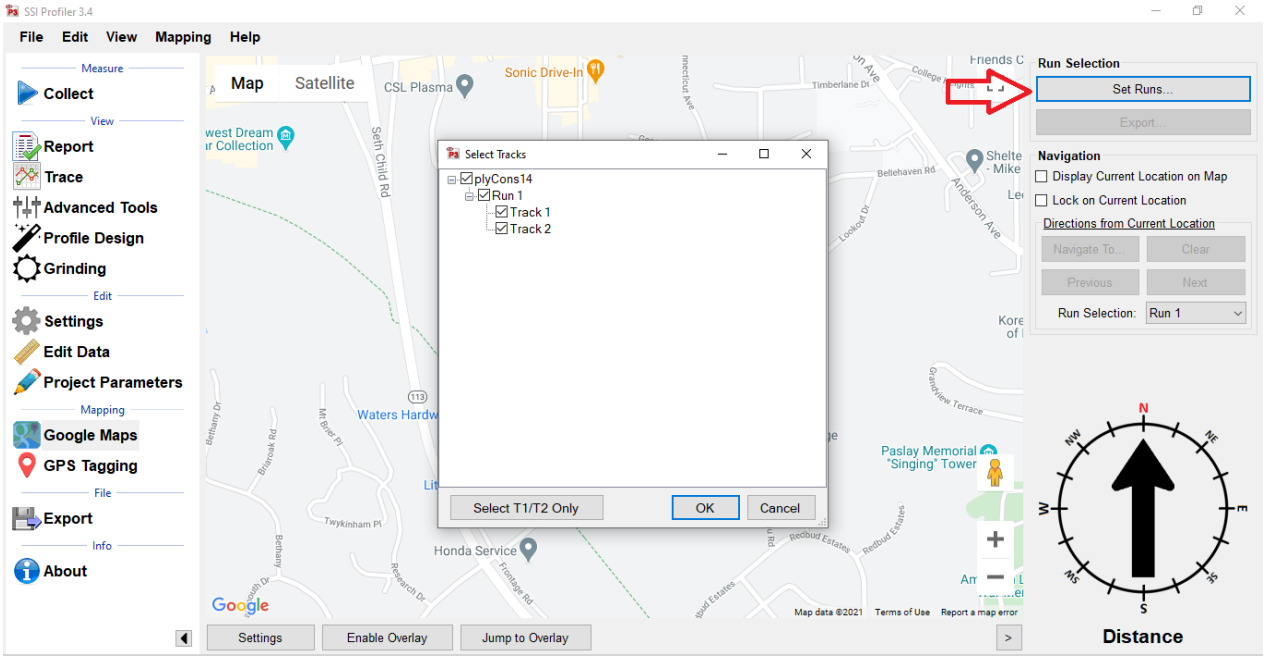


Figure 164. Set runs window

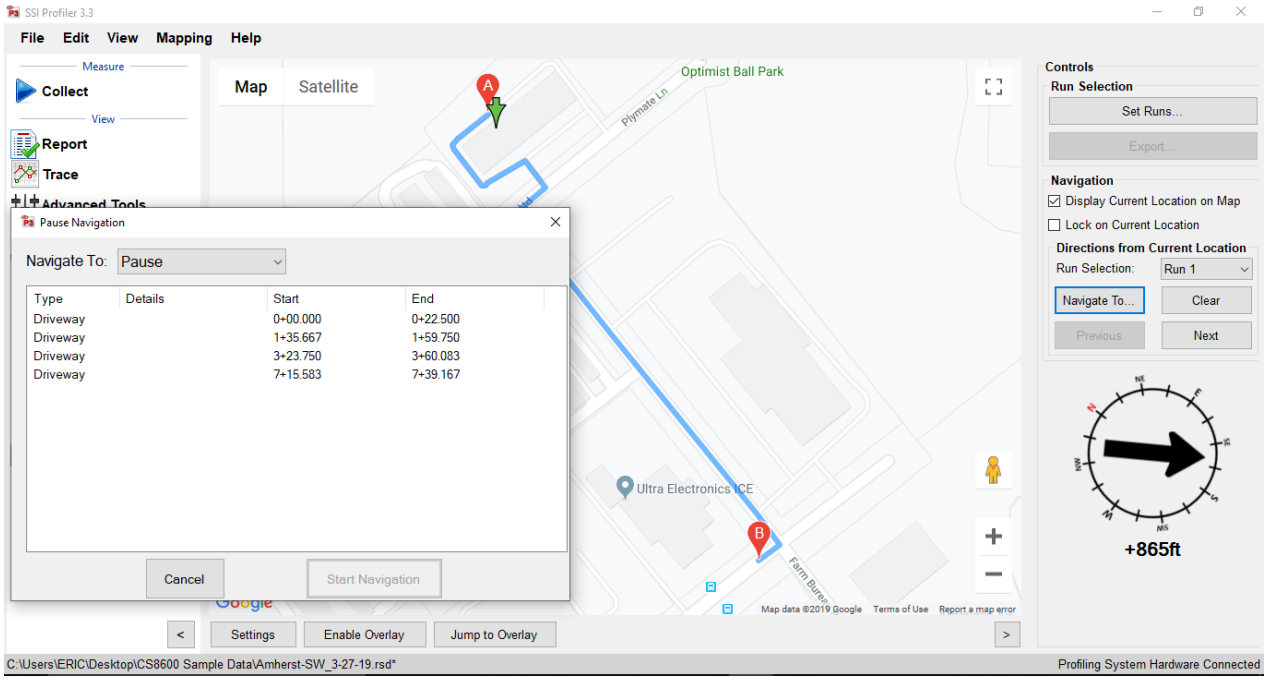


Figure 165. Google Maps Navigation

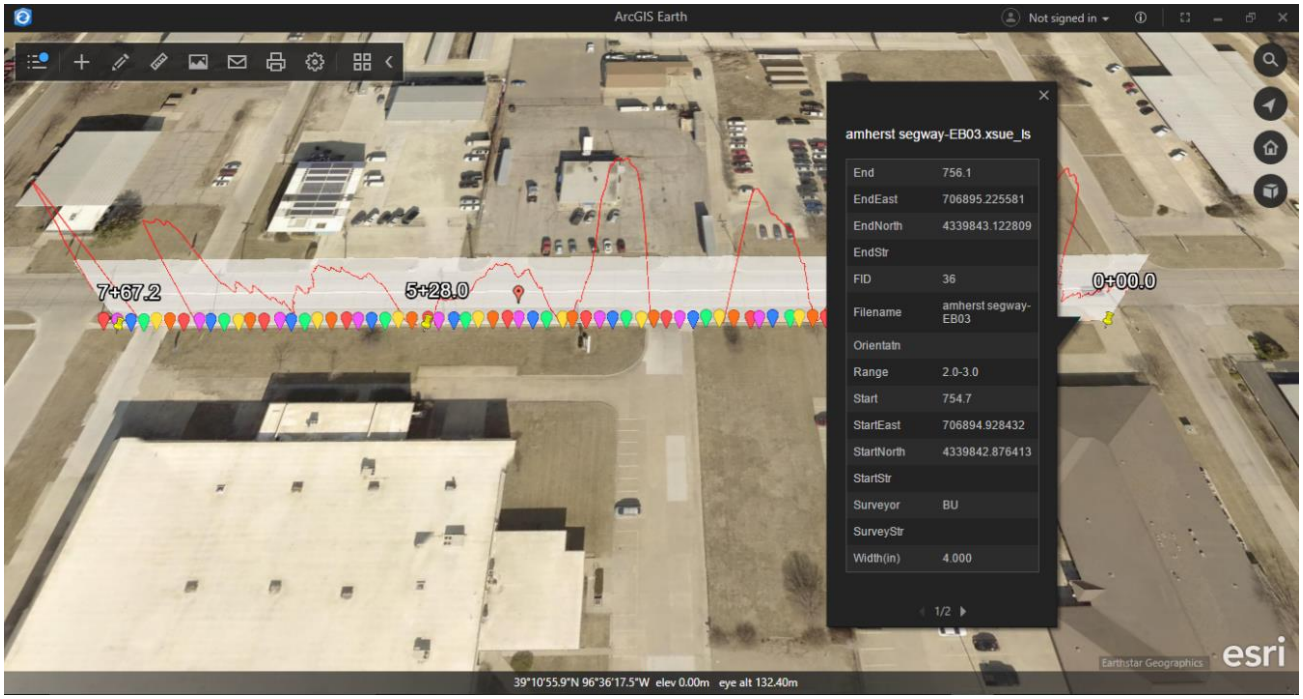


Figure 166. KML export in ArcGIS Earth

About

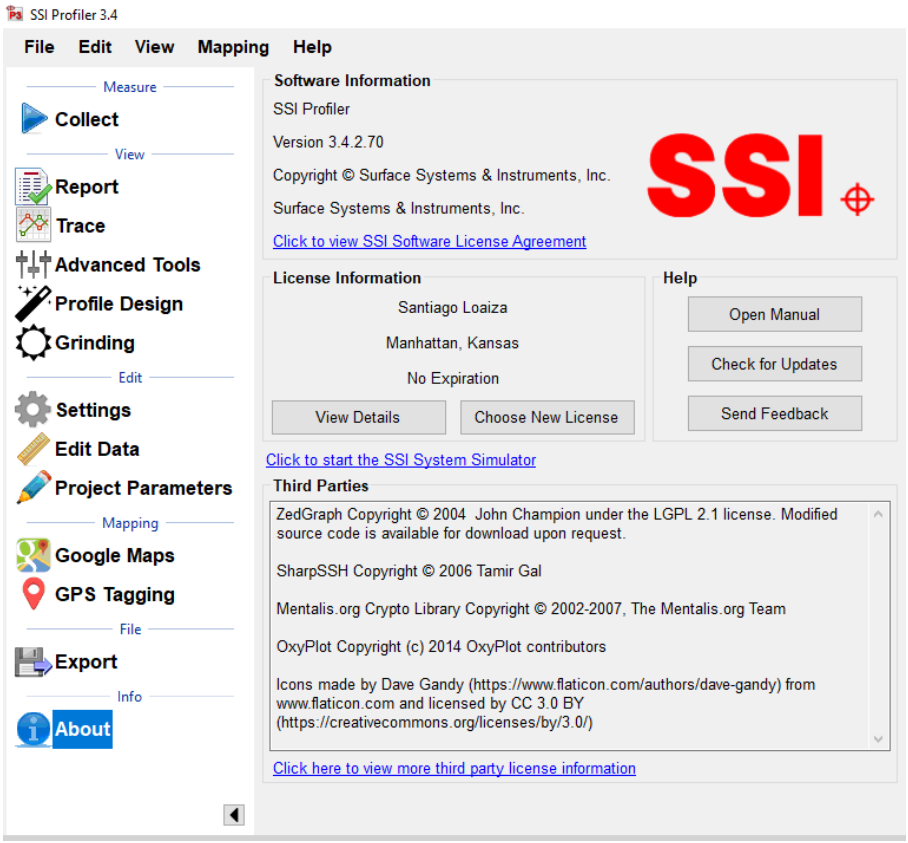


Figure 167: About Window

The About section has information concerning Profiler V3 software version, copyright, terms, license and software features enabled. Select View details to see the applicable collection devices and software features that are enabled. The update icon allows the user to update to the latest version of software.

Manual

The manual can be found under the Help Tab or on the About Section window. Contact Support@smoothroad.com for any manual requests.

Check for Updates

The operator can manually check for updates through Help>Check For Updates. By default, the program will check for updates every time it is opened. To not check for updates at each opening, deselect the check box in this window.

Send Feedback

If SSI should be informed of issues or advancements of the software, please send us feedback so we can improve our services.

Third Party Components

The Third Party Components of Profiler V3 are:
ZedGraph Copyright © 2004 John Champion under the LGPL 2.1 license.
Modified source code is available for download at:
http://www.smoothroad.com/support/download.asp.
SharpSSH Copyright © 2006 Tamir Gal
Mentalis.org Crypto Library Copyright © 2002-2007. The Mentalis.org Team

Full copies of all third party licenses can be found in the Licenses folder located inside the Profiler V3 installation directory.

