

Recon-3D

HOME

SUBSCRIBE

TRAINING

FAQ

TUTORIALS

ACCESSORIES

SAMPLE DATA

RESEARCH

ABOUT

CONTACT

R3D

RECON-3D



ACCURATE DATA FOR FORENSIC INVESTIGATIONS



Download on the
App Store



Let's Chat!

Use of Recon-3D in Scene and Vehicle Documentation

presented by

Daniel W. Vomhof III

4N6XPRT Systems

www.4N6XPRT.com

8387 University Avenue - La Mesa, CA 91942 - USA

Ph: (619) 464-3478 - Email: dv3@4n6xpert.com

for

SCARS 2023 Conference

South Carolina Accident Reconstruction Specialists

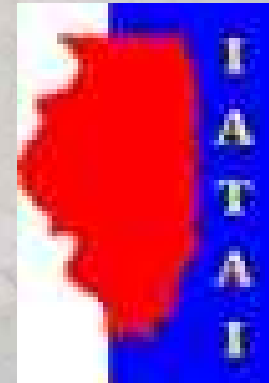
July 23-28, 2023

Mt Pleasant, SC

Use of Recon-3D in Scene and Vehicle Documentation

Daniel W. Vomhof III

- ACTAR # 484
- EIT
- Involved in AI/AR work since 1976



484



Recon-3D & Cloud Compare

- ★ This is not the typical Recon-3D and Cloud Compare presentation. For typical Recon-3D presentations (which ARE important) see the [Cloud_compare_comparisons-Patrick_Davis.pdf](#) and the [WYMAN_Symposium_Lidar_App.pdf](#) presentations that are included as separate downloads
- ★ This presentation is geared specifically towards the vehicle accident investigation and reconstruction field.

Recon-3D & Cloud Compare

- ★ This presentation deals with considerations as to app operation selection and accuracy within the Recon-3D tool.
- ★ The Cloud Compare portion takes the user through the steps to obtain crush measurements with Cloud Compare.

Recon 3D

What is it? What is it not? Why use it?

- ★ Recon-3D is an Apple App to be used on either an Apple iPhone or Apple iPad that has the LIDAR function
- ★ It combines the LIDAR measurement function with photogrammetry using the video taken while “scanning” the object/area of concern

Recon 3D

What is it? What is it not? Why use it?

- ★ It is not meant as a replacement for a “real” scanner (i.e. - FARO, Leica, etc)
- ★ It does not have the density of scan points the larger scanners have
- ★ It also doesn't require the tripod or multiple scans of the larger scanners
- ★ It doesn't have the associated costs of the larger scanners.

Recon 3D

What is it? What is it not? Why use it?

- ★ Cost - relatively low
- ★ Flexibility - You walk around and scan, you cover the area of interest, you don't have to set up a tripod multiple times, you don't need to pick up and set down the scanner multiple times, you just walk around and scan.

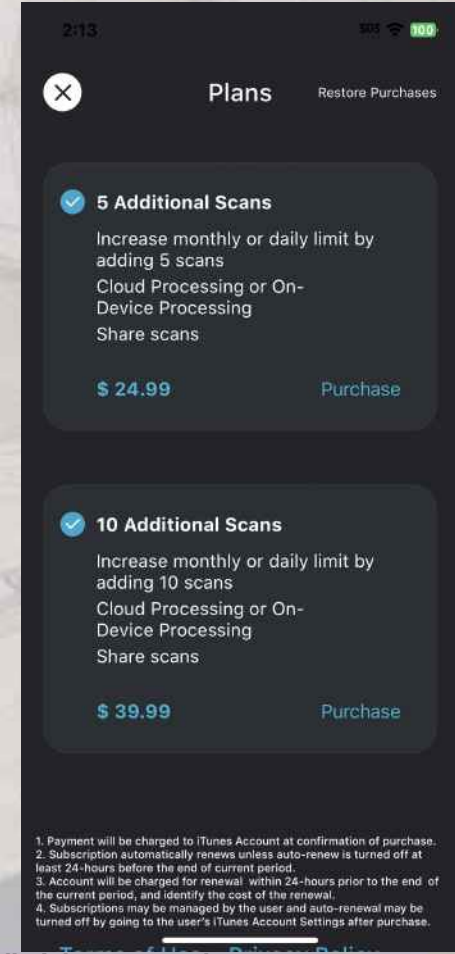
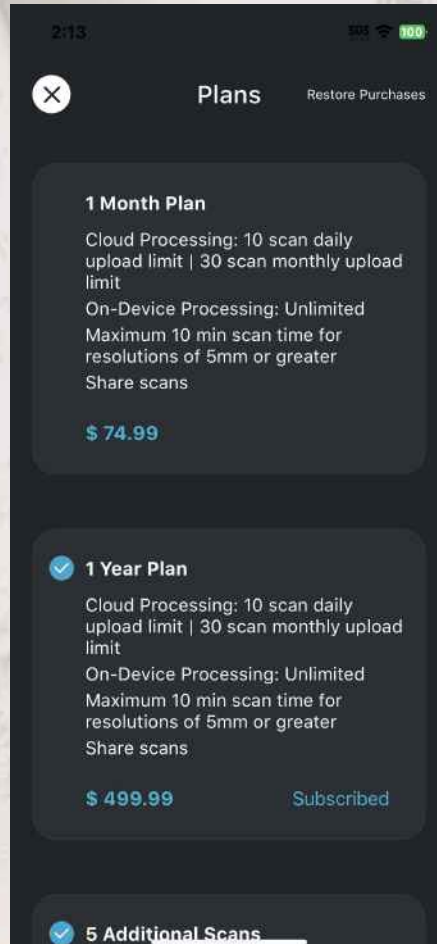
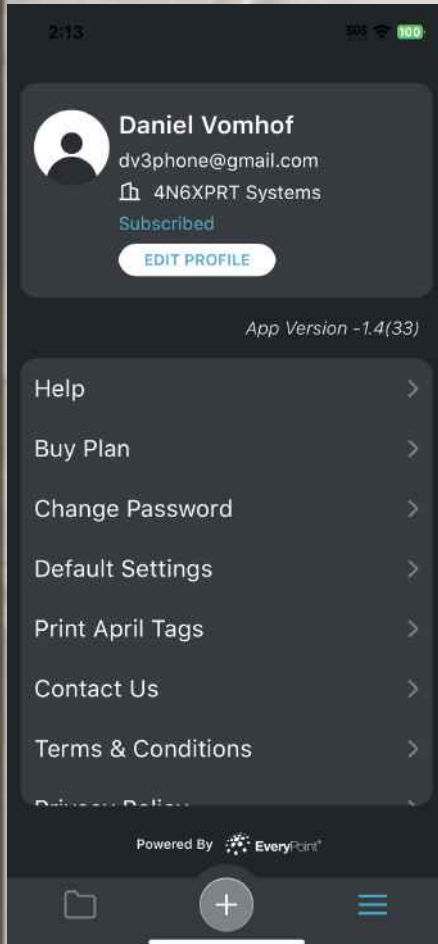
Recon 3D

What is it? What is it not? Why use it?

- ★ Time - In many instances you can cover the area of interest in 2 minutes or less.
- ★ "Accuracy" - the accuracy is at least as good as a rolling wheel, and often times better.
- ★ Documentation - it allows for documentation of area data for later possible use with minimal cost

