ARTICLE

Mock Incident Scene Results Using a FARO Freestyle^{3D} with Capture & SCENE Software

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I recently had the pleasure of spending a week with laser scanning and forensic animation expert David Dustin, President of Dustin Forensics and a member of IAFSM's Board of Directors (International Associationof Forensic & Security Metrology). The job took us to the island of Guam where we were able to put some of the FARO laser scanning & imaging products, along with the associated software, to use in a customer demonstration.

All of the imagery and scans presented here represent mock accident scenes. The equipment that we put to use included a FARO Focus^{3D} X 330 Laser Scanner and the latest FARO Freestyle^{3D} X Handheld Scanner along with FARO's SCENE Capture the latest revision of FARO's SCENE software (Version 5.5). Finally, we would like the express our gratitude to the Guam Police Department and the staff of their Crime Laboratory in assisting with the scene set-ups.

The mock scene was first scanned with the Freestyle^{3D} X in four scans and in less than 1,000 total frames. As part of the Freestyle^{3D} scanning workflow, we incorporated FARO's photogrammetry targets into the scene. The use of the targets simplified the post-processing effort and allowed us to align each frame in the scan and easily register multiple scans together. The Freestyle^{3D} scans do take slightly more processing time than the Focus^{3D} laser scanning data due to the dense point clouds and larger data files, however the workflow is quite simple to implement.

We then scanned the same scene with the FARO Focus^{3D} X 330 at 1/5 the resolution and 3x the quality. We also used several 80mm Koppa target spheres. These small Koppa spheres are easy to transport and their magnetic mounts allow the user to easily attach them to metallic surfaces such as vehicle doors, or in this case, a riding lawn mower that was set up in the scene. The spheres are also recommended for bullet trajectory analysis. Finally, use of the spheres allows the user to merge Freestyle^{3D} X and Focus^{3D} data scans together since both datasets recognize the spheres, and a standard target registration aligns the scans in a snap. Once the data was processed into two clusters, we hid the visibility of the Focus^{3D} and Freestyle^{3D} X independently to compare the results. The reader can see the comparison between the Focus^{3D} and Freestyle^{3D} X data in **Figures 1 and 2**.

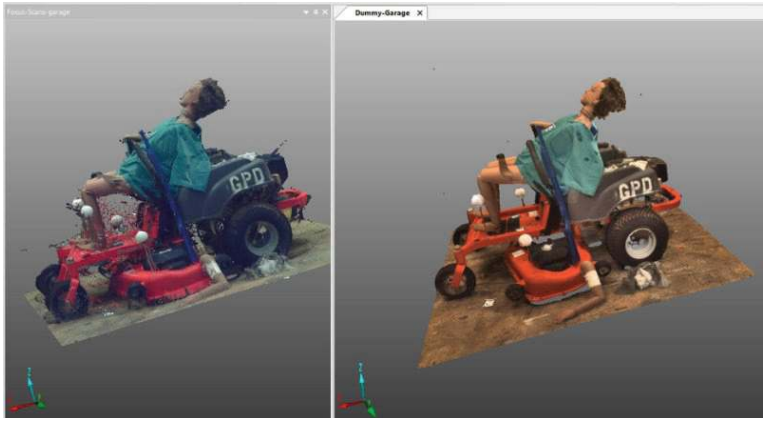

Figure 1: Mock accident scene data scan comparison (profile view). Data collected using the FARO Focus^{3D} X 330 appears on the left, and the Freestyle^{3D} X data appears on the right.

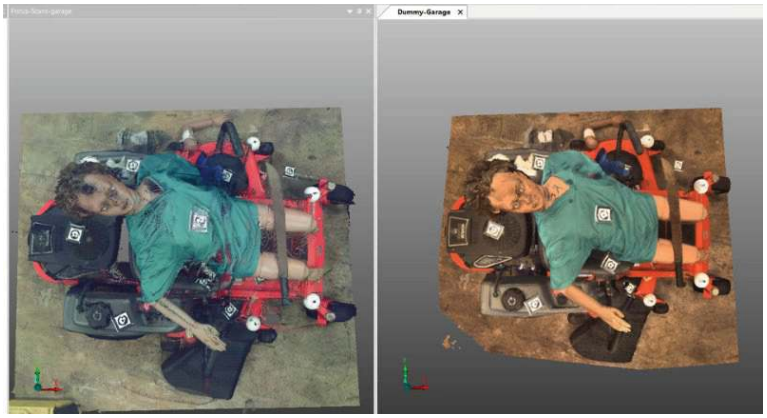

Figure 2: Mock accident scene data scan comparison (overhead view). Data collected using the FARO Focus^{3D} X 330 appears on the left, and the Freestyle^{3D} X data appears on the right.