Recommended Tools

Create a personal default file name convention for your project

Under General Settings the operator may select “Configure File Naming” to create a new file name convention.

Load analysis parameters and settings from previous projects

When a previous file has the correct project information and settings saved within it, the operator may load the previous file’s settings into the current file. By selecting “Load” under General Settings the user may select the previous RSD file and load its settings into the current project.

Set a default file location

The user may select a default folder to save all files and reports under General Settings.

Use hot keys during collection

During collection the operator can assign a command to any keyboard key except for the space bar and the enter key. The keys can start or end a collection, arm and electric eye or create an event for various types of scenarios such as pavement distresses or debris.

Troubleshooting and Support

When Contacting SSI Technical Support

If possible, have the profiler system type, profiler software version, operating system, computer model number, and company of ownership ready. If an internet connection is available, SSI staff may request your data files for comparison and troubleshooting.

Attaining Profiler Software and Replacement Parts

For technical support with the CS8600 software contact SSI. Software issues should also be reported to SSI by email at support@smoothroad.com, with a copy of any data files to be reviewed by SSI technical support staff. SSI support staff can also be contacted by telephone at (530) 885-1482 (Auburn, CA); or (785) 539-6305 (Manhattan, KS).
Parts can be ordered online from SSI at http://www.smoothroad.com. For support issues involving the profiler hardware (DMI, Pelican cases, hardware, cables, etc.), contact the SSI office in Auburn, California at (530) 885-1482 or by email at support@smoothroad.com.

Panasonic Toughbook Computer

For technical support for Panasonic Toughbook computers, contact Panasonic Technical Support at 1-800-Laptop5 (800- 527-8675) or go to the Panasonic support website at:

http://www.panasonic.com/business/toughbook/support.asp.

Paper Supplies or Printer Servicing.

For printer paper supplies or printer servicing, contact SSI at support@smoothroad.com or (530) 885-1482.

Is your Software Up to Date?

Contact SSI to upgrade your software if your problems reoccur after support assistance.

Do Not Attempt To Repair Electronic Components

All of the electronics within the SSI Profiler systems are built custom for Surface Systems and Instruments. Do not attempt to fix issues without contacting SSI.

Is your Power LED Illuminated?

No power to the system would cause the hardware to disconnect from the software.

Hardware Not Found

Check the cables of your system for any wire breaks. If the Amphenol connections are twisted, it can break the soldered wires. If problem persists, contact SSI Support Staff.

Example Diagnostics

By selecting the button on the upper right of the Collect screen with a single digit number on it. The single digit number will be the same as the number of lasers on your system. The button is colored green for systems without an issue, yellow for systems with a device disconnected and red for connectivity issues.

SSI Profiler 2.1: Q0g0r0r0x0x0x0

'0' means that the device is connected.
Q is the encoder symbol
g is Trimble GPS
r is for a Roline laser. The order is Track 1 laser, Track 2 laser, Track 3 laser (if equipped).
x is an open port

Failed Height Verification

1) Check block Orientation. Do not block receiving laser sensor.
2) Check Laser Type in System Settings
3) Check the integrity of the cables and pins. Make sure the pins are not bent inside the connectors and that the cables are not damaged.
4) Check the height of the lasers from the measurement surface. For Gocator and low stand-off spot lasers the minimum height is 200 mm (7.8 inches). For high stand-off spot lasers the minimum height is 12.8 inches (325mm).
5) Is there a glare on the verification blocks?
6) Make sure the vehicle is out of the wind and has absolutely no motion to it.

Lasers Not Firing

Main Cause: No/ insufficient power reaching the lasers

- Is the blue light flashing on the laser?
- Is the blue LED on the white housing emitting light?
- Are the red lights on the grey box serial ports emitting solid red light?
- Check the condition of the pins in the cables.
- Is the vehicle off or running?
- Does the same problem happen with the engine running?

Distance Not Correct

When was the last calibration performed?
Was the actual distance traveled during calibration entered correctly?
Is the DMI damaged or loose?
Is the DMI Amphenol cable attached correctly?
How long is your calibration track?
Is there a large temperature gradient?
Is the calibration track a straight line?

Electric Eye Events/Pause/Start/Stop Collection Did Not Work

Is the correct EE turned on?

There will be an amber or green light on the back of the EE. Flip the switch on the white housing if it is not on.

Is DOT-C2 reflective tape being used?
Is the angle of the reflector matching with the EE orientation?

GPS Navigation Timed Out (Map Point, Google Maps, Trace View)

1) Check if the system lost GPS signal (Open the Collect window then GPS Options to check the satellite reception).
2) Disconnect hardware and reconnect hardware.
3) Check that all cables are securely connected.
4) Check power source for consistency.
5) If using a Topcon system, review the MC-R3 rover settings for accurateness.

The Camera is not taking color pictures

1) Choose another pre-formatted option (Low, Medium and High Resolution).

Advanced User Options (Custom Resolution)

1) The camera settings can be found under the Collect window in System Settings.
2) Go to the Camera Settings tab
3) Open Advanced Camera Settings
4) Review Custom Video Mode to affirm that Raw 8 is the pixel type.
5) Select Standard Video Mode
6) Select the button for resolution and pixel type to be Y8 (Raw 8) and 1280x960.
    a. Once this change is made the preview will also be in color

Profiler Hardware Not Found

Check the serial port connection from the profiler to the computer. Check that the profiler has power and is charged. If software disconnects from hardware, close SSI Profiler and reopen the program with the profiler powered on. If problem persists, close the program and shut the power off to the profiler. Wait five seconds then turn the power to the profiler on. Then open the SSI Profiler program. If the issue is not solved, contact SSI customer support.

Do Not Replace the Device Components with Store Bought Items

Surface Systems and Instruments designs and manufactures their custom-built profilers in house. Replacing damaged parts that are inadequate will adversely affect the ability to collect accurate profiles. Please contact SSI for replacement parts.

Updating the Software

If your SSI Profiler license has expired, you will not be able to update. Contact SSI to renew your license and receive new software updates.

CS9500 Transverse Profiler Guide Supplement

Featuring INS with SSI inertial profiler (Post-Processing Corrected GNSS topo data)

Introduction

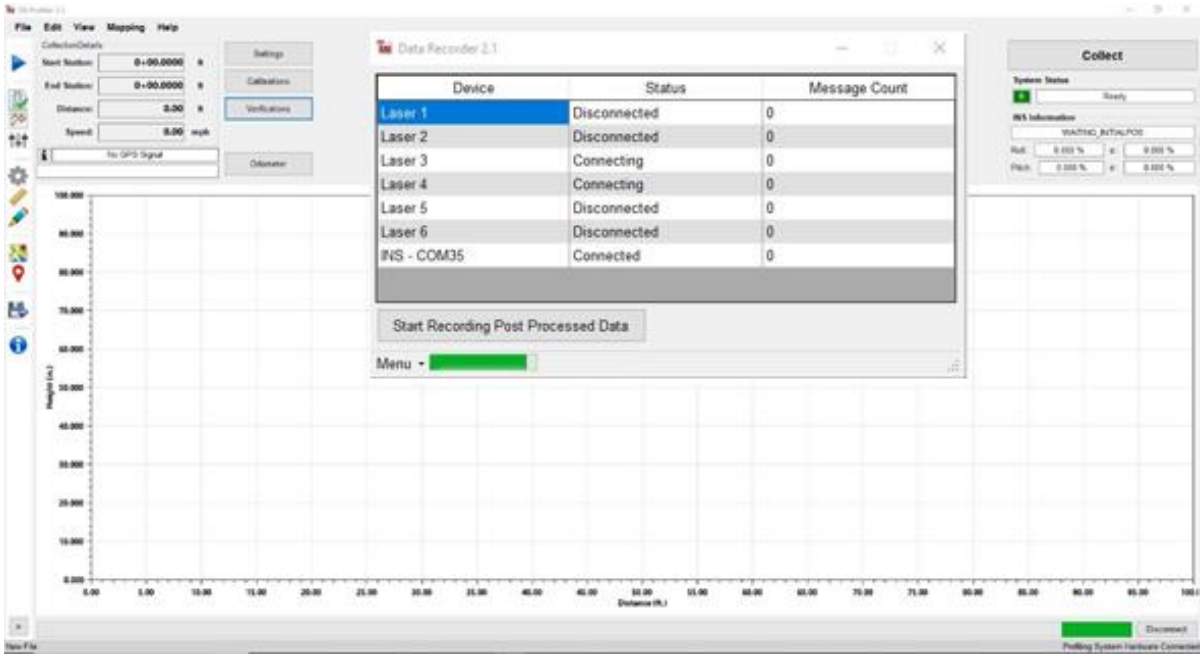
The CS9500 Transverse Profiler system is used to collect full lane width transverse profiles of the roadway for rutting and cross-slope analysis. The resulting data can also be used to create high resolution 3D point clouds of as-built surfaces for use in CAD design of road surfaces. The system uses SSI's inertial profiling system and transverse profiling system combined with high resolution GPS and IMU (Inertial Measurement Unit) for very accurate road surveying.

Collection of Data with Mobile Survey Profiler

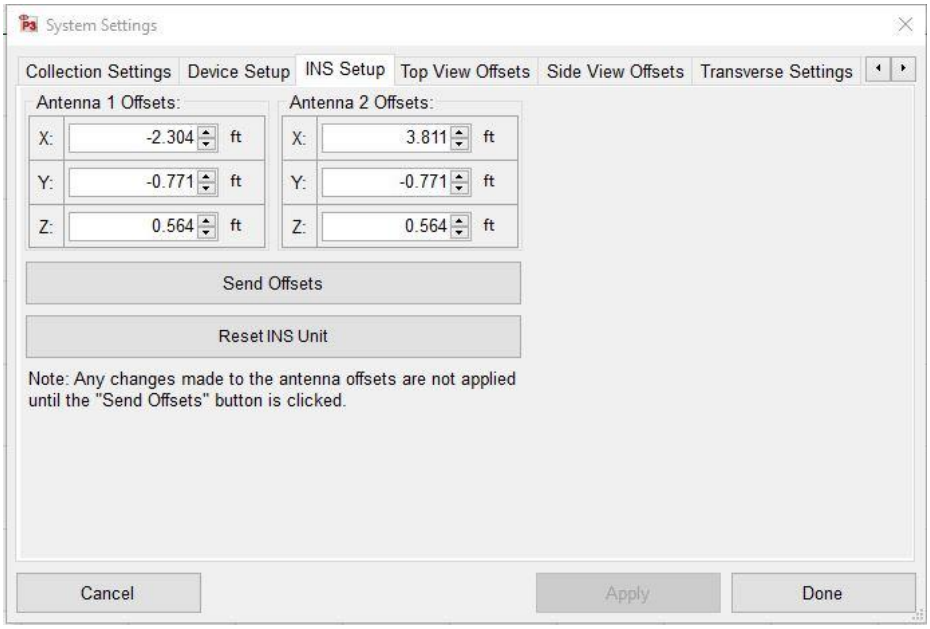
The CS9500 system is comprised of 6 scanning lasers combined to give you a full lane width transverse profile of the roadway. Accelerometers can be used with the wheel path lasers to obtain an inertial profile (IRI, PRI) for the wheel paths. The CS9500 also has an IMU and Dual-antenna GPS receiver embedded in the main electronics box. When equipped with Zero-Speed lasers, an additional laser sensor and accelerometer are added to each wheel path for maximum accuracy on longitudinal profiles even through vehicle stoppages. There are two GPS antenna that connect to the main electronics using a standard TNC cable. Once the system is installed and the laser components are mounted, the user can begin the setup process. The setup process requires obtaining measurement offsets and calibrating the system with the IMU. The procedure is as follows:

Profiler Connection and Settings

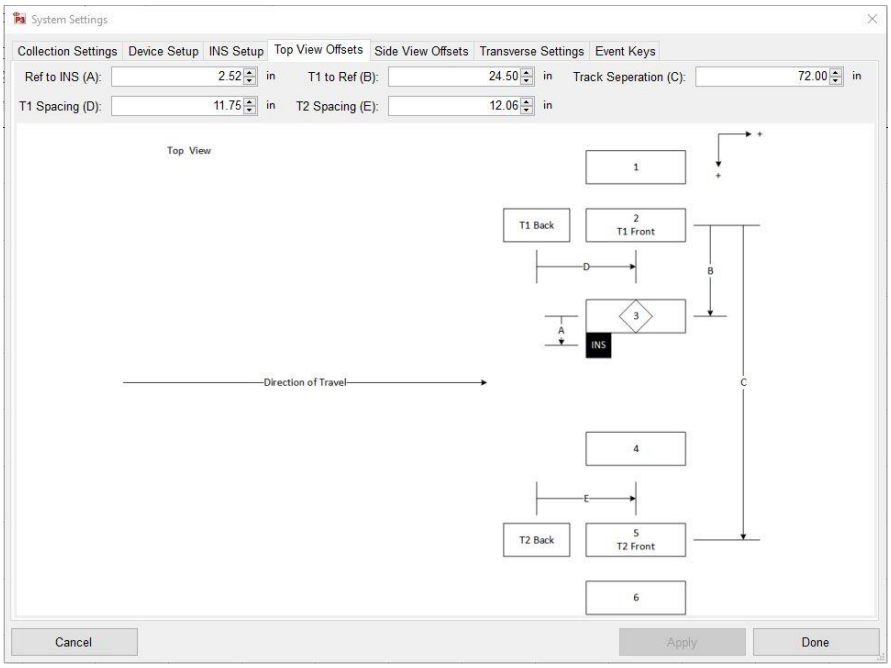
1. Connect associated RS-422 cable (for main electronics communication), 232-TTL cable (for post-processing INS data), and Ethernet cable (for transverse laser data) into the laptop.
2. Boot the system by selecting the collect button in Profiler.

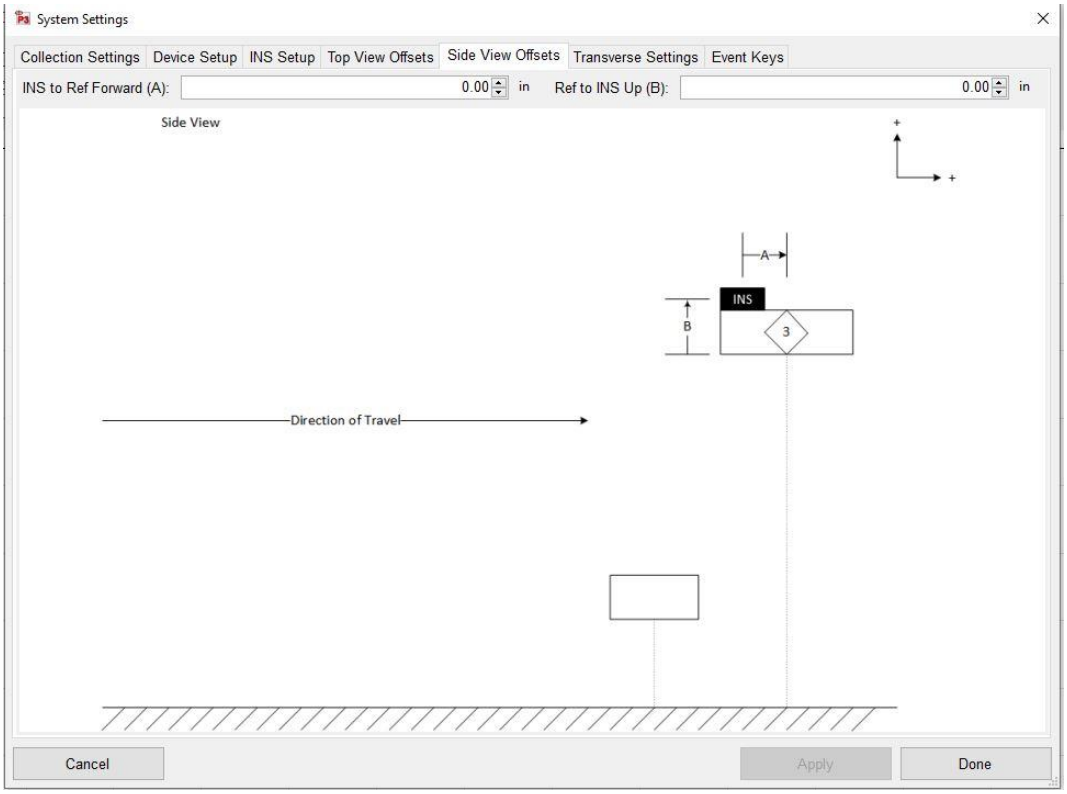


3. Obtain the IMU to GPS antenna offsets by measuring the distance from the IMU phase center to the GPS antenna phase center in the X, Y, and Z directions for each antenna. The IMU center can be found by locating the decals on the laser 3 cover (or separate IMU enclosure located above laser 3). The GPS antenna phase center is described on a diagram on the antenna. The centrifugal center of the antenna is the X and Y center. The Z phase center (or L1 phase center) is located 0.050-0.062mm above the bottom of the antenna (where it meets the GPS mast) depending on the antenna used: 1. With the INS P antenna, X+ is forward, Y+ is to the right of the vehicle (Towards driver), Z+ Down towards ground. 2. With the INS N antenna, Y+ is forward, X+ is to the right, and Z+ is up away from ground.

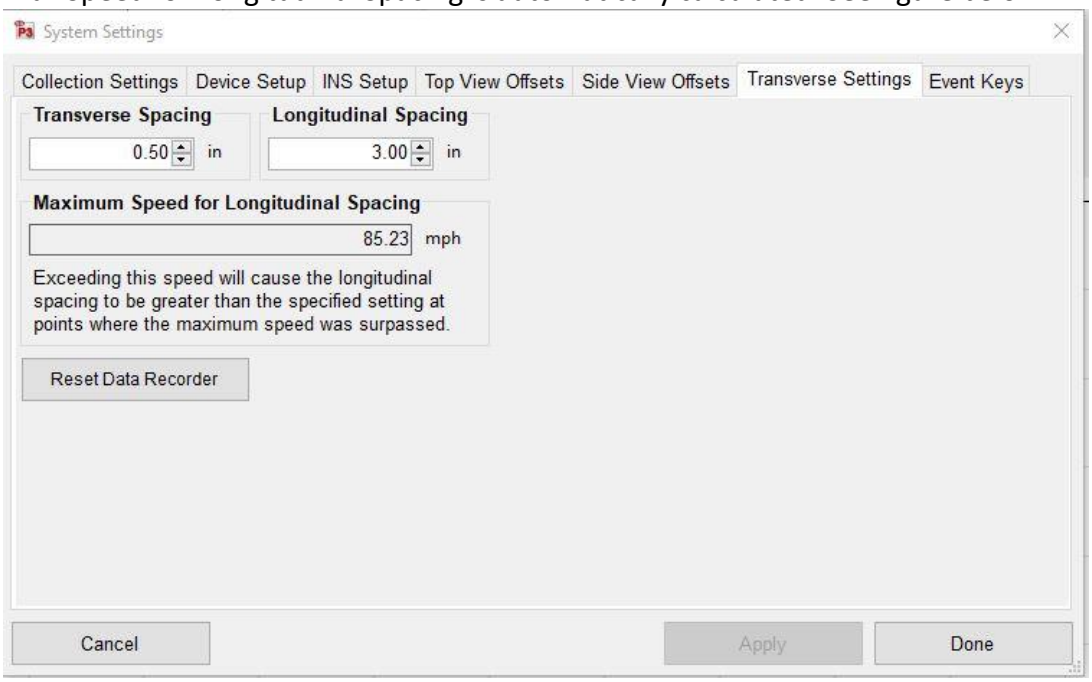


4. Enter the system's top view offsets and side view offsets for he various sensors according to the diagrams in Figure 3 and Figure 4.



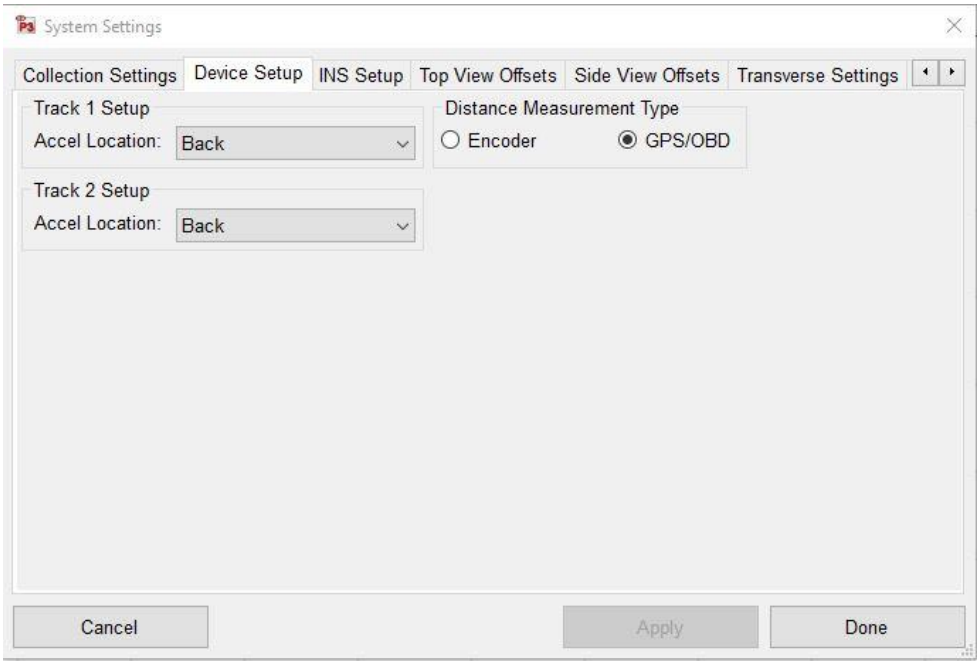


5. Modify the transverse spacing or the longitudinally spacing for desired data resolution. The values in the figure below are typical for most applications. The Longitudinal Spacing must be a multiple of the sample interval (usually 1 inch, 25.4mm) and has a minimum of 5mm. The Transverse Spacing minimum is 3mm. Max Speed for Longitudinal Spacing is automatically calculated. See figure below



6. In the Device Setup tab, select whether the accelerometer is mounted on the front laser or back laser. In most cases with the CS9500, the accelerometer will be in the

"Back" location mounted with the lower standoff laser. Most Transverse systems will always have the accelerometers mounted on the zero speed lasers and thus the setting will always be 'back'. The GPS/OBD is the preferable Distance Measurement Type. Calibrate Encoder if you plan to go below 5mph and use GPS/OBD. **The GPS/OBD is not reliable under 5mph if Encoder is not installed and calibrated.**



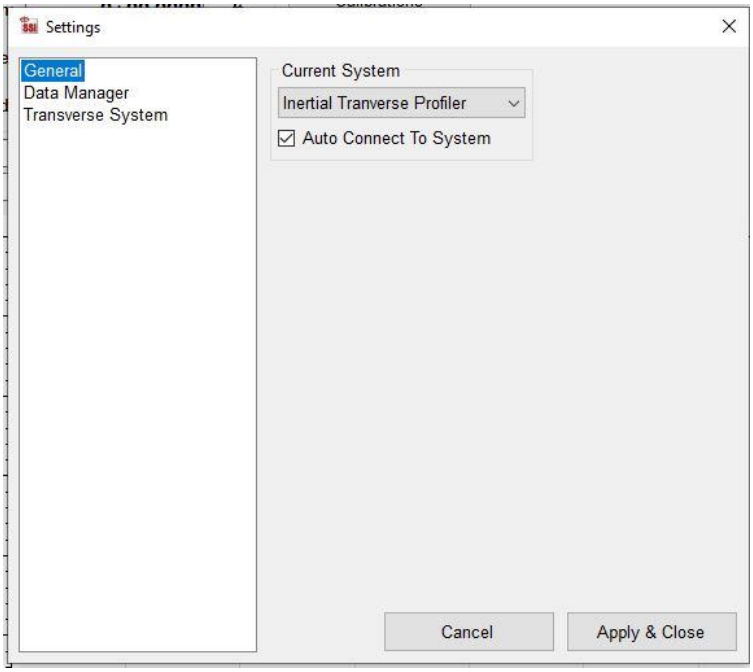
Data Recorder Setup

1. The Data Recorder program should automatically start up when the system is connected to hardware. Alternatively, go to System Settings on the collect window and click the "Reset Data Recorder" button on the Transverse Settings tab.

