White Paper

Inside Trimble TX6 and TX8 Color Acquisition

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ABSTRACT

With the release of the new Trimble TX6 and TX8, Trimble introduced a new integrated HDR camera to efficiently capture color images to colorize scans. The camera provides the fastest image capture available, in line with the scanning performance of the Trimble TX6 and TX8 to maintain the highest level of productivity possible. The Trimble TX scanners are the fastest, most productive 3D laser scanners on the market and the camera enables users to colorize scans with minimal impact on productivity. The purpose of this paper is to:

- Demonstrate the benefits of the Trimble TX integrated HDR color camera
- Explain the limitations of the camera and scan colorization
- Demonstrate the benefits of external camera options
- Compare integrated and external camera options

TECHNOLOGY THAT transforms

Trimble

The Trimble TX integrated camera solution was designed to be fast and easy to encourage color acquisition, not restrict it because of time constraints in the field and office. Users of other 3D laser scanners are often discouraged from capturing color images because it can take as long to capture images as it takes to scan, doubling the overall scan duration at each station. The additional time to acquire and process images can have a significant impact on productivity and end users often choose to avoid it completely unless it's a project requirement. With more industries requiring color deliverables to more clearly visualize projects or identify color coded elements, color may no longer be a choice, but rather a mandatory requirement to bid a project. Here is how we solved the problem.

INSIDE TRIMBLE TX COLOR ACQUISITION

BENEFITS OF THE INTEGRATED CAMERA

Fastest image capture

The Trimble TX integrated HDR camera provides the fastest image capture on the market to minimize the impact on productivity in the field. This is accomplished with a 10 Megapixel camera taking 60° x 180° full field of view pictures for each 360° scan. The single exposure Standard mode takes six pictures in only one minute and the HDR mode with three exposures takes 18 pictures in two minutes or less. The table below shows TX6 and TX8 scan times with no color compared to the time required to also collect Standard and HDR images with the scan.

Trimble TX6	No Color	Color Standard	Color HDR
Preview	2 min	3 min	4 min
Level 1	3 min	4 min	5 min
Level 2	5 min	7 min	7 min
Level 3	19 min	20 min	21 min

Trimble TX8	No Color	Color Standard	Color HDR
Preview	1 min	2 min	3 min
Level 1	2 min	3 min	3 min
Level 2	3 min	4 min	5 min
Level 3	10 min	11 min	11 min
Extended	19 min	20 min	21 min

Flexibility to address different lighting conditions

The two color acquisition modes provide the flexibility to effectively address different lighting conditions. The Standard auto exposure mode can provide good results in areas where lighting is consistent throughout the scene, for example indoors with no variation in light, or outdoors with an overcast sky. The HDR auto exposure mode is useful in areas with extreme variations of light, for example indoors with bright sunlight shining through a window or outdoors where there is bright sunlight and darker shaded areas. The three HDR exposures will help achieve the best exposure in extremely bright or dark areas of the scene.