Result Comparisons

Comparing the results, we see a very clean dataset from the Freestyle^{3D} X. The new Freestyle^{3D} X data had very low-noise and better colorization than previous versions of the Freestyle^{3D} – even comparable to, and slightly better than, the Focus^{3D} in some indoor lighting environments. The unique design of the Freestyle^{3D} X's dual-infrared color cameras allow the device to collect data from two different angles which delivers clean and accurate data while reducing noise levels (accuracy of 1.5mm and 1mm with the Freestyle^{3D} and Freestyle^{3D} X respectively). Combined with the new visualization tools and best-points filtering schemes, we see fantastic scanning results using the product in different applications. **Figures 3-5** show several examples of Freestyle^{3D} data scans with and without the new best-point filtering.

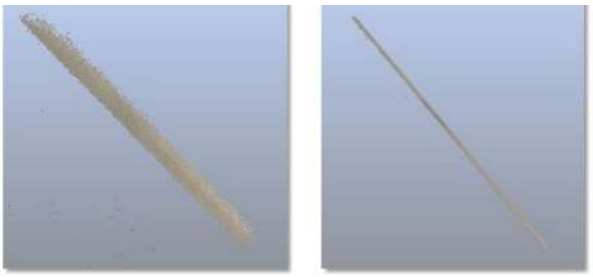

Figure 3: Freestyle^{3D} data without using best-point filter (left) and with the filter (right).

Some of the recent feature additions for the Freestyle^{3D}, SCENE Capture, and SCENE Version 5.5 include:

- Significantly decreased scanning times; prior scans taking 210 seconds have been reduced by 80 seconds (~ 40% reduction)
- Ability to scan point clouds in color or greyscale
- New Visualization Tool provides the user with a much more realistic image
- One-click auto-leveling allows easier navigation in SCENE
- An automatic flash mode that activates the built-in LED depending on external lighting conditions; at slow pace to keep tracking stable and increase performance.
- A new best-points filter to dramatically reduce noise by filtering up to 40% when scanning the same object from different distances, and removing points from far distances whenever there is a sufficient point density from a closer distance.
- A printable pdf calibration report
- An optional NIST-traceable calibration plate (see **Figure 6**).

Additionally, the new Freestyle^{3D} X includes an IP52 rating and an accuracy of 1mm.

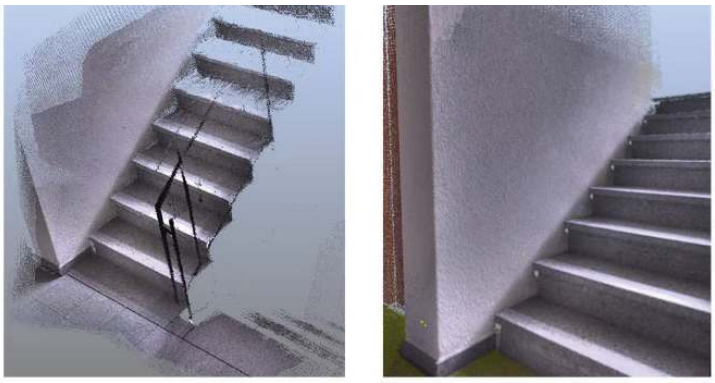

Figure 4: Stairway scanned using a Freestyle3D. Data without using best-point filter (left) and with the filter (right).

Figure 5: Carry bag scanned with a Freestyle3D. Data without using best-point filter (left) and with the filter (right).

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Calibration Certificate

Model: On-Site Calibration Plate
Serial Number: CP0C000400
Certificate Number: CP0C000400-20150907-EU
Certification Date: 2015-09-07

Measurements traceable to NIST

The measurements of this on-site calibration plate are traceable to a NIST (National Institute of Standards and Technology) calibrated length normal. Amongst others, traceability is achieved by an unbroken chain of measurements and associated uncertainties (U_{MPE}, $U_{Repeatability}$, $U_{Reproducibility}$, U_{Drift}). The values for $U_{Reproducibility}$ were derived empirically.

	U_{MPE}	$U_{Calibration}$	$U_{Reproducibility}$	U_{Total}
x-axis	2.95µm	5.00µm	22.83µm	27.83µm
y-axis	2.95µm	5.00µm	11.58µm	16.58µm

Coverage factor k=2 (95% confidence interval)
Temperature: 20°C

Y=172.641mm
X=307.782mm

This certificate shall not be reproduced, except in full, without permission of FARO Technologies, Inc. It invalidates all other certificates generated before the certification date.
The results of this certificate relate only to the items calibrated or tested.

Authorization: Rene Pfeiffer, Quality Control
Date: 2015-09-07

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Figure 6: NIST traceable calibration certificate

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