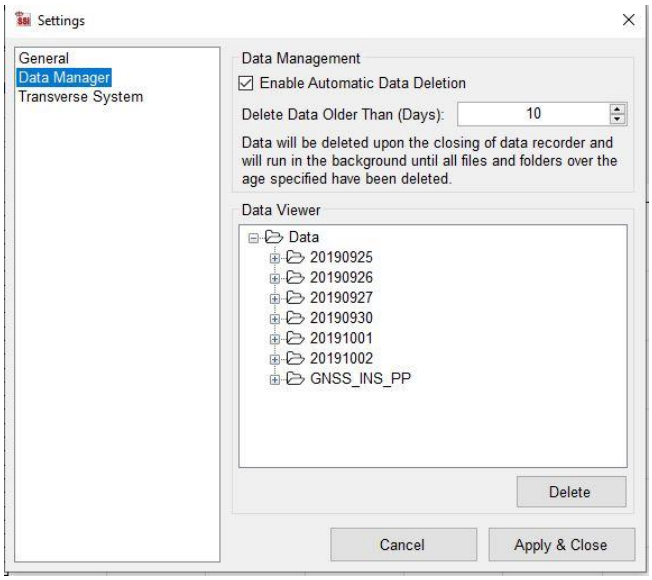
2.Data Recorder is used for collecting the transverse laser data via ethernet and the raw INS data for post-processing (Rover to Base Station data correction on survey systems).

3.You can access Data Recorder settings by clicking the menu button and then selecting "settings".

4.In the **General tab** the operator can modify which system to connect. Its recommended to have the Auto-detect checkbox selected. For the CS9500, it should be set to "Inertial Transverse Profiler". See pic to the right.



5.Under the **Data Manager tab**, manage the raw data stored after each collection. Once an RSD file is created, this data should no longer be needed on the laptop unless there are issues with data not properly loading into the RSD file. Within this manger tab, setup the automatic deletion of the raw data to help save hard drive space. See pic to the right.

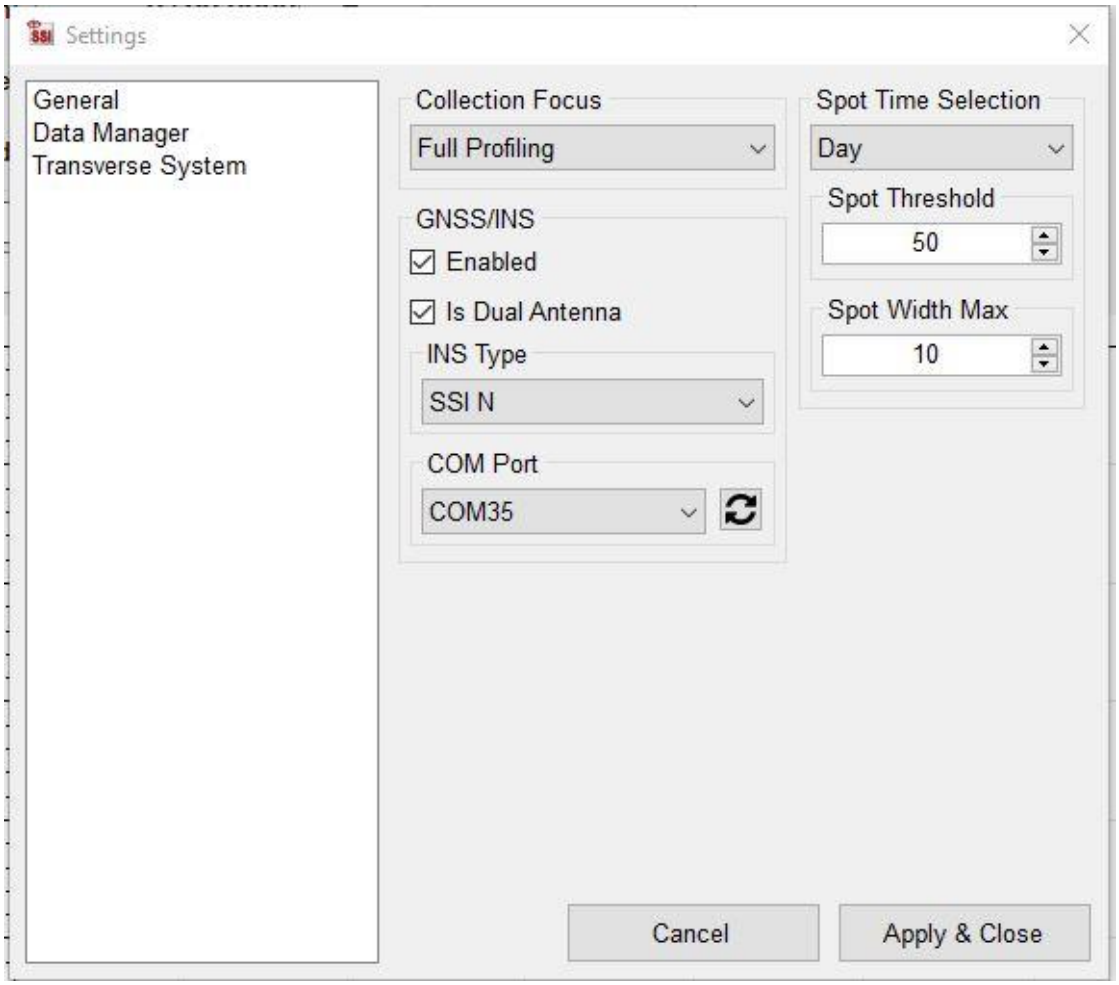


6. Under the **Transverse System tab**, set the collection focus of the lasers

a) Full Profiling is for a full lane width scan of the roadway. See image below.

b) Wheel path Only is for only collecting IRI with the wheel path transverse lasers (this setting is used to pass AASHTO bounce/static tests and laser height tests. If using a Zero-Speed configuration, this setting only provides a slightly better Zero-speed profile at stoppages.

c) Set the spot threshold and width max for your transverse lasers. Typical settings are 50 for spot threshold and 10 for spot width max. These can be changed for different Day/Night or surface environments to get better profiles. See image below.



d) Last, set up the GNSS/INS for Data Recorder logging of raw data only used for post-processing with a Base Station for Survey purposes. See pic above for the following settings.

a. If enabled, the program connects to the 232-TTL or RS-232 usb for the INS receiver
b. If the system is equipped with 2 GPS antenna, check the box for 'Dual Antenna'. See pic above
c. Choose your INS type based on the INS receiver being used with the system. See pic above
    i. 232-TTL is SSI N receiver type
    ii. RS-232 usb is SSI P receiver type
d. Choose the associated COM port generated by the usb cable plugged in to the laptop. This can be found by looking at the dropdown at what ports are available, plug in the USB, refresh the port list and see which port is new to the list. Select that port and Apply. The port should say connected in Data recorder. See pic above.

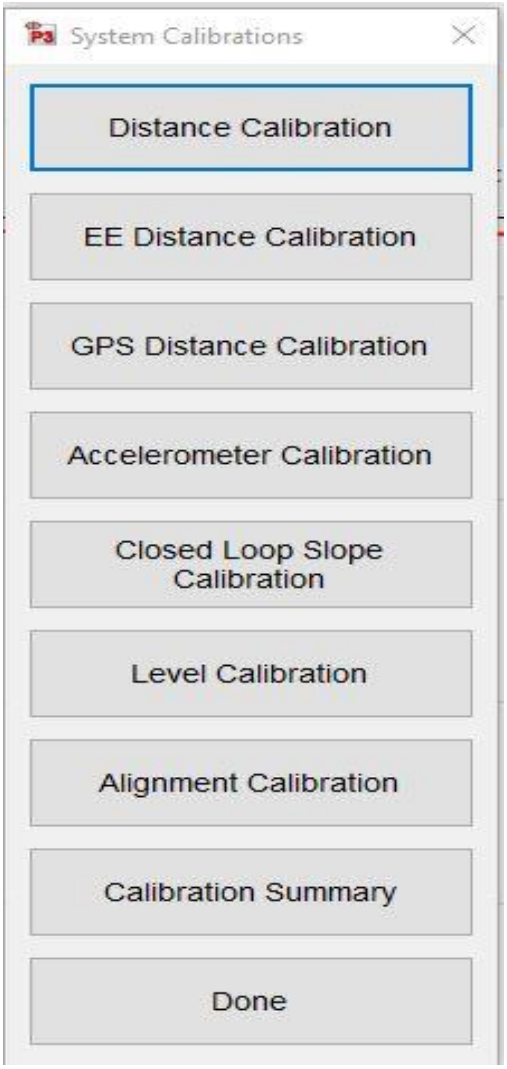
Calibration

(1) Perform the accelerometer calibration prior to doing any longitudinal profile collection.

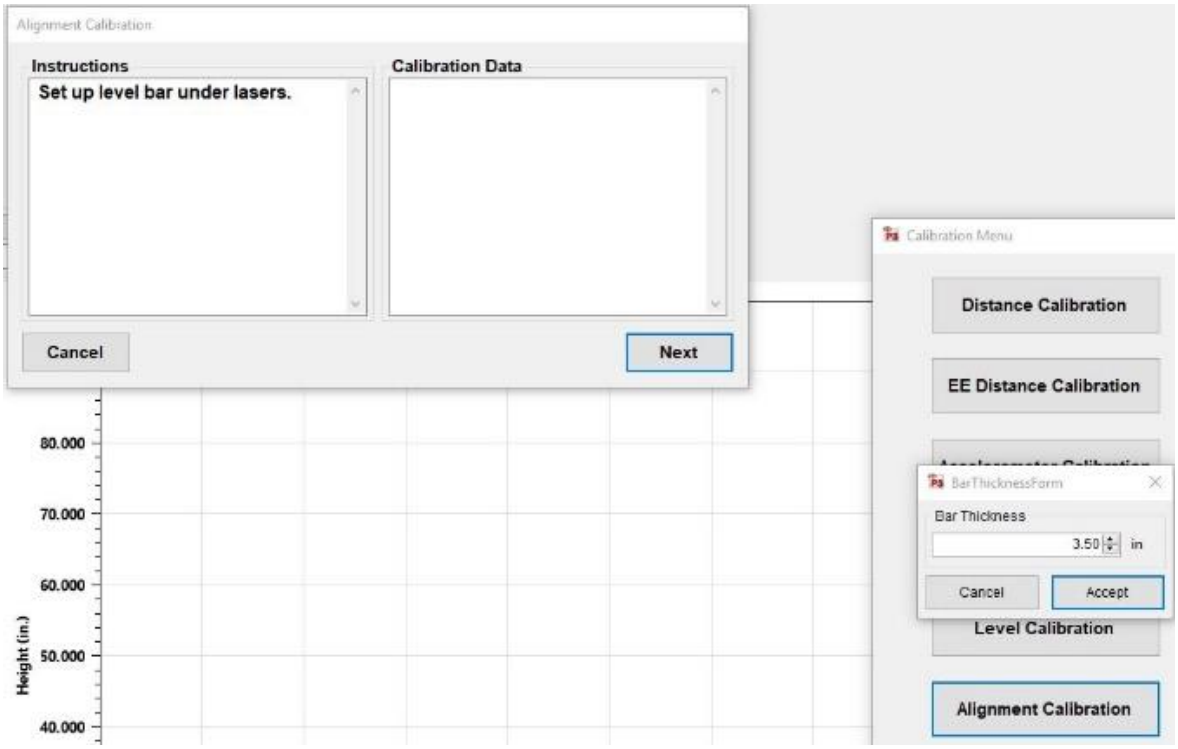
(2) Obtain GPS in open sky and allow INS solution to get to "INS Solution Good". For single-antenna systems, this may require driving the system around until alignment process is completed. Driving in figure 8s helps for single-antenna solution.