Recon 3D

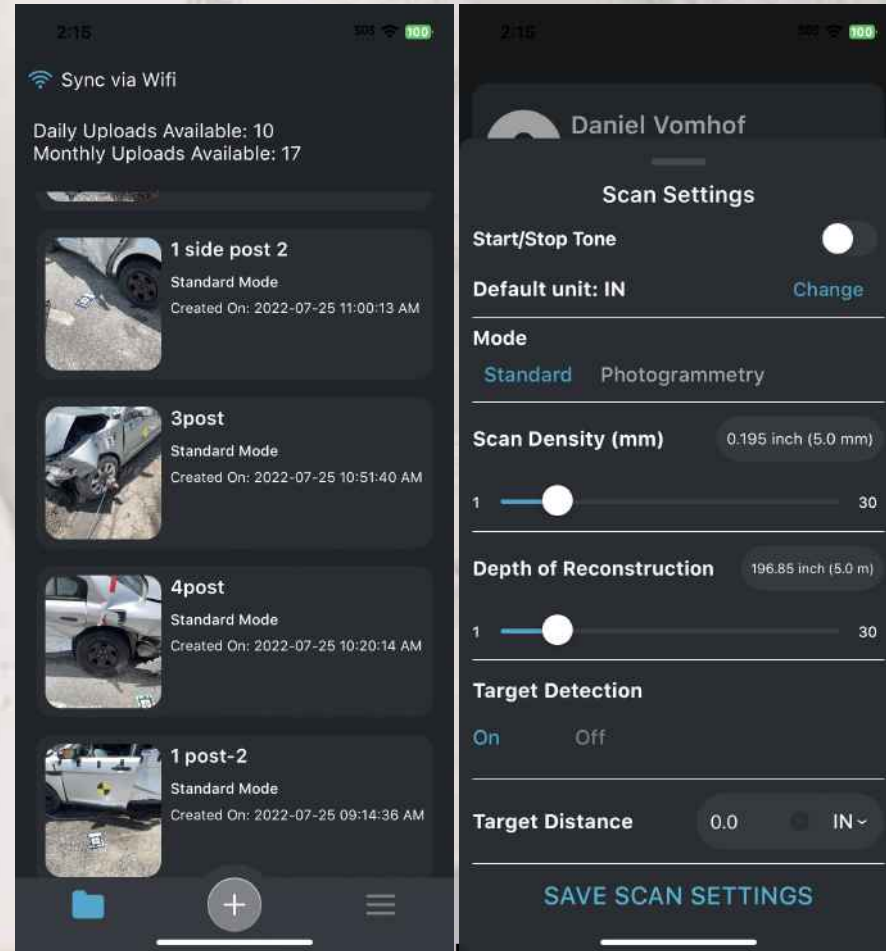
Screens



Recon 3D

Screens

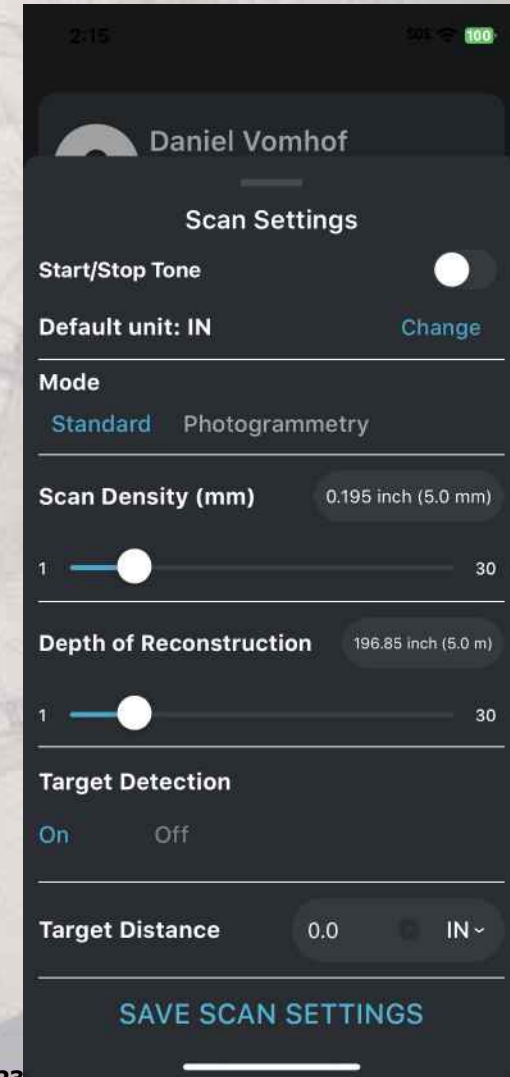
★ When you click the “+” button, you are presented with the SCAN SETTINGS. These are, per the most recent training, is the settings to be used by the CLOUD processing.



Recon 3D

Screens

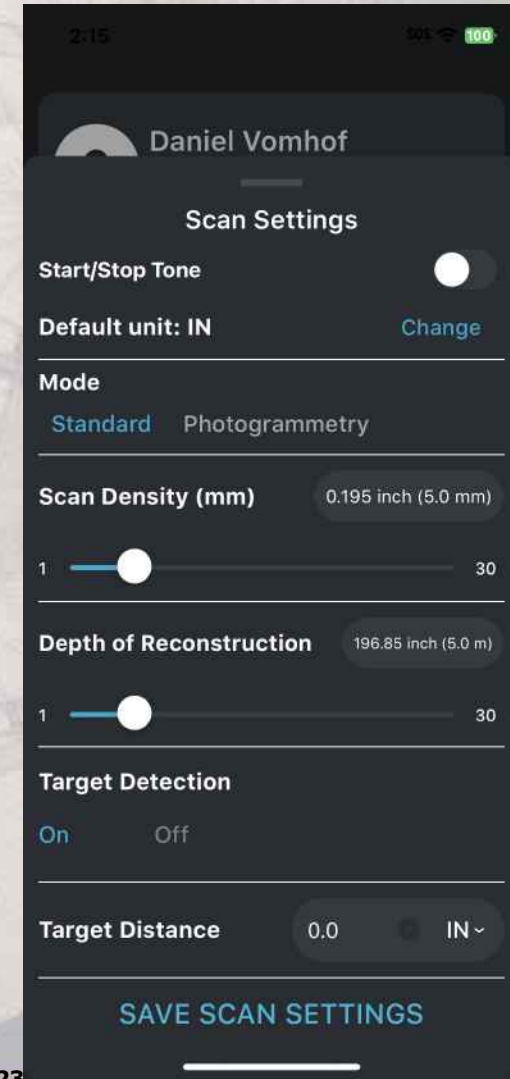
- ★ Units - I use INCHES, also available are METERS, FEET, and CENTIMETERS
- ★ Mode - In general you will want to use STANDARD which is the melding of the photogrammetry with the LIDAR
- ★ SCAN DENSITY - Due to recent changes, you will probably want 5 mm



Recon 3D

Screens

- ★ Scan Density - “tighter” densities (1,2,3,or 4 mm) can be set, but you will not be allowed to scan for the “full” 10 minutes
- ★ Depth of Reconstruction - This is how far into the distance will be included. In general 5-10 meters (~15-30 feet) will be sufficient.



Recon 3D

Screens

★ Target Detection - If you are using the APRIL targets to help set scale in your scan, you want this ON, however, for a variety of reasons, OFF has become my preferred mode. I have not seen a negative hit in my scans by not using the targets.



Recon 3D

Screens

★ Target Distance - For a variety of reasons, I set my targets at 72 inches. If you have the ability to utilize a larger distance for scenes and vehicles, it would be advisable to do so, as it is always better to interpolate rather than extrapolate.



Recon 3D

Screens

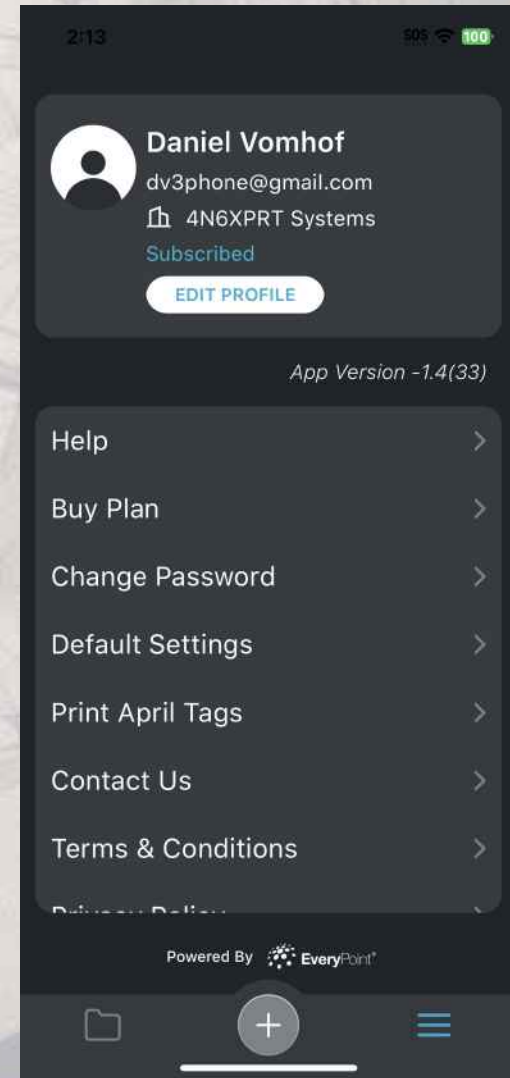
★ **SAVE SCAN SETTINGS** -
You have to save the
settings in order to
proceed.



Recon 3D

Screens

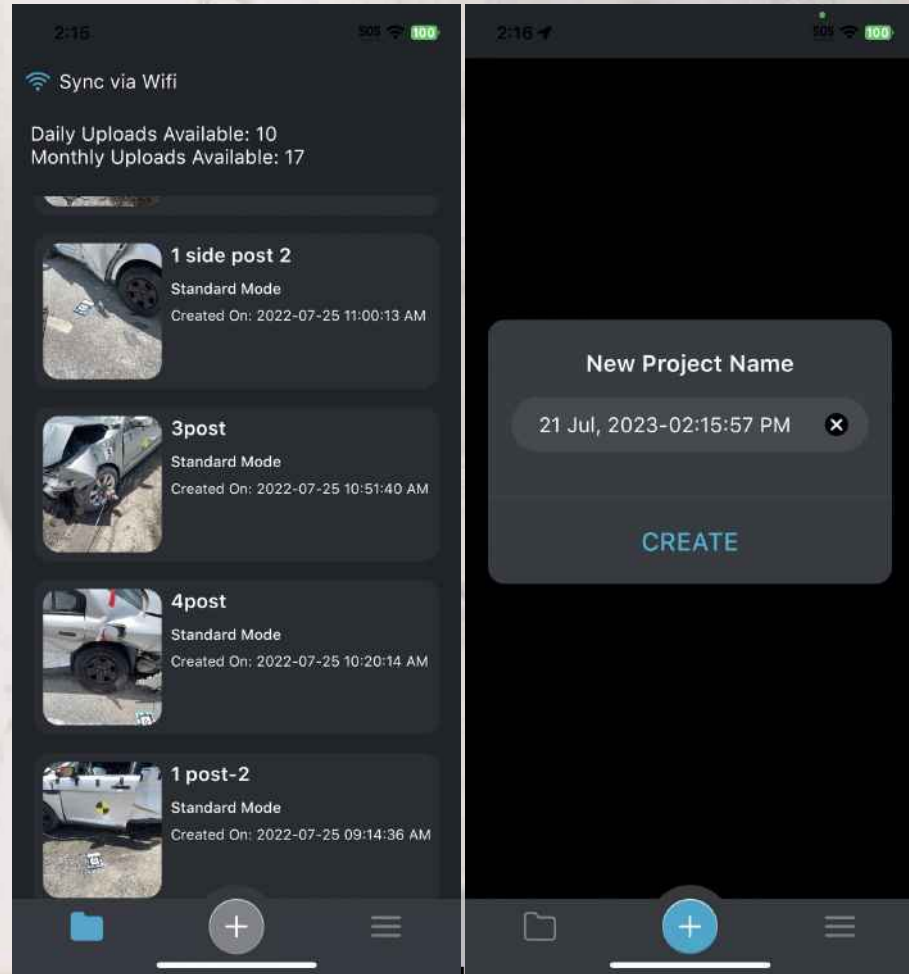
★ The previous Settings were set from the main menu. By setting the settings here, it saves time in the field, as the “base” settings are pulled up for each scan. The settings can be changed on a case by case basis if desired.