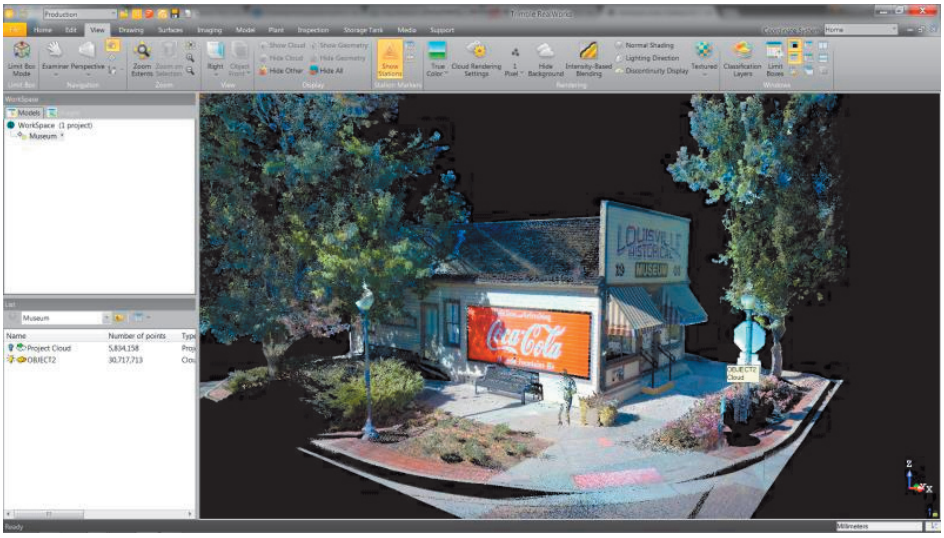

Figure 1: Outdoor sample in RealWorks Examiner

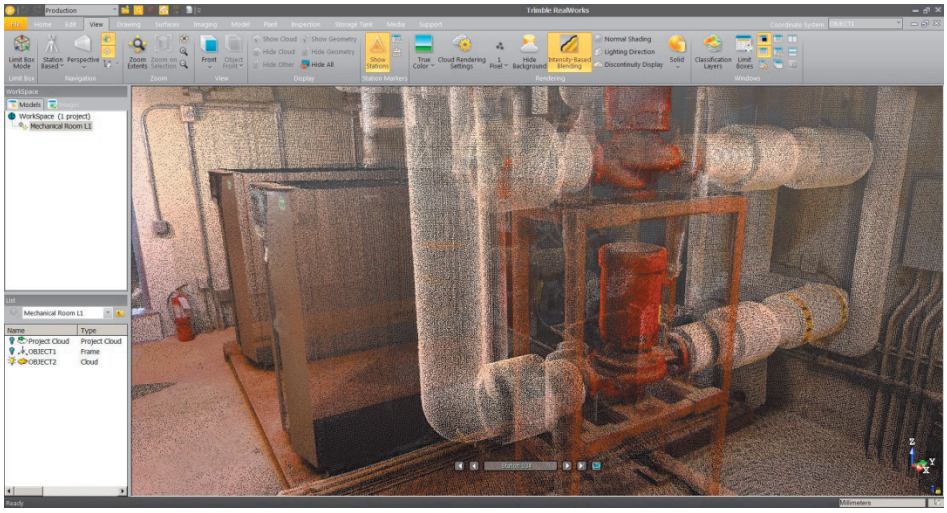

Figure 2: Indoor sample in Realworks Station Based view

The Trimble TX also provides a Fixed exposure option to use in conjunction with the Standard or HDR modes. Fixed exposure applies the exposure of the first picture to each of the remaining pictures in the scan. Fixed exposure will provide consistency throughout the scene where auto-exposure will adjust the exposure for lighter or darker areas. Each option has advantages in different environments so experiment to see which option works best in your setting. The samples below compare Auto and Fixed exposure on Standard and HDR images.

Figure 3: Comparison of Auto and Fixed exposure for Standard and HDR modes

Automatic Scan Colorization

When color acquisition is enabled, a TCF image file is created and linked to each associated TZF scan file. These files are processed automatically with the Trimble RealWorks software to colorize the scans. The workflow to process colorized and non-colorized scans is exactly the same. RealWorks uses a patented image/scan matching algorithm to accurately colorize the scan point cloud with no user interaction. There is also no possibility of the camera losing calibration because there are no calibration requirements.

LIMITATIONS OF THE INTEGRATED CAMERA

Point Cloud Colorization Only

Trimble RealWorks scan colorization will only colorize scan data that has been captured. If no points are captured, no color will be matched. Image panoramas and individual photos are not available. When viewing an indoor scan in Trimble Scan Explorer it will appear to be a panoramic image if a full dome of points was collected, but in fact you are viewing the colored point cloud and not a panoramic image. Areas where no data is collected will appear black, for example the sky or water in outdoor scans.

Figure 4: Sample indoor scan in Trimble Scan Explorer

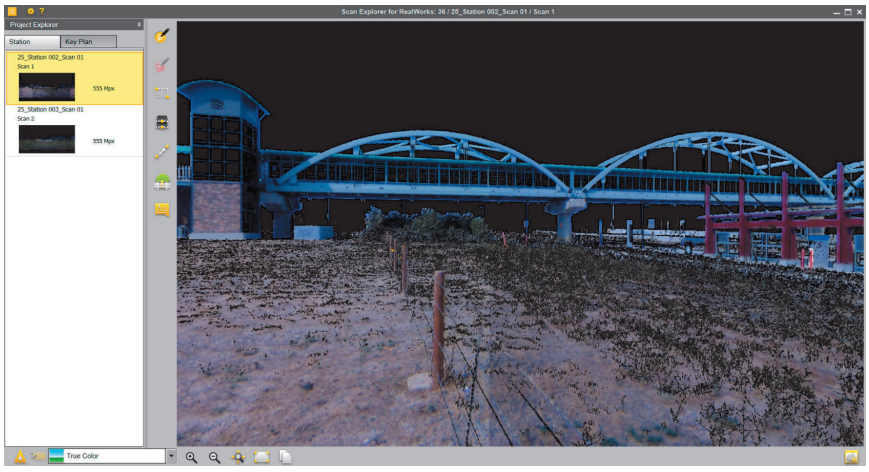

Figure 5: Sample outdoor scan in Trimble Scan Explorer

Image/Scan Parallax

The Trimble TX integrated camera has an image/scan parallax because the camera is lower than the center of scanners rotating mirror assembly. This can result in some points being scanned, but not captured by the camera. Scanned points that do not have associated imagery will display in grey scale intensity. The parallax effect is most noticeable when viewing single scans in Trimble Scan Explorer and is less apparent when viewing a colorized point cloud of multiple scans in RealWorks.