(3) After you have "INS Solution Good", you can park the vehicle on a level surface with sufficient space in front to place a straightedge bar.

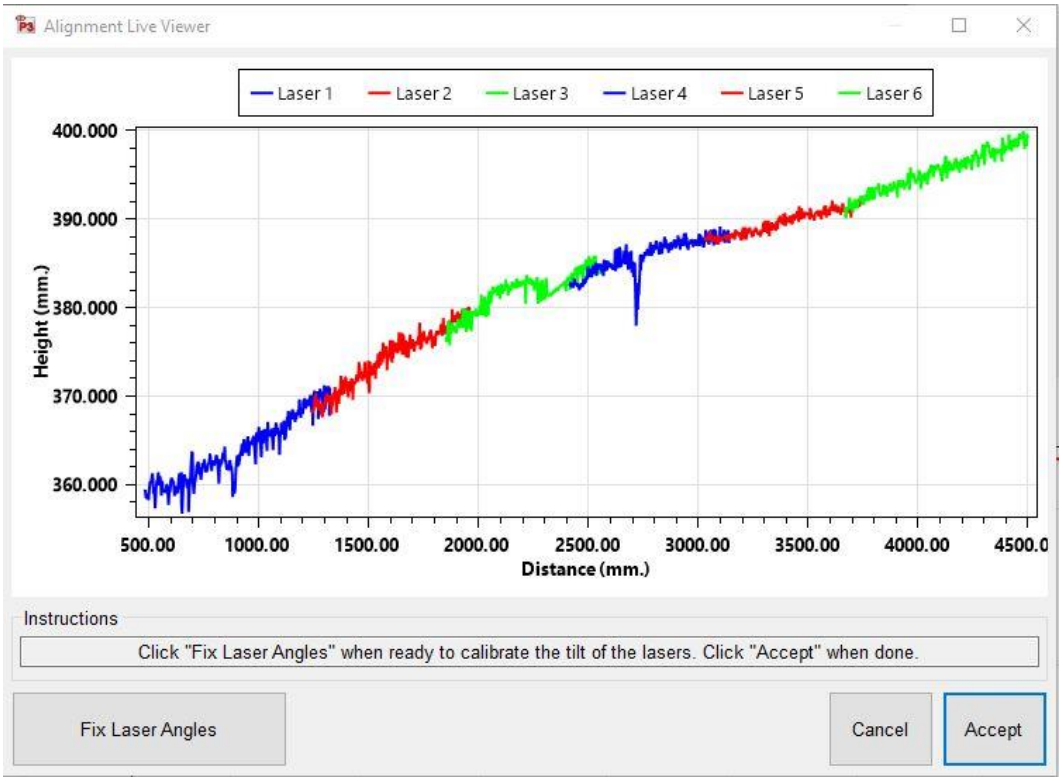
(4) Perform the Alignment Calibration by going to Calibration and then selecting alignment calibration.



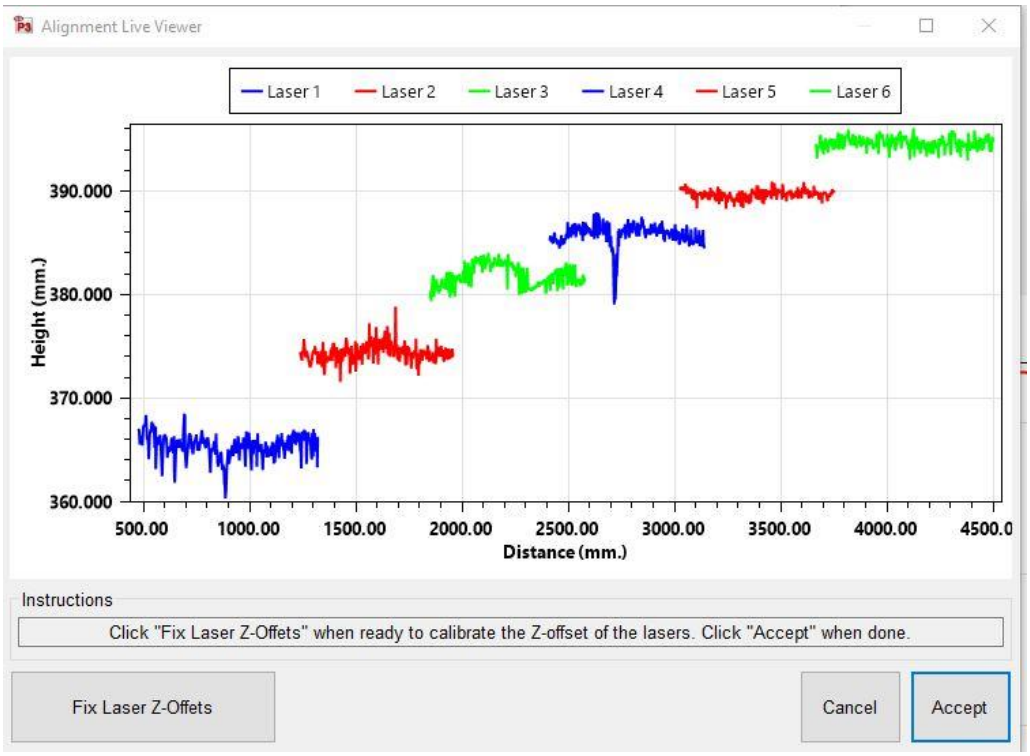
a) Enter the thickness of the straightedge bar that will be placed under the transverse lasers (See pic below).



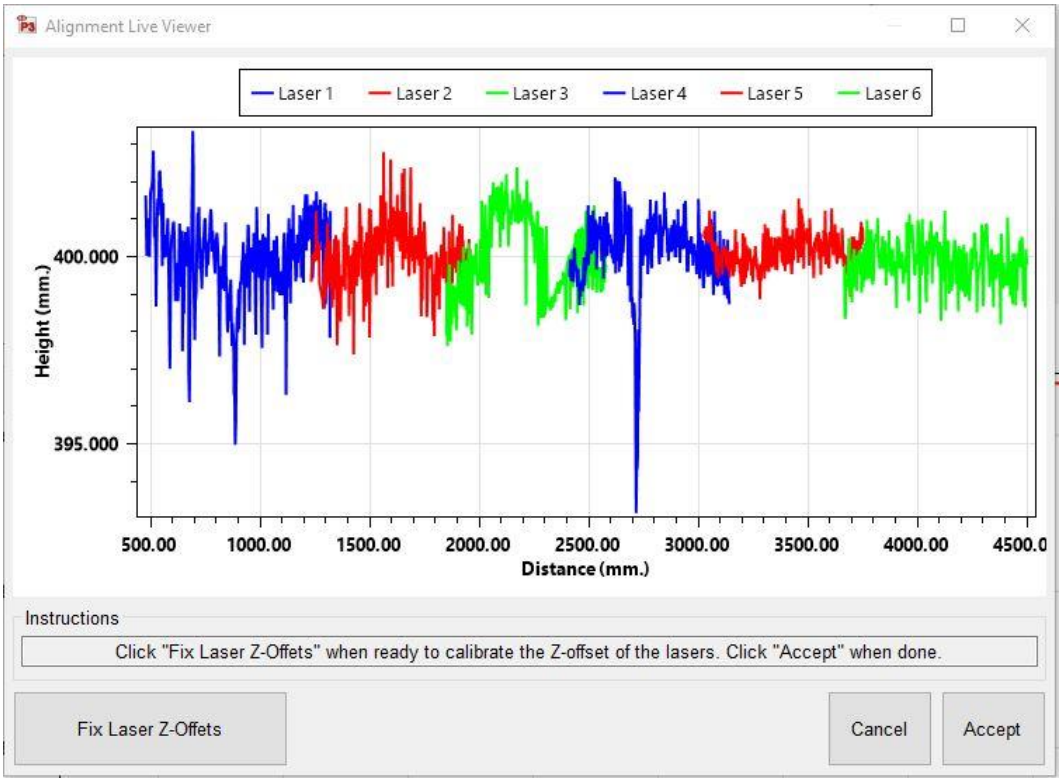
b) The 6 lasers should then show up in a viewer (See pic below). Note their current elevations and then begin placing the straightedge under the lasers until you can see all the lasers change by the thickness of your calibration bar. Once all lasers are under the bar, you can then you can Fix the Angle for all the lasers. Press the 'Fix Laser Angles' button in the lower left hand side of the screen. See pic below.



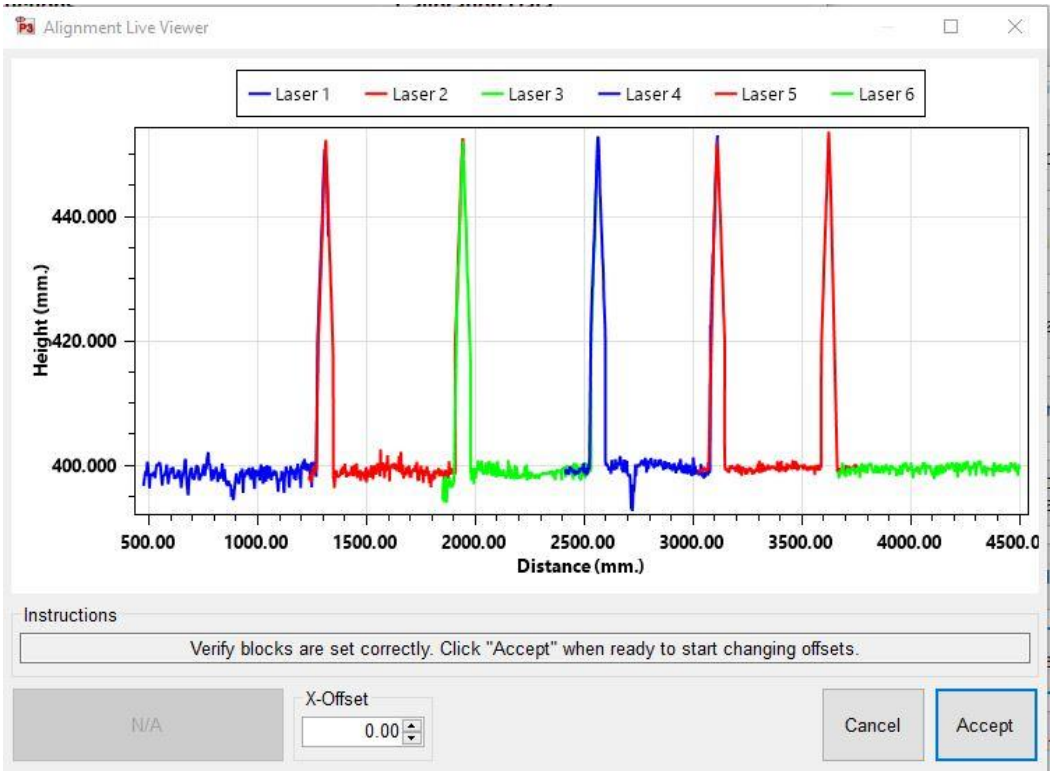
c) After the laser angle has been set, fix the elevation offsets for all lasers in order for them to line up with each other in elevation values. Click the Fix Z-offsets button in the lower left hand section of the screen. See pic below.