Recon 3D

Screens

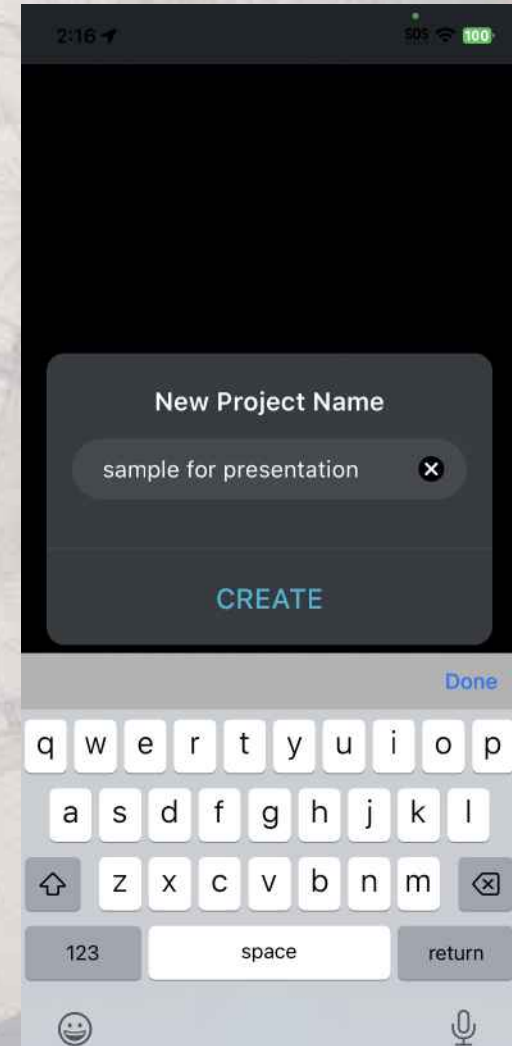
★ To start a scan, click the "+" button, which then brings up the NEW PROJECT NAME screen. It is advisable to name your scans instead of going the "date-time" route



Recon 3D

Screens

- ★ This is the name I am using for a scan of my 2004 Hyundai Santa Fe for this presentation.
- ★ Settings used for the scan are 5mm, 5m, No Targets.



Recon 3D

Screens

- ★ This sample scan took 1 minute 10 seconds to complete, that is 3 circuits around the vehicle. The 08:50 showing is the time remaining for the possible 10 minute scan time.
- ★ Click the white circle with the square to stop the scan



Recon 3D

Screens

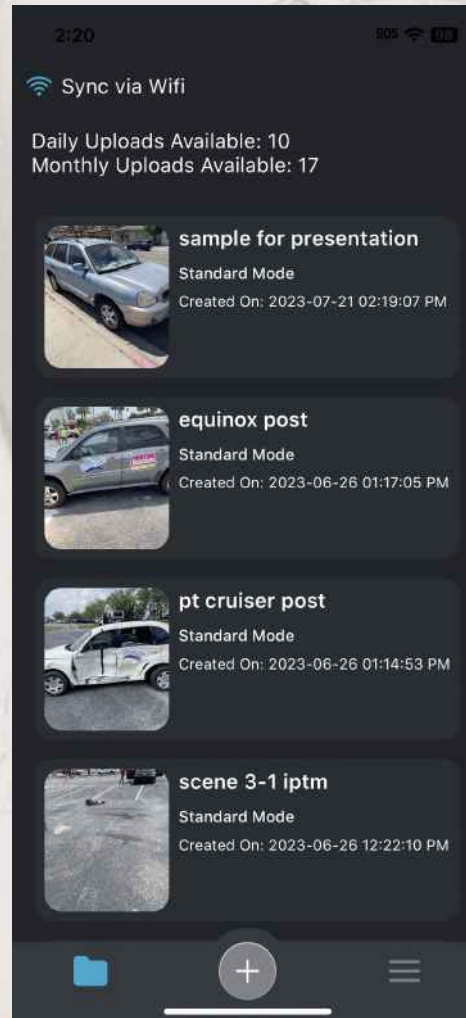
★ When you stop the scan you are presented with this screen. Given that I have completed a (in theory) “successful scan” I ALWAYS ALWAYS ALWAYS select **SAVE FOR LATER**. The other selection I may make is RESTART. This is done when I have problems mid scan.



Recon 3D

Screens

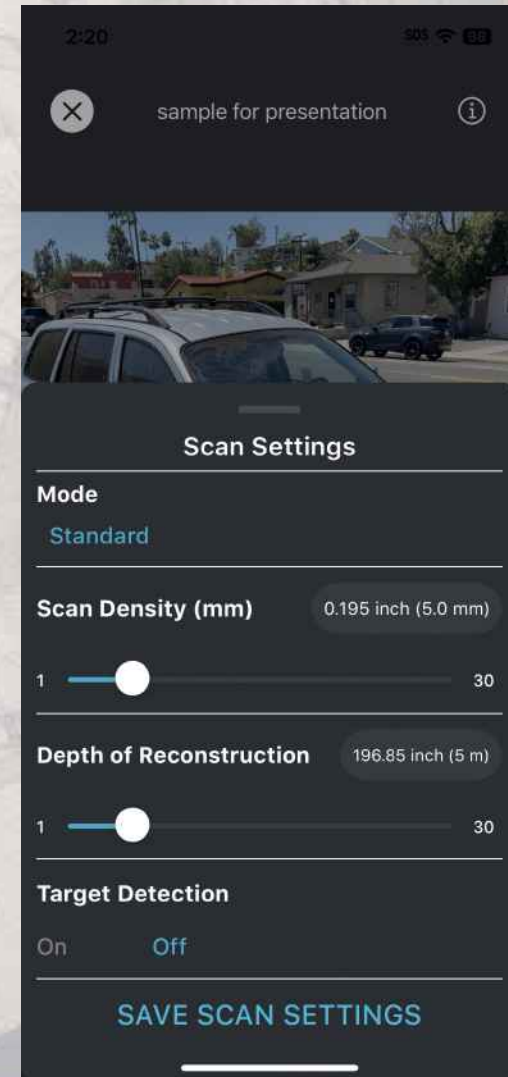
★ Once the scan is saved, you can click on it and then either process on your device, or process on the cloud, or both.



Recon 3D

Screens

- ★ If you decide to process on the cloud, it uploads and processes using the settings input prior to your scan.
- ★ If you choose to process on the device you are again presented with the settings in case you want to change any settings for the “on device” processing.
- ★ The processing starts out showing you the video recorded as part of the scan. The next several pages are frame grabs of the video.



Recon 3D

Screens



Recon 3D

Screens

- ★ Processing on the device goes through 7 “passes”.
- ★ To process this scan on my iPhone 12 Pro took 33 minutes.
- ★ Some screen grabs of the processed point cloud follow -



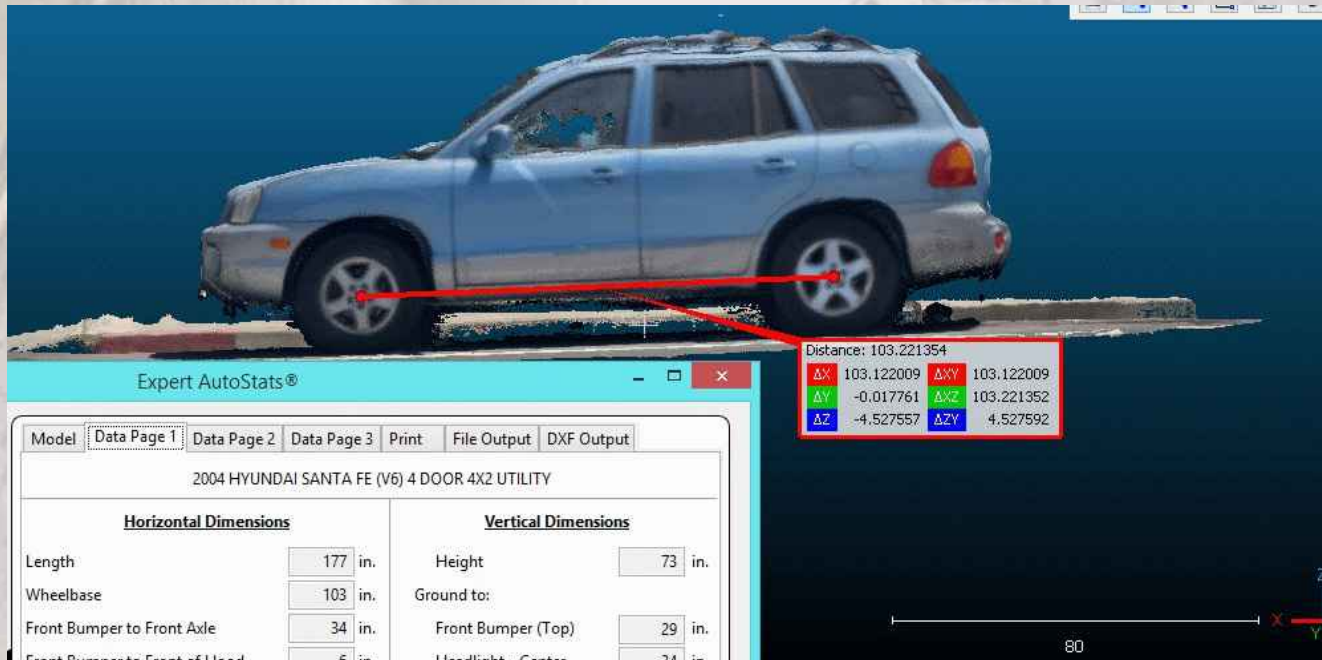
Recon 3D

Screens



Recon 3D

"Accuracy"



★Note - No targets. However, wheelbase in the scan is 103.1 inches, wheelbase as we have it in Expert AutoStats is 103 inches.