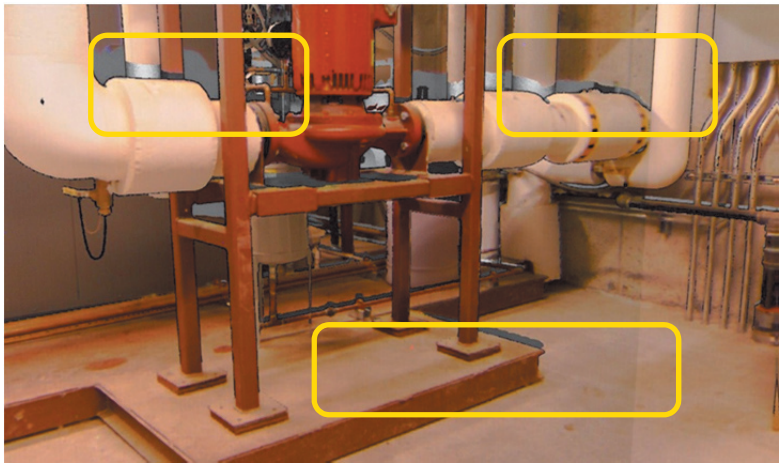

Figure 6: Sample in Trimble Scan Explorer

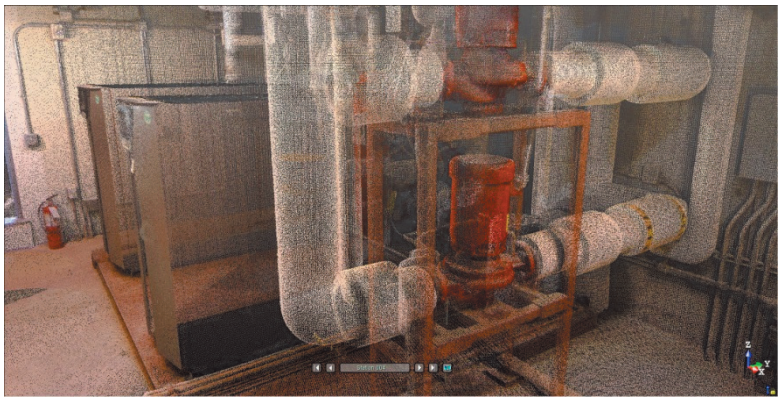

Figure 7: Colorized point cloud in RealWorks Station Based view

Figure 8: Colorized point cloud in RealWorks Examiner

EXTERNAL CAMERA COLOR ACQUISITION

Nodal Ninja External Camera Kits

External camera kits for the Trimble TX6 and TX8 are available from Nodel Ninja to provide higher resolution, parallax free panoramic images. You can manually capture images, create panoramas with the Autopano Giga software and match the panorama images to TX scans with the Trimble RealWorks RealColor tool to deliver the highest quality color deliverables on the market. The following external camera kits are available direct from Nodal Ninja.

Part Number	Description
B-D7100	Nodal Ninja Trimble TX8 3D laser scanner kit w/ Nikon D7100 24.2MP
B-JH4	Nodal Ninja Trimble TX8 3D laser scanner kit w/ Nikon D5300 24.2MP
B-JH5	Nodal Ninja Trimble TX8 3D laser scanner kit NO CAMERA

- Nikon digital SLR camera (not included with kit B-JH5)
- Sigma 8 mm f/3.5 EX DG circular fisheye lens (Nikon mount)
- Pelican 1400 lockable case with "pick n' pluck" foam. Kits may also be delivered with the slightly larger 1450 Pelican case.
- 8 GB Class 4 SDHC flash memory card
- USB 2.0 high speed compact card reader
- Nodal Ninja R1w/RD5 bracket with ring clamp F6120
- Stop plates F2106
- Tribrach kit R10/R1 with 63.8 mm height adapter (P/N D12603)
- Autopano Giga software (electronic delivery)

Comparison of Integrated and External Camera

The integrated camera delivers sufficient image resolution for most applications however; the external camera will enable you to see greater detail when you zoom in on the image in Trimble Scan Explorer and provide a full panoramic image versus colored points.