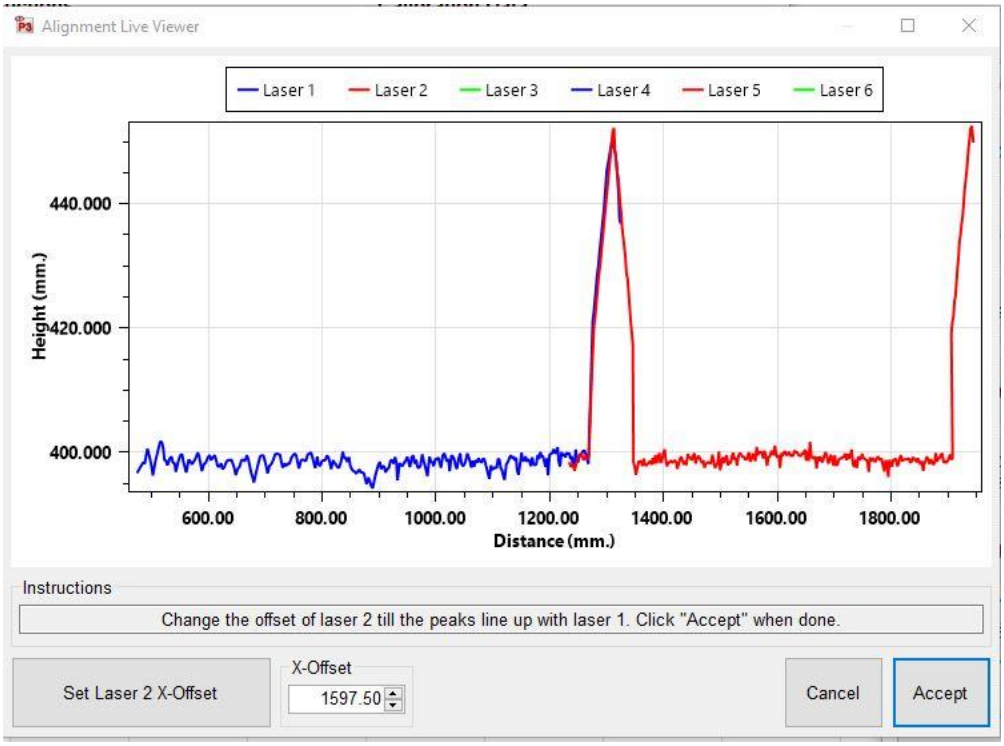
d) Once angles and z-offsets are set, accept the results and move on to the X-offset calibration (See figures below).



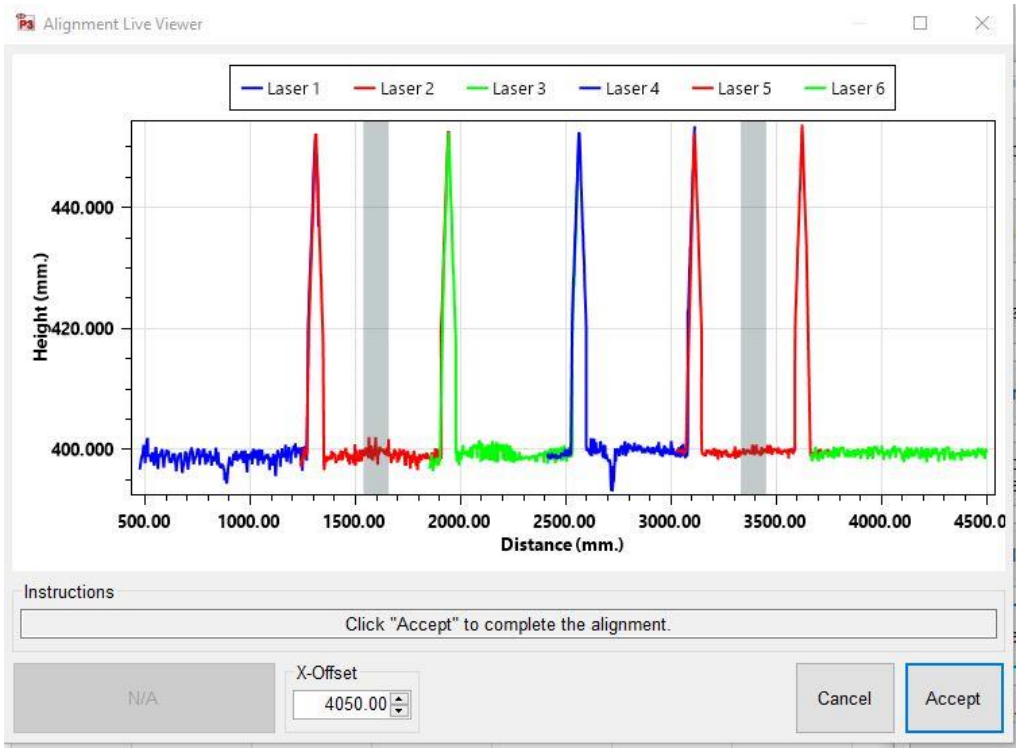
e) The X-offset calibration aligns the lasers side-to-side on the vehicle. Start by placing distinct objects between each of the transverse lasers (so that adjacent laser beams overlap on the object and you can see the object in between both laser in the Alignment Live viewer. See figure below.



f) One laser at a time, go through each laser and adjust the X-offset value until the laser is positioned in such a way that the object appears in the same position for both lasers. Do this for all the lasers.



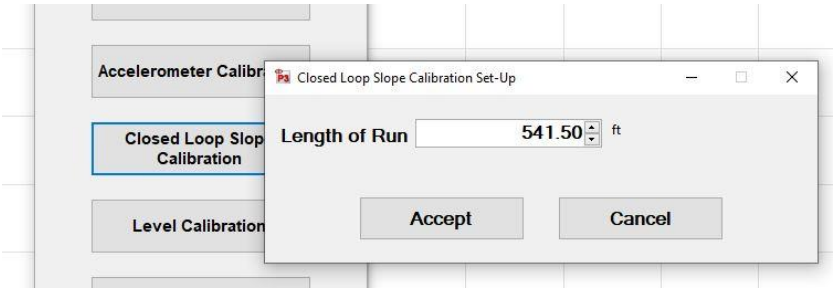
g) When complete, an overview window will appear for the calibrated lasers with shaded regions for wheel path lasers. This is a good opportunity to adjust laser pointers in order to identify where the wheel path lasers are getting their data. For Zero-Speed systems, you will want to make sure the lower stand-off line laser behind the transverse lasers are in line with the graph.



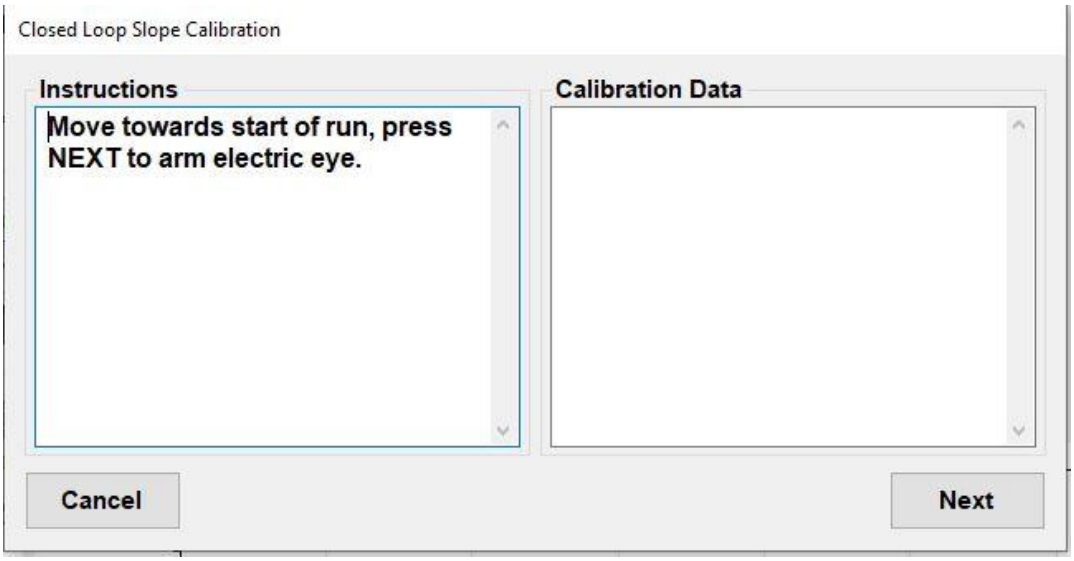
h) Once satisfied with the alignment calibration, press the 'Accept' button in the lower right hand side of the screen and move on to another calibration. If not satisfied with the result, try the calibration again.

i) Once the alignment calibration is complete, proceed to a distance calibration for the encoder. If using GPS-DMI without dropping below 5mph, you can move to the next step. If using GPS-DMI with zero speed lasers and expecting to collect under 5mph, calibrate encoder. See the main manual for Inertial Systems.

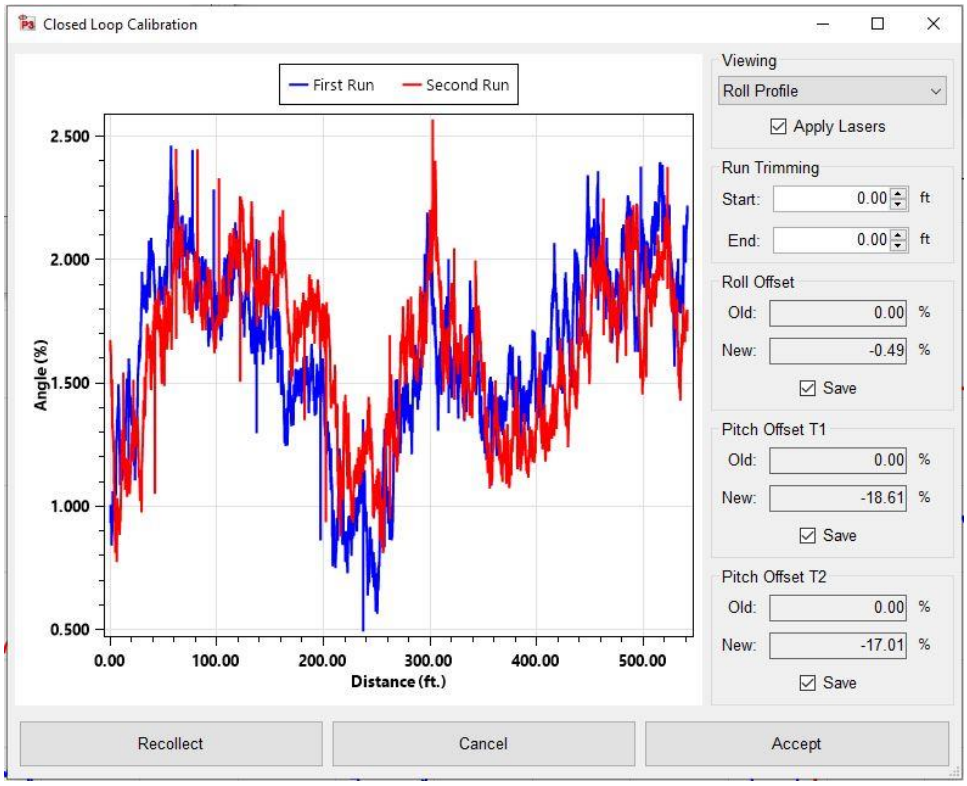
j) The next and last calibration is the "closed Loop" calibration. This calibration tunes the slope and pitch of the INS in order to align it with the lasers.



k) Make sure the INS status is “INS Solution Good” and then perform the calibration by collecting in one direction, turning around, and then collecting the same exact lane going the opposite direction (Driver wheels where Passenger wheels were the first direction). To do this you will need a start cone at both ends of the track, on opposite sides of the roadway. You will also need to know the exact distance between these two cones prior to starting the calibration.



l) At the end of this calibration, you will be given a plot of the results. You can view the Roll, T1 Pitch and T2 Pitch profiles for the forward and reverse runs and make sure they are satisfactory before saving. It is good practice to do a second (or multiple) calibration(s) to verify you yield the same offsets.