Recon 3D

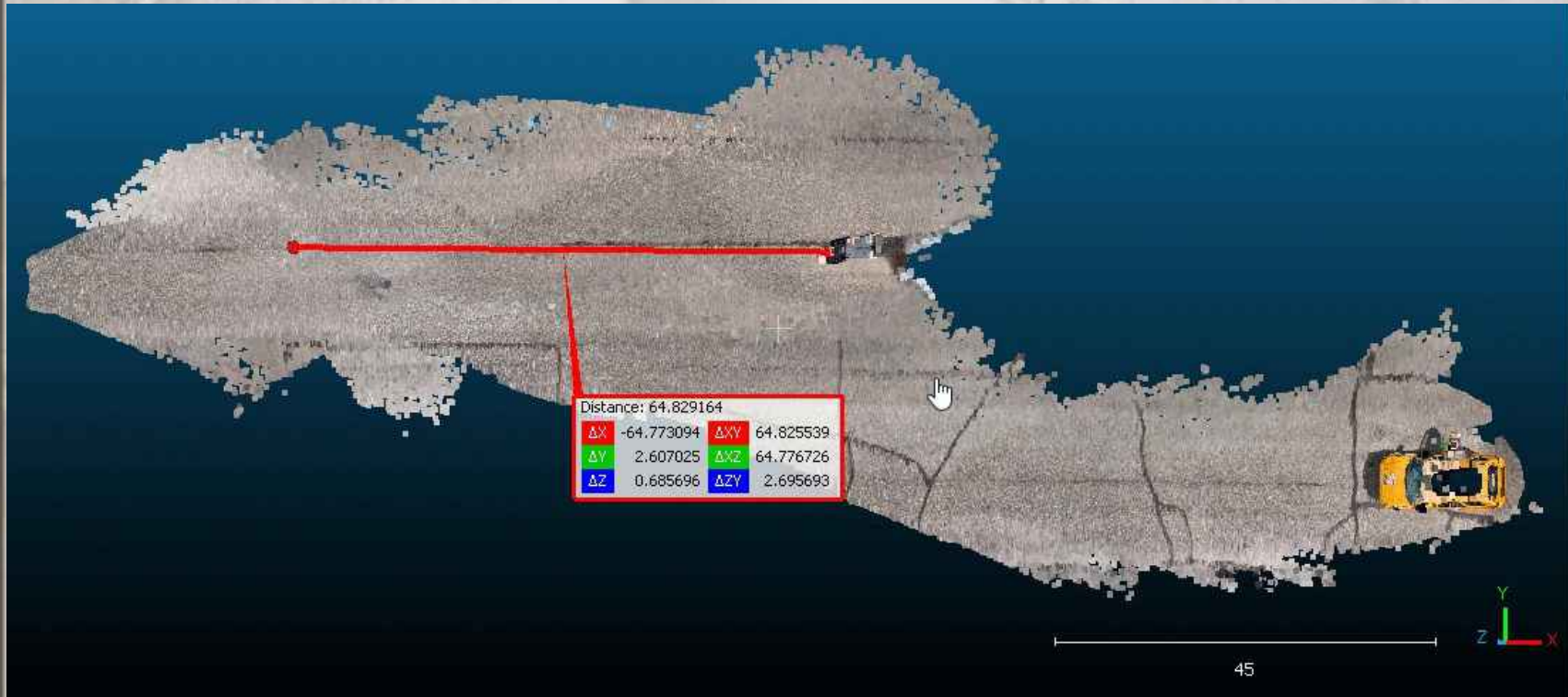
“Accuracy”

- ★ Whats important to us as Vehicle Accident Investigators??
- ★ Are the measurements reasonably correct?
- ★ Do the measurements obtained from the scans reflect the “real life” measurements?
- ★ Will the measurements obtained result in “correct” calculated values?
- ★ To that end

Recon 3D

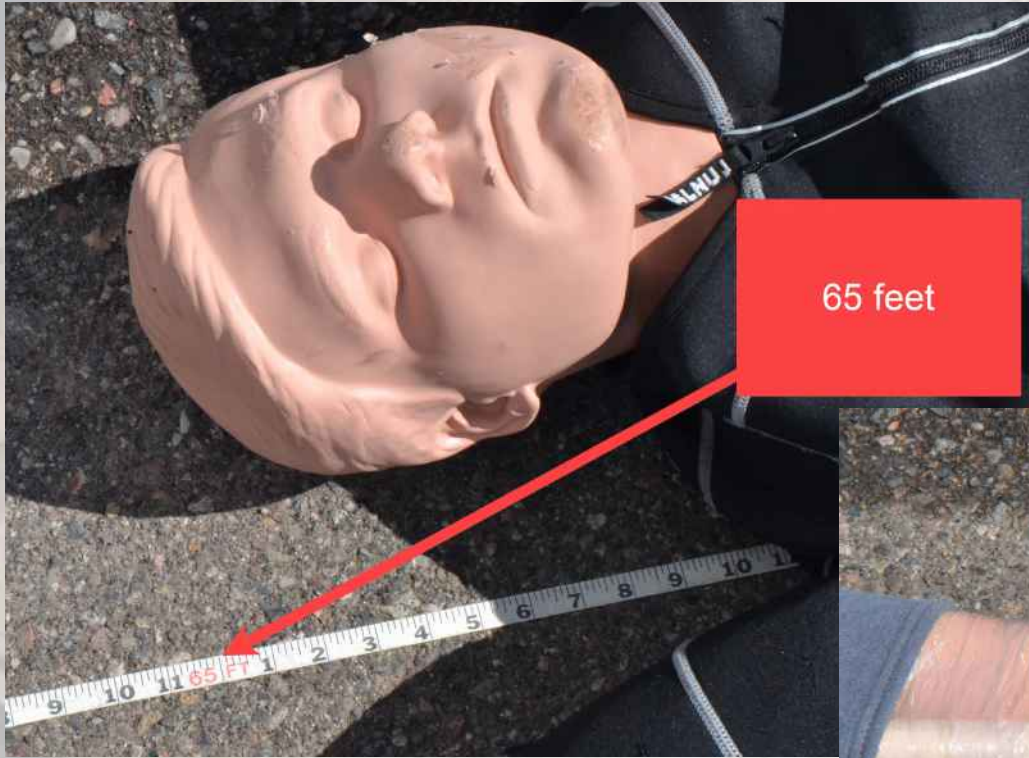
"Accuracy"

- ★ Ped Test at SATAI in 2023
- ★ Instrumented impact speed 34-37 mph



Recon 3D

"Accuracy"

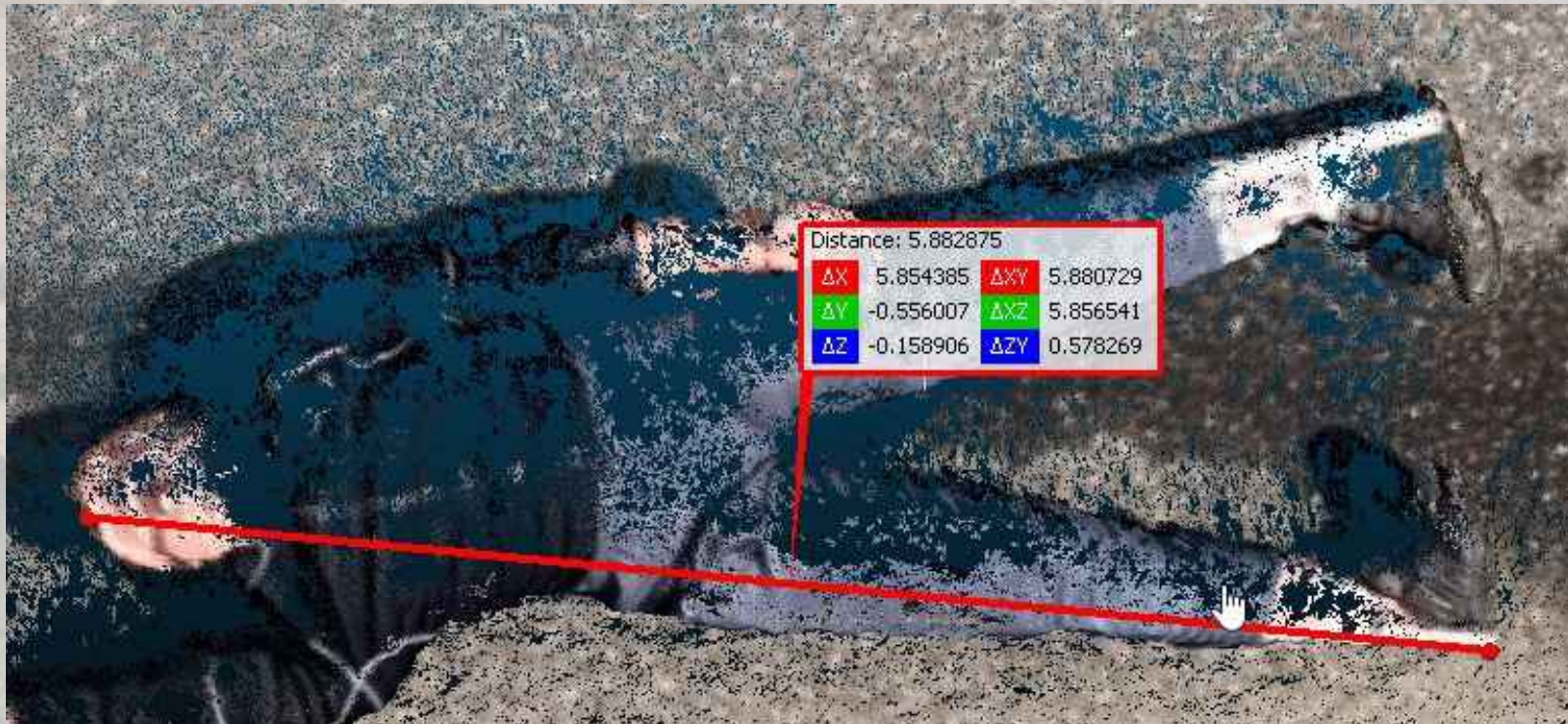


Recon 3D

"Accuracy"