Figure 9: Resolution comparison

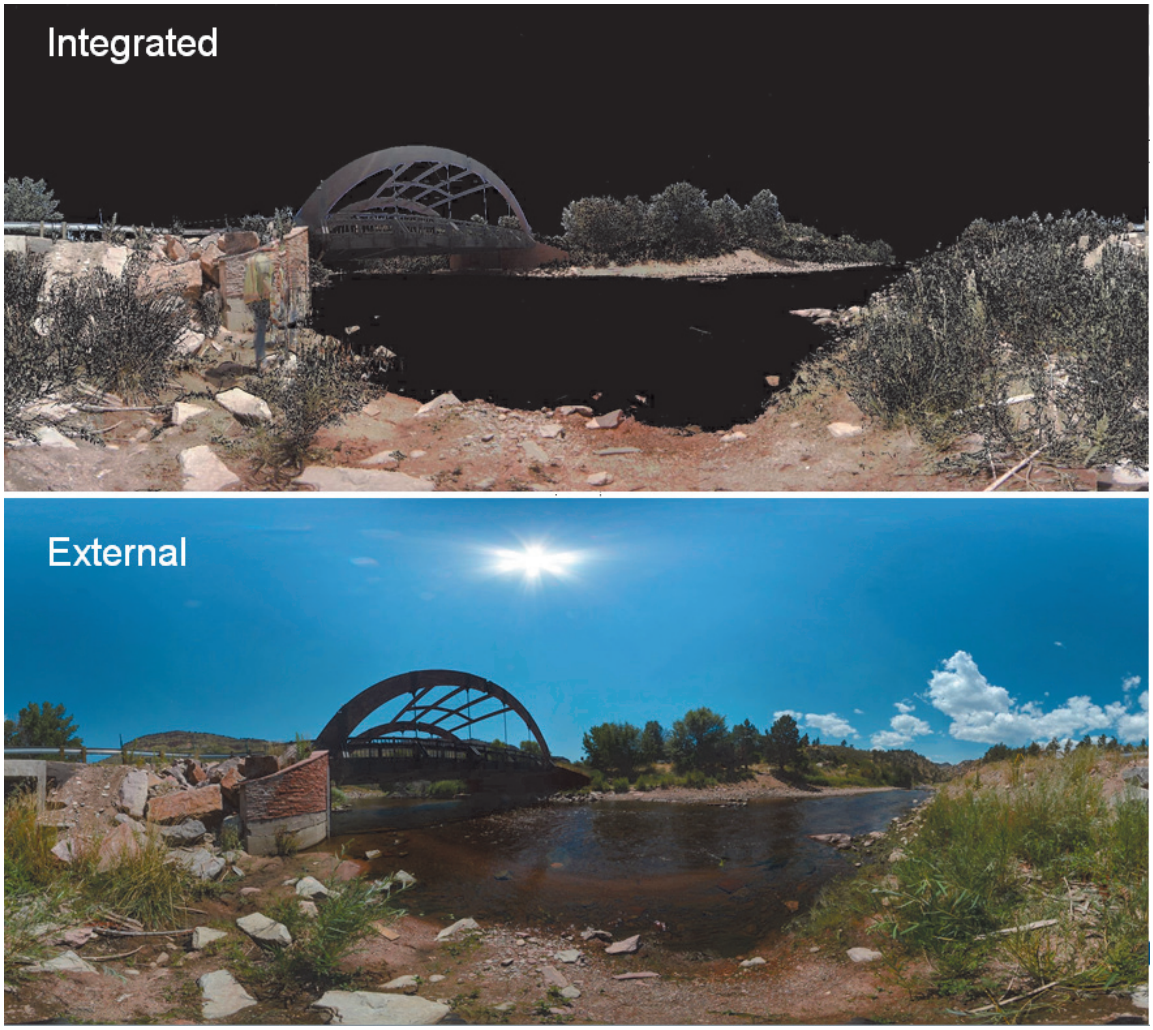

Figure 10: Full panorama versus colored points

- Integrated Camera
  - Fastest acquisition on the market
  - Fully automated acquisition
  - Fully automated HDR and images/scan fusion processing with RealWorks
  - Colored points instead of panorama
  - Parallax effect
  - Color resolution similar to Level 1 scan
  - Ideal for fast and easy color deliverables
- External Camera Kit
  - Fastest solution on the market for high quality panorama/scan fusion
  - High color quality through full control and larger optics
  - Manual image acquisition
  - Semi-automated processing with Autopano Giga and RealWorks software
  - Panorama instead of colored points
  - No parallax effect
  - High color resolution
  - Ideal for the highest quality color deliverables

Conclusion

The Trimble TX integrated camera and RealWorks software provide the most productive and easiest solution available to automatically acquire and process data for scan colorization. When higher resolution panoramic images are required, Trimble offers external camera kits to effectively deliver the highest quality color deliverables on the market. Color acquisition can now be accomplished with no negative impact on productivity in the field or office so users can efficiently recognize the value of scan colorization.