Survey Data Collection Logging

Base station logging

(1) Always start the base station logging before you start Rover logging. And end the base station logging AFTER you complete Rover logging.
(2) Novatel Base Station
    a. Connect computer to base station via usb cable and use Novatel connect to establish a connection.
    b. Issue the command "Logfile open filename.gps" to start the logging of a file.
    c. Go to tools/Run/Batch, and run the batch file for the base station.
(3) For other base stations, set them up to log Observable and Ephemeris in Rinex Format at 1hz

Rover Logging

(1) Get to a good open sky position. Click "Start Recording" on Data recorder to begin Rover data logging.
(2) Once it is logging data, sit for 10 seconds.
(3) Drive the vehicle forward until you are above 20mph for at least 300ft and then do a few turns in different directions stopping in between.
(4) Proceed to do your data collections with the system while this is logging in data recorder. Check periodically that the messages for the INS in data recorder are increasing.
(5) When finished collecting necessary data, drive around for a bit and then make a stop in open sky. Click the "stop recording" button in data recorder and save the INS file to a known location for post-processing later.
(6) Click the save data button to end the data logging.

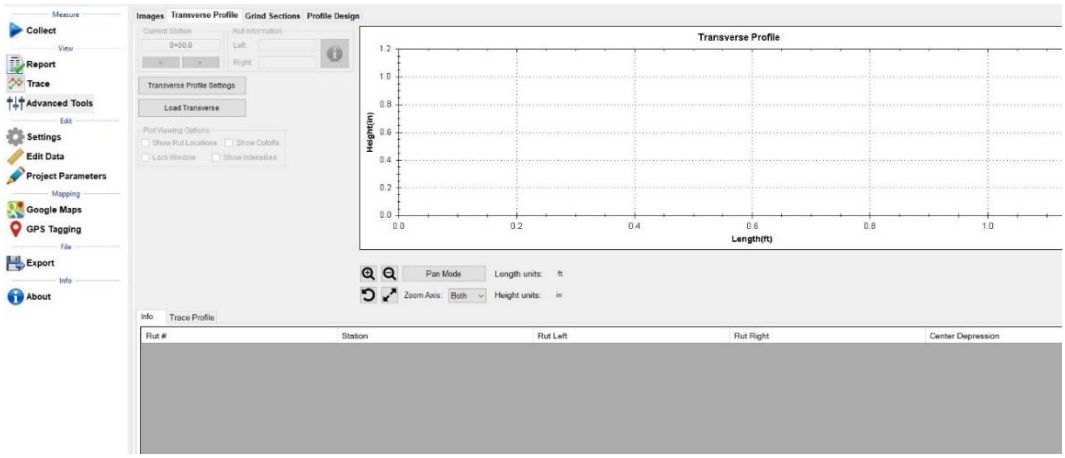
Data collection

(1) Collections can be done as per instructions in SSI Inertial Profiler manual. Monitor Data recorder to make sure all transverse lasers are connected and getting messages during collection. At end of collection, all laser messages should come out to within 1-2 messages of each other.

(2) If performing Survey collections that need to be corrected later on, collect data with multiple passes going across the road with sufficient overlap to stitch multiple passes to each other. It is best to have all passes collected uniformly going the same length as each other (starting and stopping in similar locations but shifted over slightly from one another) if they are to be stitched together.

Analyzing Data

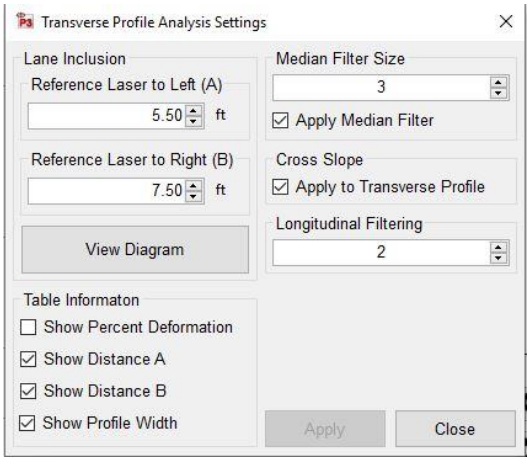
(1) The Transverse Profile data can be viewed in Profiler directly after collection in the Advanced tools section under the Transverse Profile tab.

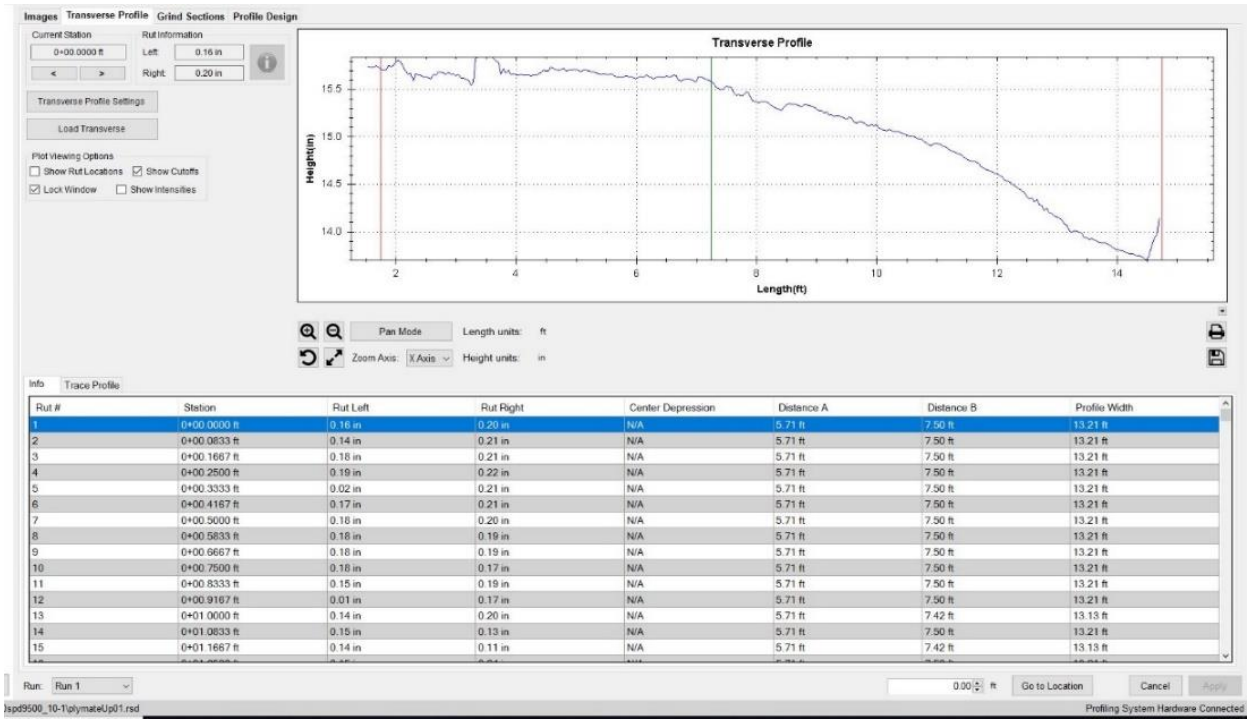


a) Click on the transverse profile settings button to modify filtering and cutoffs desired on the data.

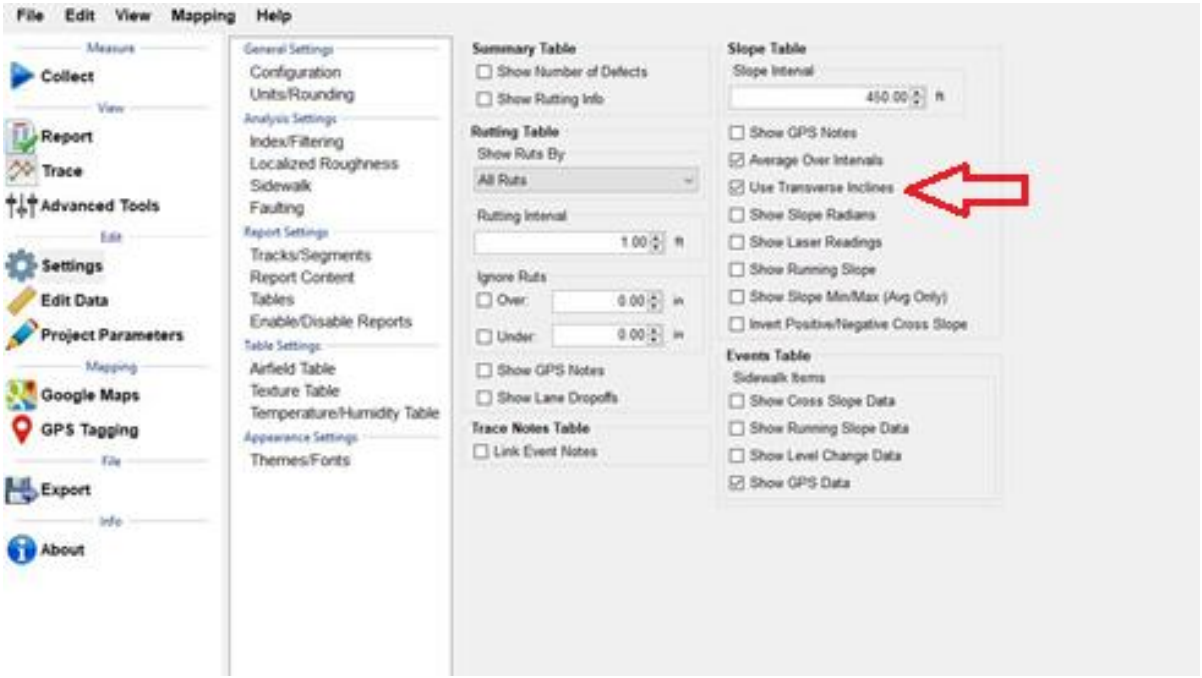
b) Show rut locations, cutoffs, intensities, etc. by checking the boxes on the screen.

c) Once set, click the “Load Transverse” button to load the transverse profile data. Click on different rut numbers in the table to view that particular transverse profile in the Transverse Profile graph.





For calculating transverse profile cross-slope, use the slope table report in the report tab. To insure use of the full transverse profile for slope values, make sure “use transverse inclines” is selected in the Settings/Tables/Slope Table. Set the interval and any other statistics Desired in this report. See figure below.



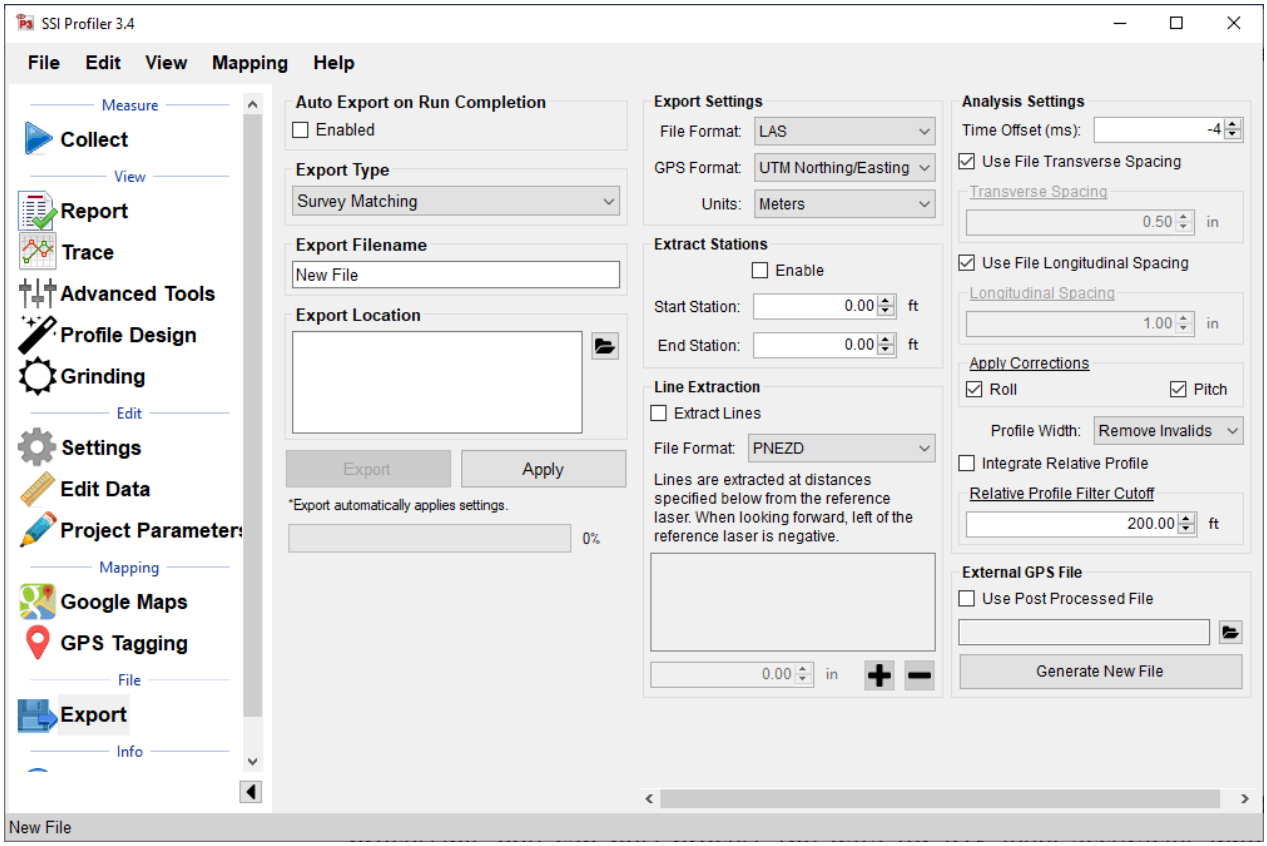
Rut Reports can be generated in the report tab. Settings for the rut report can be found in the Settings/Tables/Rutting Table.