★ $5.88 - 6 = -0.12$

★ $(-0.12/6) * 100 = -2.0\%$



Recon 3D

"Accuracy"

$$\star 64.83 - 65 = -0.17$$

$$\star (-0.17 / 65) * 100 = -0.26\%$$

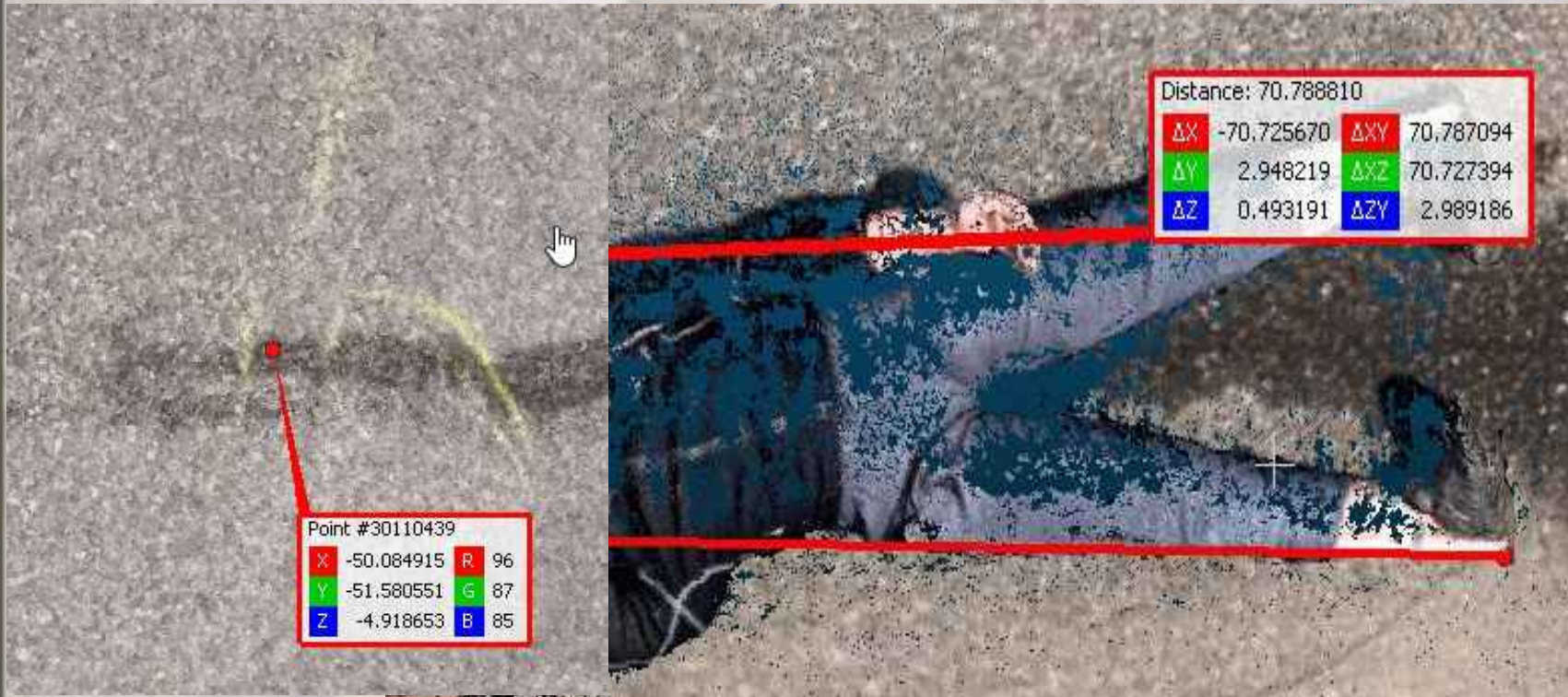


Recon 3D

"Accuracy"

★ $70.789 - 71 = -0.211 \text{ ft}$

★ $(-0.211/71) * 100 = -0.29\%$



Recon 3D

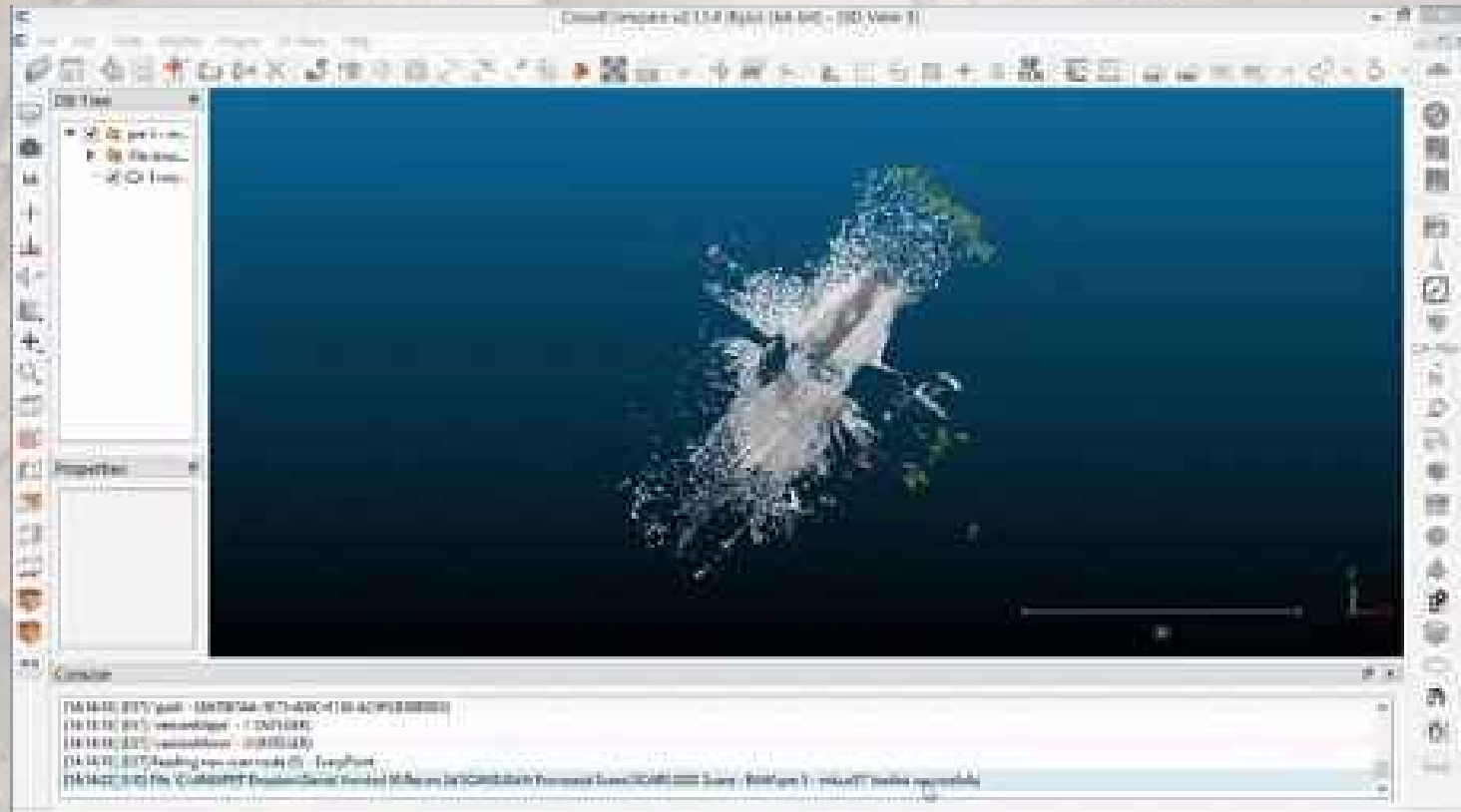
“Accuracy”

- ★ In multiple instances I have “measured” a 72 inch distance in Recon-3D. I generally find that I get a distance within +/- .75 inches.
- ★ $(0.75/72)*100 = +/- 1.0\%$
- ★ From the SATAI test it can be seen that the accuracy is, for that test, -2% or better.
- ★ Think, rolling wheel, tape, pacing -how often have you been MORE THAN 2% off? Have you ever checked to see?

Cloud Compare

Trim, Clean, Scale

★ Now that you have a Point Cloud, What next??



Cloud Compare

Trim, Clean, Scale

- ★ One piece of software that will allow you to view and edit the point cloud.
- ★ Once you have the E57 file, processed on either your device or the cloud, it needs to be cleaned up and scaled to the preferred units (if using Cloud Compare). The units when first imported into Cloud Compare is METERS.
- ★ 1 Meter = 3.28084 feet
- ★ 1 Meter = 39.37008 inches

Cloud Compare

Trim, Clean, Scale

- ★ Most “Good” CAD software packages have the capability to handle Point Clouds. Cloud Compare is being used here because it is, well, “FREE”, and is also a well featured piece of software.
- ★ Cloud Compare can be downloaded from -

<https://www.danielgm.net/cc/release/>

Cloud Compare

Trim, Clean, Scale

- ★ The first video will illustrate what needs to be done.
- ★ Please note, when trimming, to place points, left click on your mouse, to “close” a “loop”, right click on your mouse.
- ★ Play Video 1 in “**Cloud Compare videos**” folder - All videos are without sound, you just have to watch the mouse movements.

Cloud Compare

Trim, Clean, Scale

★ The second video shows the same vehicle after the crash test, trim, rotate, and scale the point cloud.

★ Play Video 2 in "**Cloud Compare videos**" folder



Cloud Compare

Trim, Clean, Scale

★ Now that both vehicles are trimmed, they need to be aligned so that a crush “slice” can be generated.

★ Play Video 3 in “**Cloud Compare videos**” folder

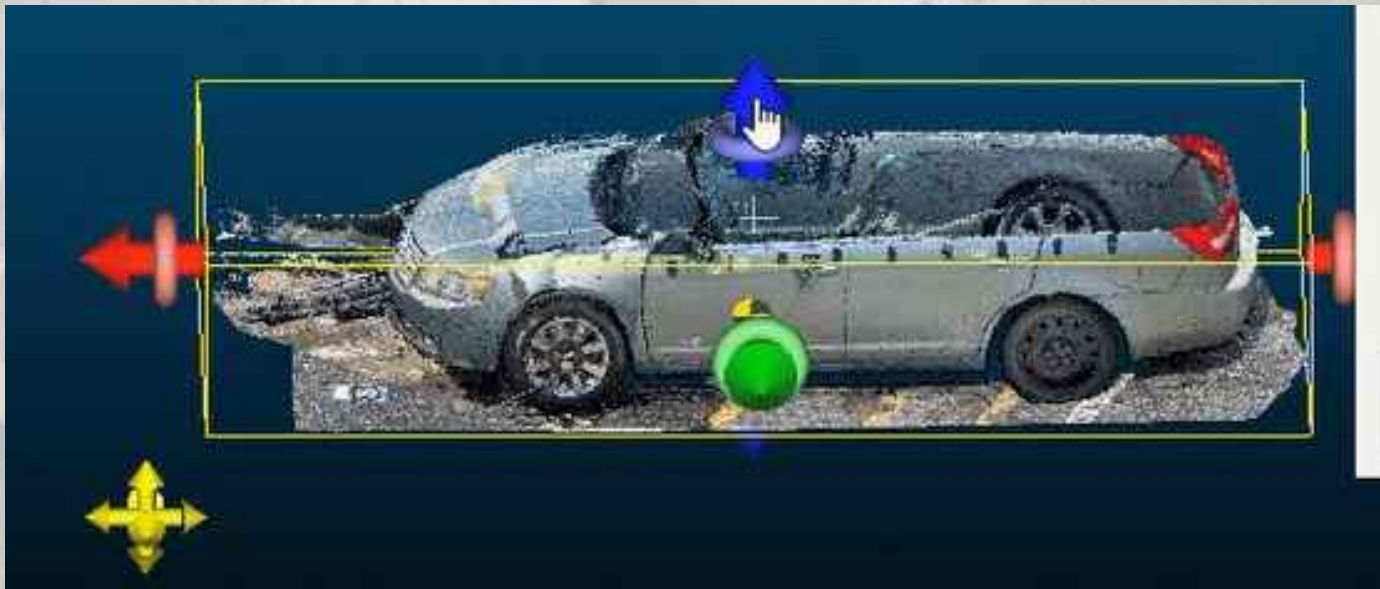


Cloud Compare

Trim, Clean, Scale

★ Once aligned, a slice can be taken from which crush measurements can be obtained.

★ Play Video 4 in “**Cloud Compare videos**” folder

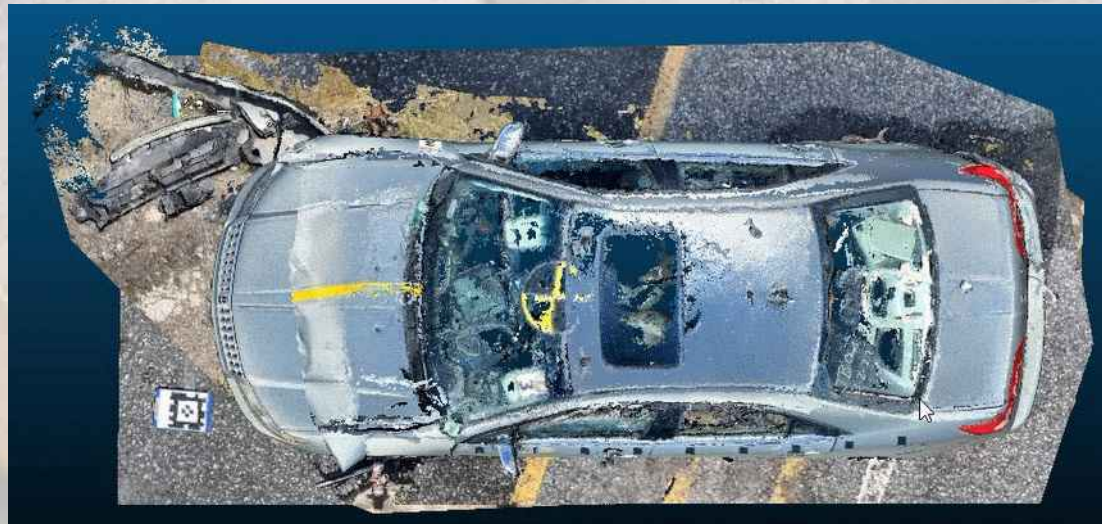


Cloud Compare

Trim, Clean, Scale

★ Once a slice has been obtained, and the vehicle is aligned along with the X-Y Axis, crush measurements can be obtained

★ Play Video 5 in "**Cloud Compare videos**" folder



Cloud Compare

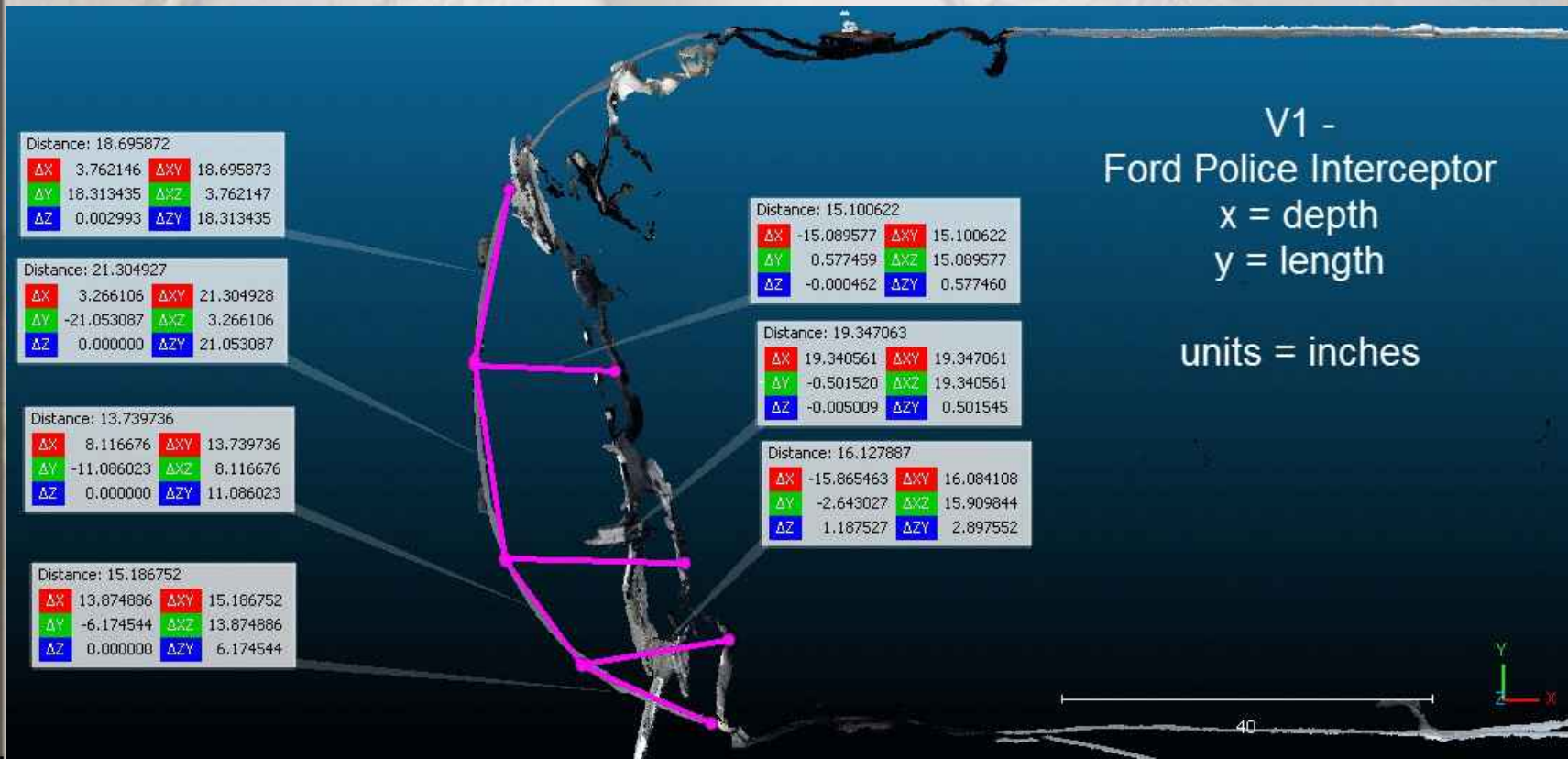
Crush Measurements

- ★ Final Crush Measurements for all 6 vehicles involved in the three SCARS Crash Tests conducted in July 2022 follow
- ★ As stated on the slides -
 - ★ The X dimension = the Crush Depth
 - ★ The Y dimension = the incremental Crush Lengths
 - ★ The UNITS = inches