Survey Export

(1) To export data to a Survey Point Cloud, use the Survey Matching Export in RSD Data Translator. See pic below for points 1-9.
(2) Import the desired RSD files associated to a given INS-XXXXX.BIN file collected in data recorder.
(3) If you are not using a post-processed file for correcting to a Base Station, you can simply leave the “use post-processed file” unchecked (see pic below). If you have a INS-XXXXX.BIN and have associated License for Post-processing, you can check the box for using post-processed file.
(4) Select the desired export format, coordinate frame format and units. Typically, LAS export type, US State Plane, and Survey Feet are used in the US.
(5) To create a new post processed file, click “generate new file” to run the post-processing wizard to correct the INS-XXXXXX.BIN file to the Base Station File collected. See further details in following Post-Processing Wizard below.
(6) Set the necessary time offset for your system. Typically, 0ms can be used.
(7) Select what spacing/density you would like to export the runs.
(8) Select the Profile Width of the export files

a. ‘Remove invalids’ will export the maximum potential data available from the transverse data on every transverse profile
b. ‘Max Uniform Width’ will find the narrowest width of the transverse profiles on each run and export that same width for the entire run.
c. ‘Use Width Cutoffs’ will utilize the cutoffs set in the advanced tools section of each file (when clicking transverse settings button).

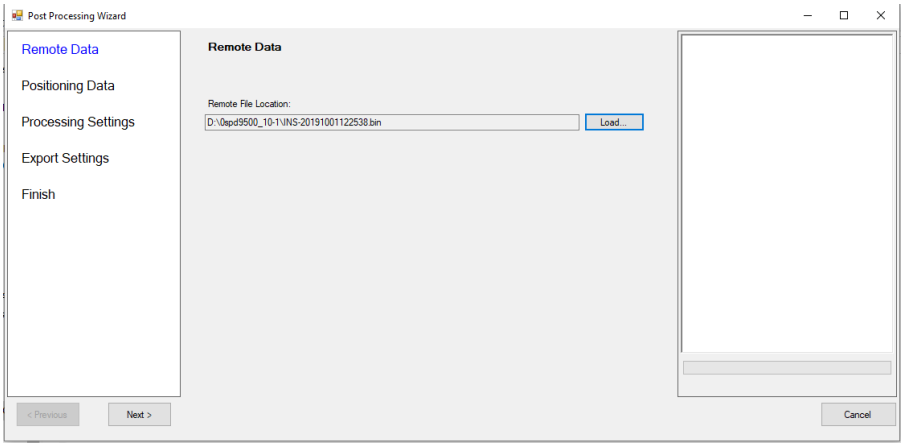
(9) If wanting to extract data between specific stations, you can specify that as well.



Post-Processing Wizard

(1) If raw rover data was collected and you have the necessary license for post-processing, you can post-process the data for RTK level accuracies when using a base station.

(2) On the first screen of the wizard, import your INS-XXXXX.BIN associated the RSD files you are wanting to export.



(3) On the second screen, import the base station data to be used for processing. There are 3 options:

a. The first option is to Add a base station file from your own base station by clicking the Add button. You could also add multiple Base Stations if desired for improved results on long projects.

i. NAD83 is normally used for the datum if doing state plane in the United States of America. Otherwise use WGS84 or whatever is necessary for your particular project.

ii. Tools are available for entering the northing/easting state plane and orthometric heights (which are commonly given on projects) below the lat/lon/height fields. This will convert the common project coordinates to Lat/Lon/Ellipsoid height. If you know the Lat/Lon/Ellipsoid height, you can enter those without doing a conversion.

iii. If you do not know the precise location of your base and only care about the data relative to itself, you can choose "load from file" where the program will grab an average coordinate value from the base logs. If precise positioning is selected and there are valid precise files available, it will give a more accurate base position when clicking load from file. **Only use "Load from Average" if you do not care about the output being relative to a known project. Only use "Load from STA" if you know the STA position of your base is set to the true coordinate of the Base.**

iv. You can use the "precise positioning" and download precise files to help the solution even if you use a base station. It is good practice to utilize this if possible, regardless of what you use for your base station.

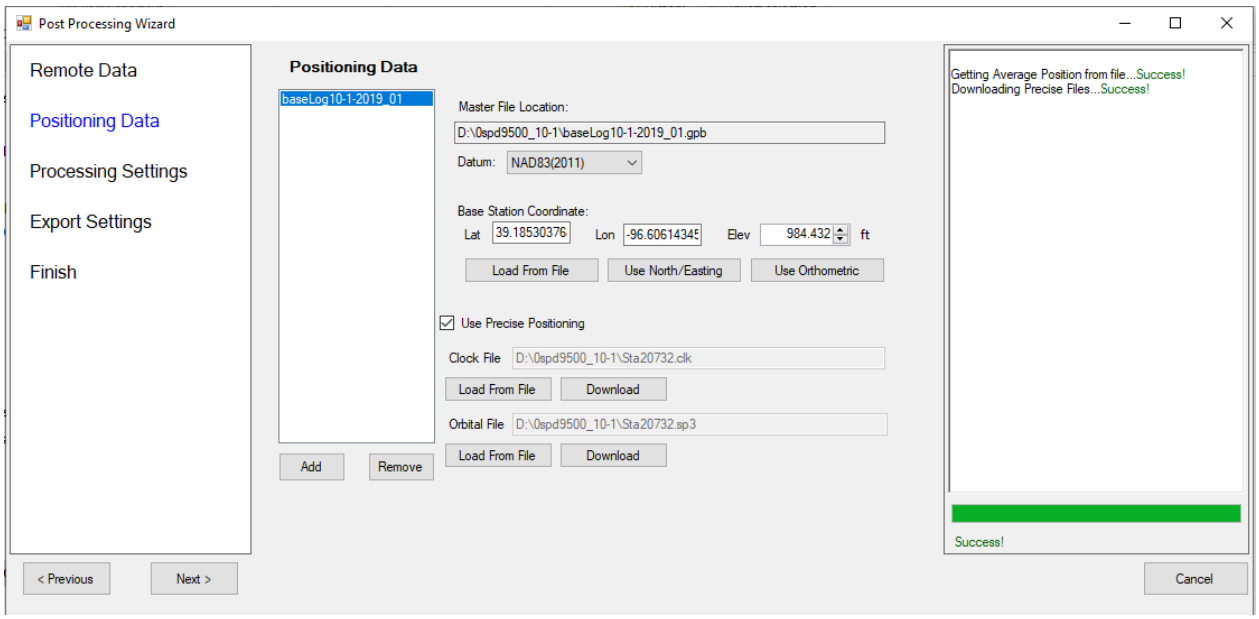
b. Alternatively, you can add a CORS station by clicking the tab for Download. Again, you can add more than one CORS station if desired.

i. If using a CORS station, click "load from STA" to have it generate the location of the base automatically. **Only use "Load from Average" if you do not care about the output**

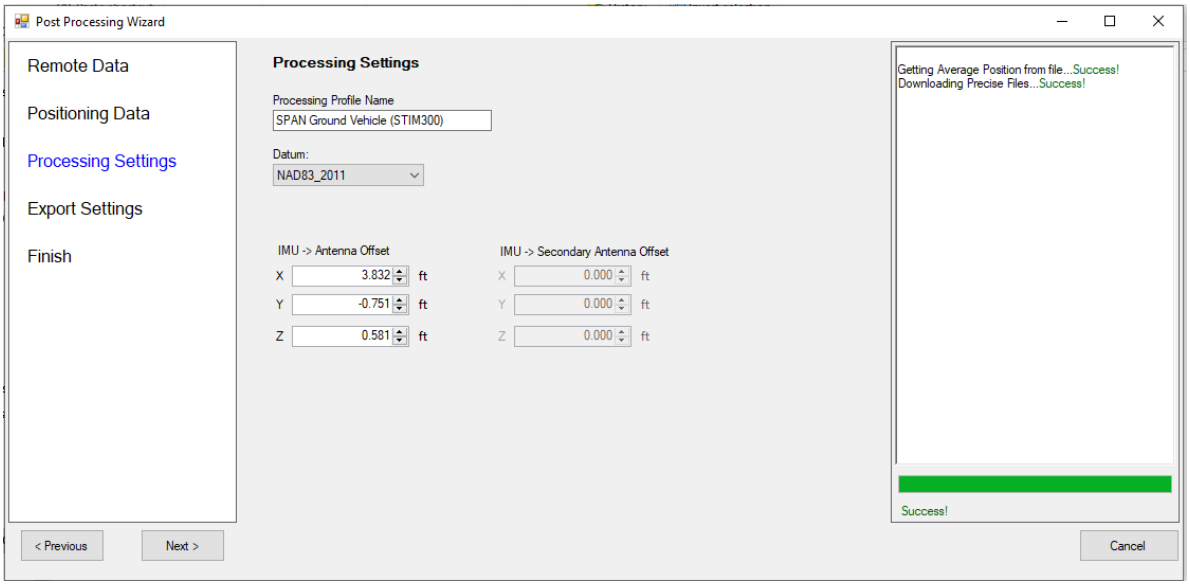
being relative to a known project. Only use "Load from STA" if you know the STA position of your base is set to the true coordinate of the Base.

ii. You can use the "precise positioning" and download precise files to help the solution even if you use a base station. It is good practice to utilize this if possible, regardless of what you use for your base station.

c. Another less accurate alternative is to use PPP in which case you would check the box for "use precise positioning" and not have any base station data added to the list.



(4) Processing Settings can be used for selecting your processing profile, datum, and IMU to antenna offsets. Typically use NAD83 for the datum if in the



United States of America and using state plane. Otherwise use WGS84 or whatever is necessary for your project. See figure below.

a. For the export settings, choose the units and coordinate system the export file is to contain. See figure below for the following settings. Set the output file location. This will be where the file is located for use in the Survey Matching output.
b. Choose Northing/Easting or Lat/Lon format. Typically, Northing/Easting is used to correlate to most projects.
c. Select UTM or State plane and choose the proper zone if using Northing/Easting.
d. Choose ellipsoid height or orthometric height. Typically, projects are in Orthometric height in which case a geoid file will need to be selected.
e. Enter the IMU to laser offset required for your INS type. For SSI N, X: -0.064m, Y: 0.000m, Z: 0.000m. The SSI P will need to be measured from the IMU origin to the laser 3 origin.
f. Set the interval to 0.01 for it to output the data at 100hz (every 0.01s).
g. Units are typically in Survey Feet and Datum is typically NAD83. Otherwise choose according to your project needs.