Cloud Compare

Crush Measurements

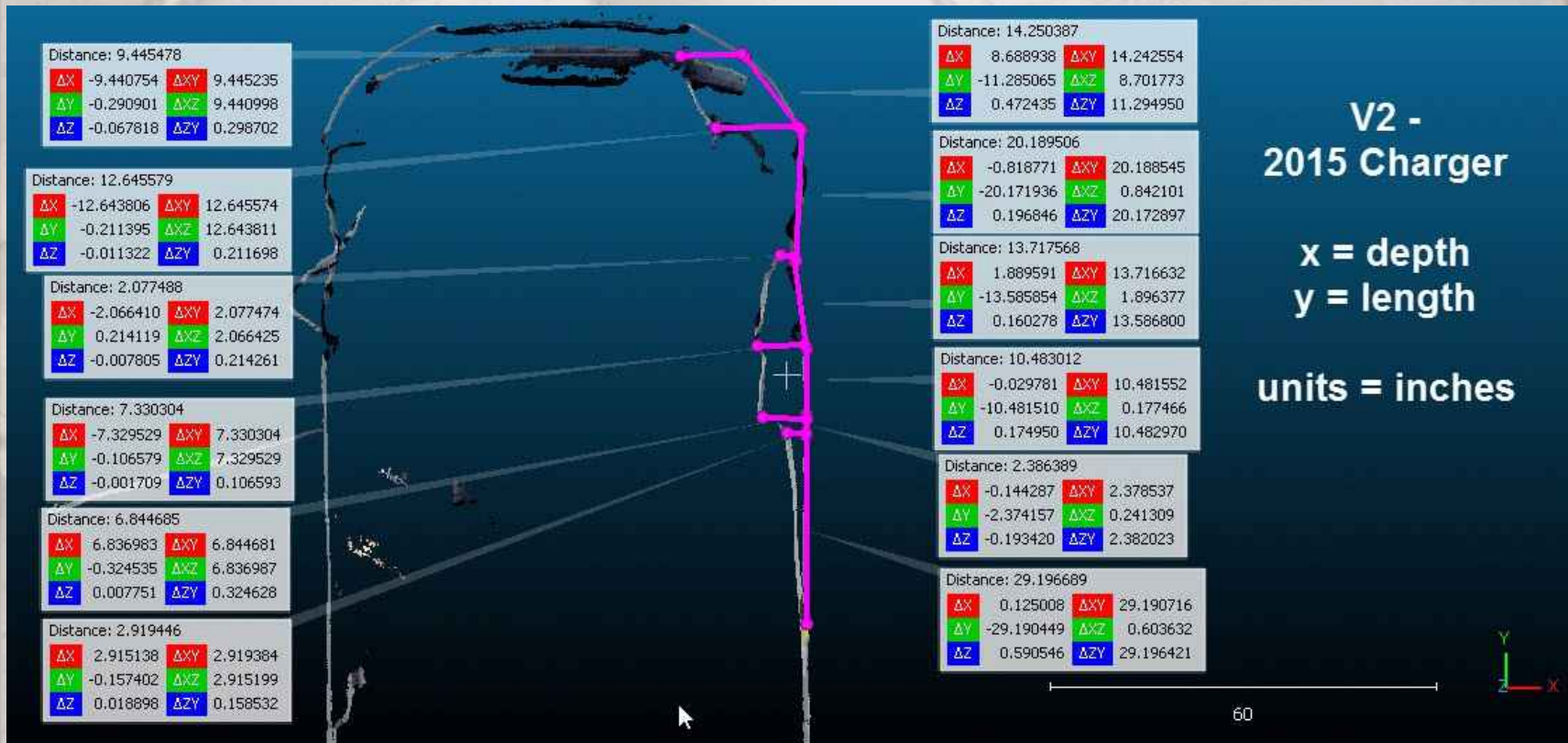
★ V1 Crush Measurements



Cloud Compare

Crush Measurements

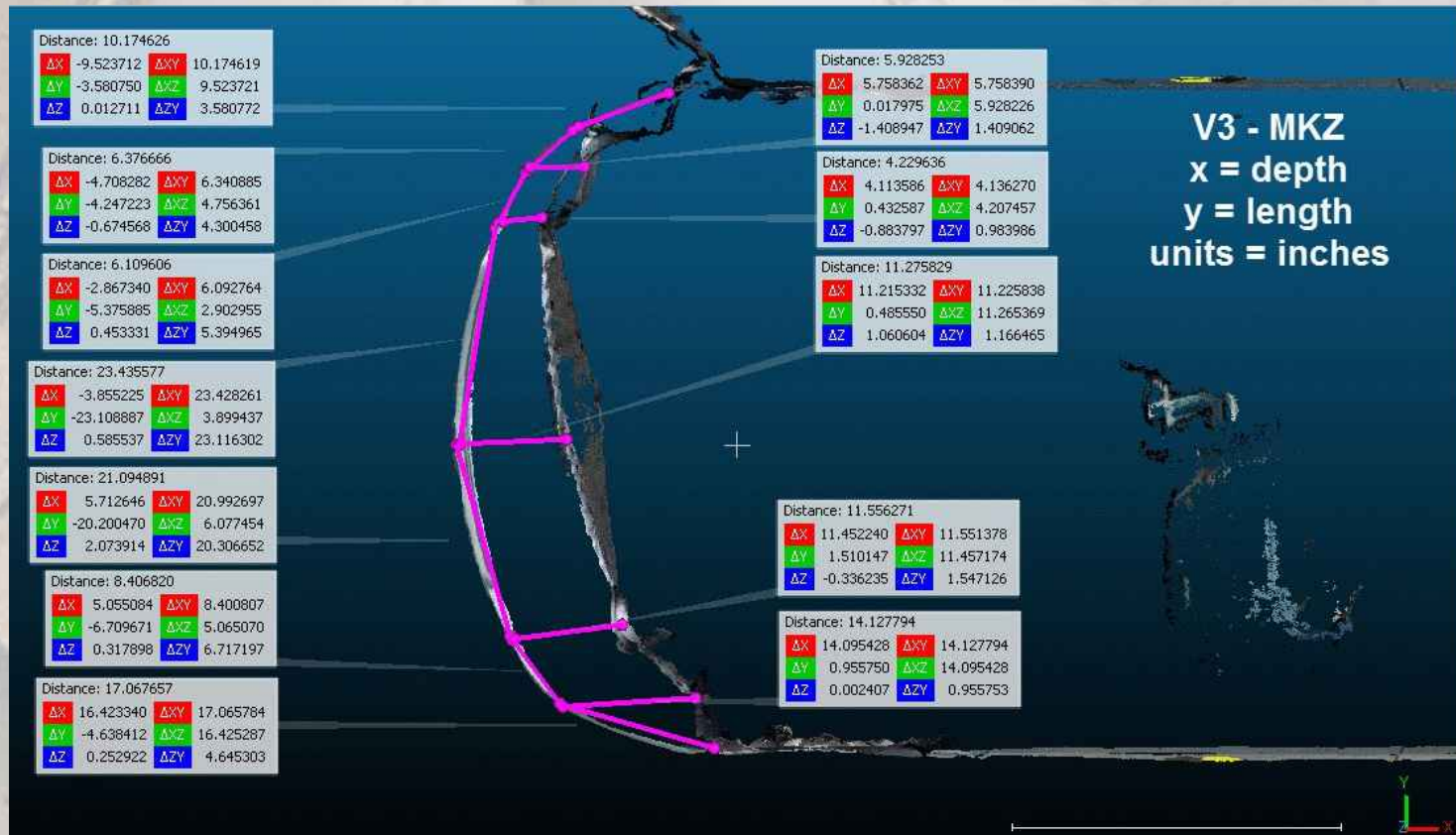
★ V2 Crush Measurements



Cloud Compare

Crush Measurements

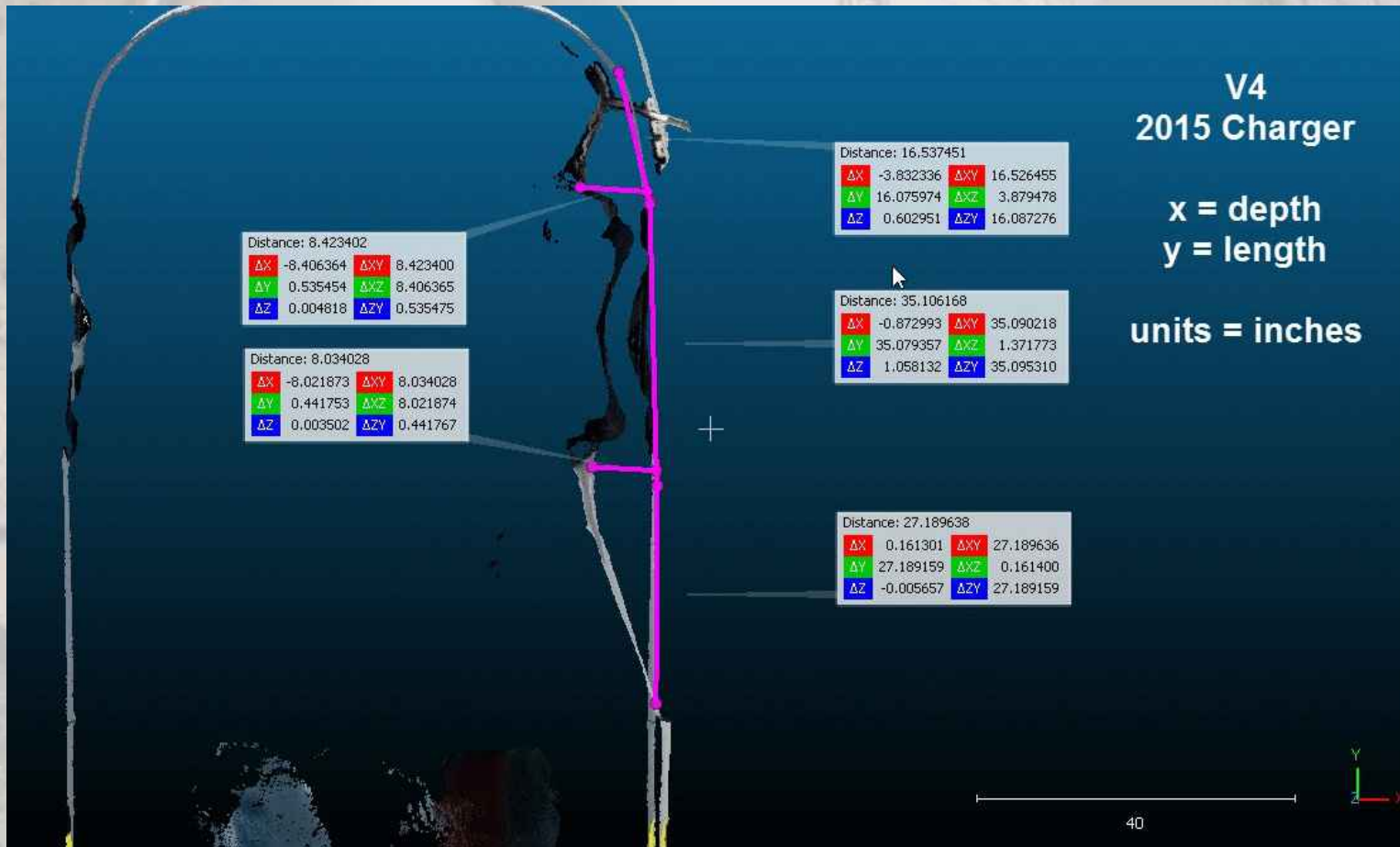
★ V3 Crush Measurements



Cloud Compare

Crush Measurements

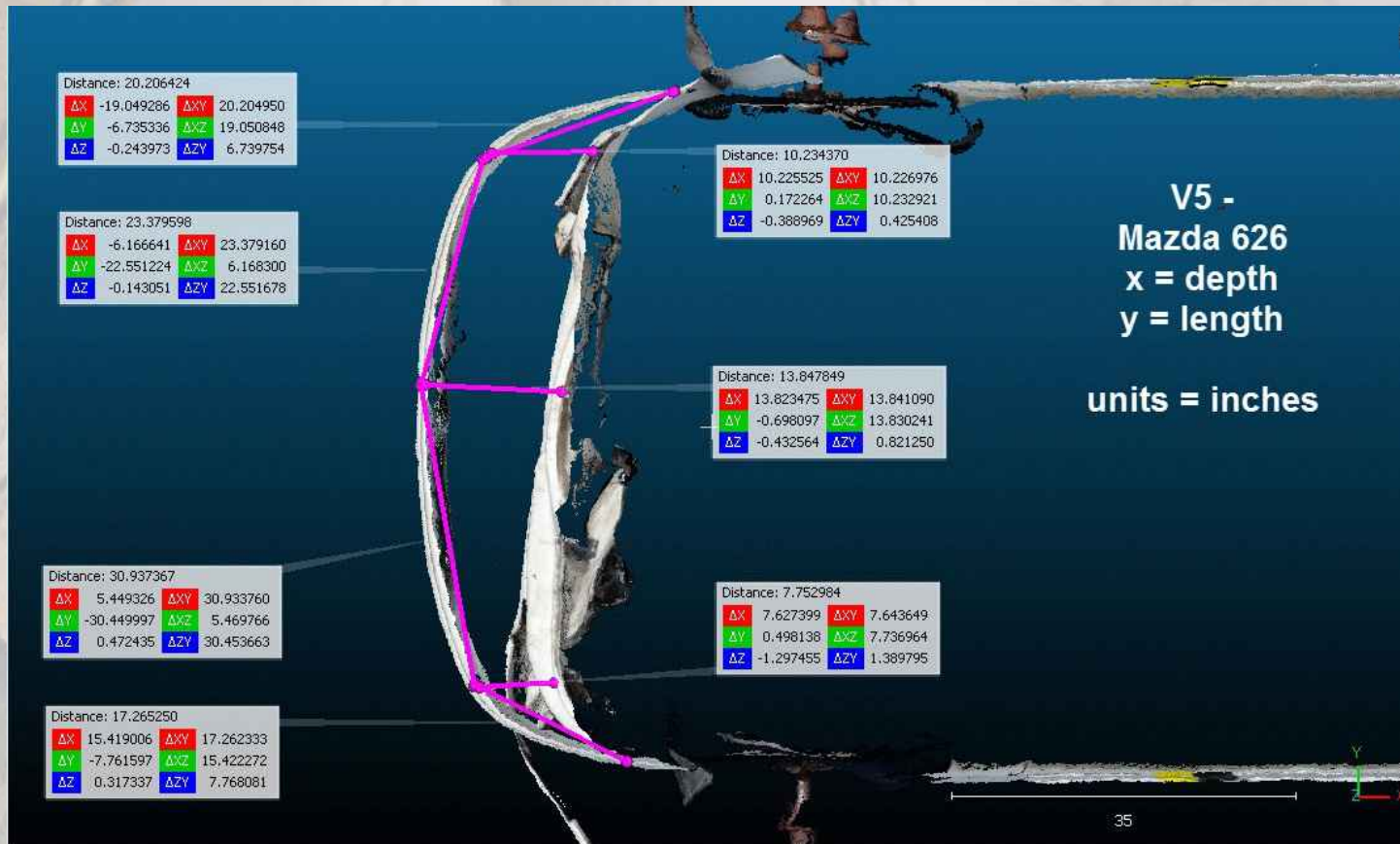
★V4 Crush Measurements



Cloud Compare

Crush Measurements

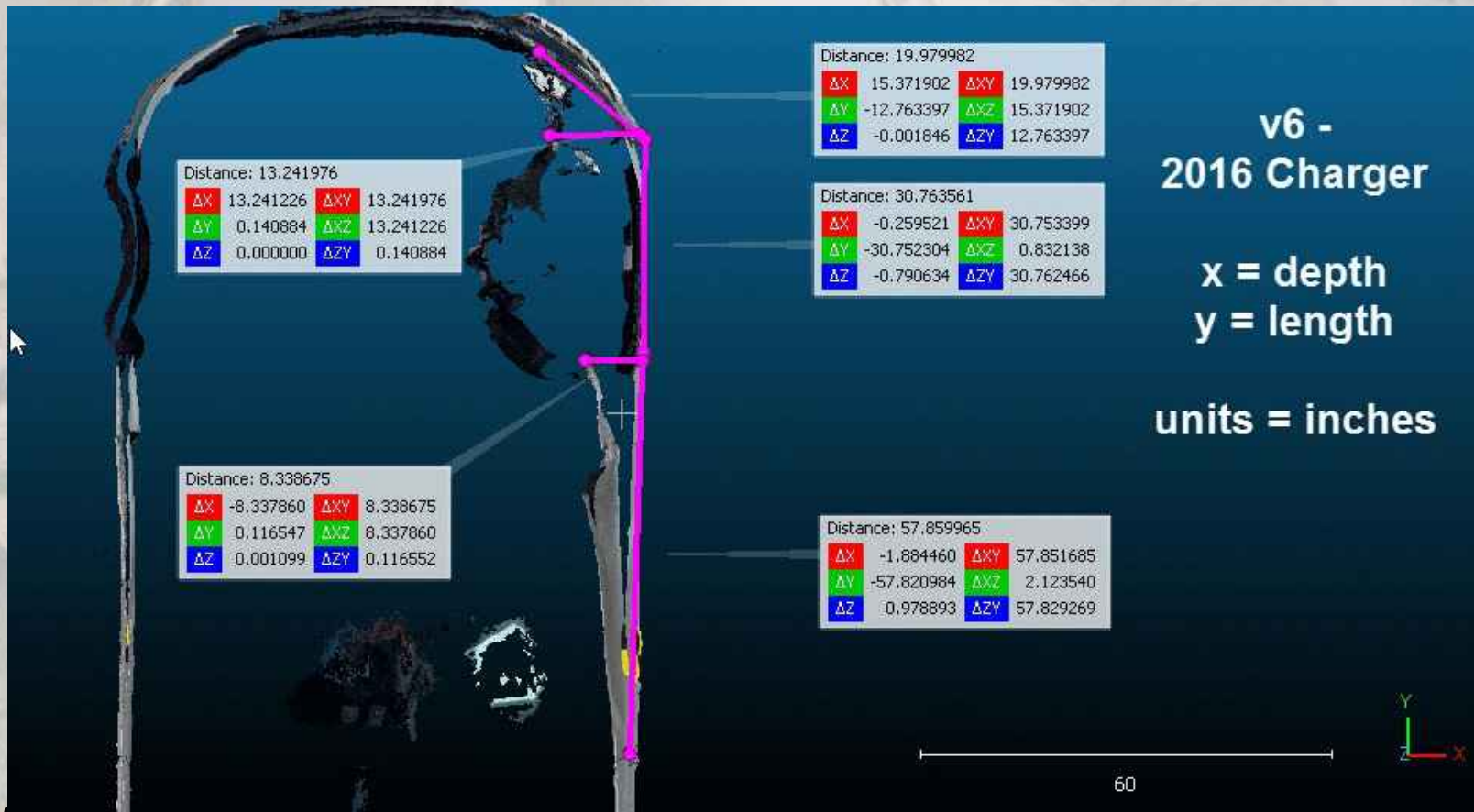
★ V5 Crush Measurements



Cloud Compare

Crush Measurements

★ V6 Crush Measurements



EXPERT WITNESS SERVICES, INC

FORENSIC RESEARCH LABORATORIES

8387 UNIVERSITY AVE., LA MESA, CA 91942
(619) 464-3477

Daniel William Vomhof III, E.I.T.

Certified Accident Reconstruction Specialist

EDUCATION:

B. S. Engineering	October 1994
A. S. Engineering	June 1992
A. S. Surveying	August 1986

ACCIDENT SPECIFIC EDUCATION

(3,196+ Hrs)

PROFESSIONAL CERTIFICATION:

- Engineering E.I.T. Registration #XE088556, 1993
- Accredited Traffic Accident Reconstructionist, The Accreditation Commission for Traffic Accident Reconstruction, Registration #484, 1993
- Certified Accident Reconstruction Specialist - Institute of Police Traffic Management, 1983

EXPERIENCE:

Expert Witness Services, Inc.

- (1992-present) - Accident Reconstructionist.
- (1984-1992) - Accident Reconstruction Assoc.
- (1981-1984) - Accident Reconstructionist.
- (1976-1981) - Technician.

Primary responsibilities include:

- Evaluation of traffic signal timing related to vehicle, pedestrian, and motorcycle accidents
- Reconstruction of vehicle, pedestrian, and motorcycle accidents
- Evaluation of Pedestrian/Facility/Walking Surface interactions
- Measurement and evaluation of lighting as it affects perception of hazards
- Measurement and evaluation of sound levels
- Documentation of vehicle evidence and scene conditions through photography and measurements
- Preparation of scale scene diagrams and other exhibits for use in depositions, arbitration hearings, and trial.

4N6XPRT Systems

- (1992-present) - General Manager/Technical Support/Programmer

Primary responsibilities include:

- Maintain data and Software Programs available for sale
- Provide Technical Support to program owners
- Provide data to Accident Investigators throughout North America when requested via email, phone, or fax

City of La Mesa - Traffic Engineering
(1988-1992) - *Engineering Technician I.*

Primary responsibilities in the field included preparation, review, and inspection of traffic control plans; preparation of striping, signing, and traffic signal plans and layouts for the field crews; traffic signal system coordination; field changes to traffic signal timing plans; and determination of proper sign type and placement to remedy existing traffic problems.

Primary responsibilities in the office included monthly review of accident reports for possible conditions contributing to the accidents which would be correctable by engineering projects; preparation of individual and system traffic signal timing plans; preparation of staff reports and exhibits for public hearings; and presentation of staff reports at public hearings.

Acted as Primary Interface between Traffic Engineering and Police Department in issues of Traffic Signal timing and downloads

SWORN TESTIMONY:

Qualified in San Diego and San Bernardino Superior Court on:
* Traffic Signal timing sequence and "who had the green" issues

Qualified in San Diego, El Cajon, Vista, San Bernardino, Pasadena, Solano, and Wisconsin Superior Courts on one or more of these issues:
*Time-Speed-Distance-Force calculations
*Speed survey design, conduction, & data analysis
*Preparation of scale diagrams of roadways
*Lighting considerations
*Vehicle and pedestrian paths of travel
*"Normal" vehicle speeds for an area
*Human factors - Perception, Reaction, Line-of-Sight
*Vehicle and Occupant movements
*Speed from Damage

Computer Software Programs Developed and Maintained:

D.W. Vomhof III, D. W. Vomhof, and S. Young, 4N6XPRT StifCalcs, 4N6XPRT SYSTEMS, La Mesa, CA (2007-2021)
D.W. Vomhof III and D. W. Vomhof, Expert AutoStats, 4N6XPRT SYSTEMS, La Mesa, CA (1993-2022)
D.W. Vomhof, D. W. Vomhof III, and S. Young, Expert VIN DeCoder, 4N6XPRT SYSTEMS, La Mesa, CA (2007-2021)
D.W. Vomhof III, D. W. Vomhof, and B. Cunningham, 4N6XPRT StifCalcs, 4N6XPRT SYSTEMS, La Mesa, CA (2003-2006)
D.W. Vomhof and D. W. Vomhof III, 4N6XPRT Ped & Bike Calcs, 4N6XPRT SYSTEMS, La Mesa, CA (1996)

Publications:

A-B-G Stiffness Values ... How to Research and Calculate Step-by-Step, Published by IPTM Press, Copyright 2014