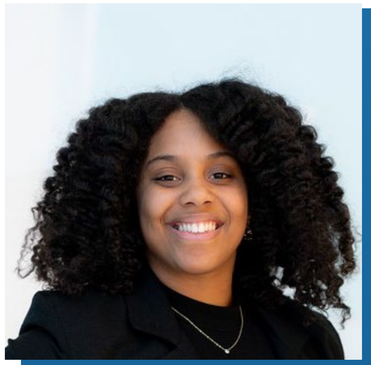
VIEW 2.0: Direct Vision Assessment System

Gabby Blake, Claire Hashizume, Myles Lack-Zell, Alex Matsoukas, Benjamin Morris

Olin College of Engineering
Senior Capstone Program in Engineering
April 24, 2024

Our Team



Gabby Blake

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Computing

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Human-Centered Design

Myles Lack-Zell

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Sponsors and collaborators

Santos Family Foundation
Sponsor

Volpe Center
Collaborator

Insurance Institute for Highway Safety
Collaborator

Overview

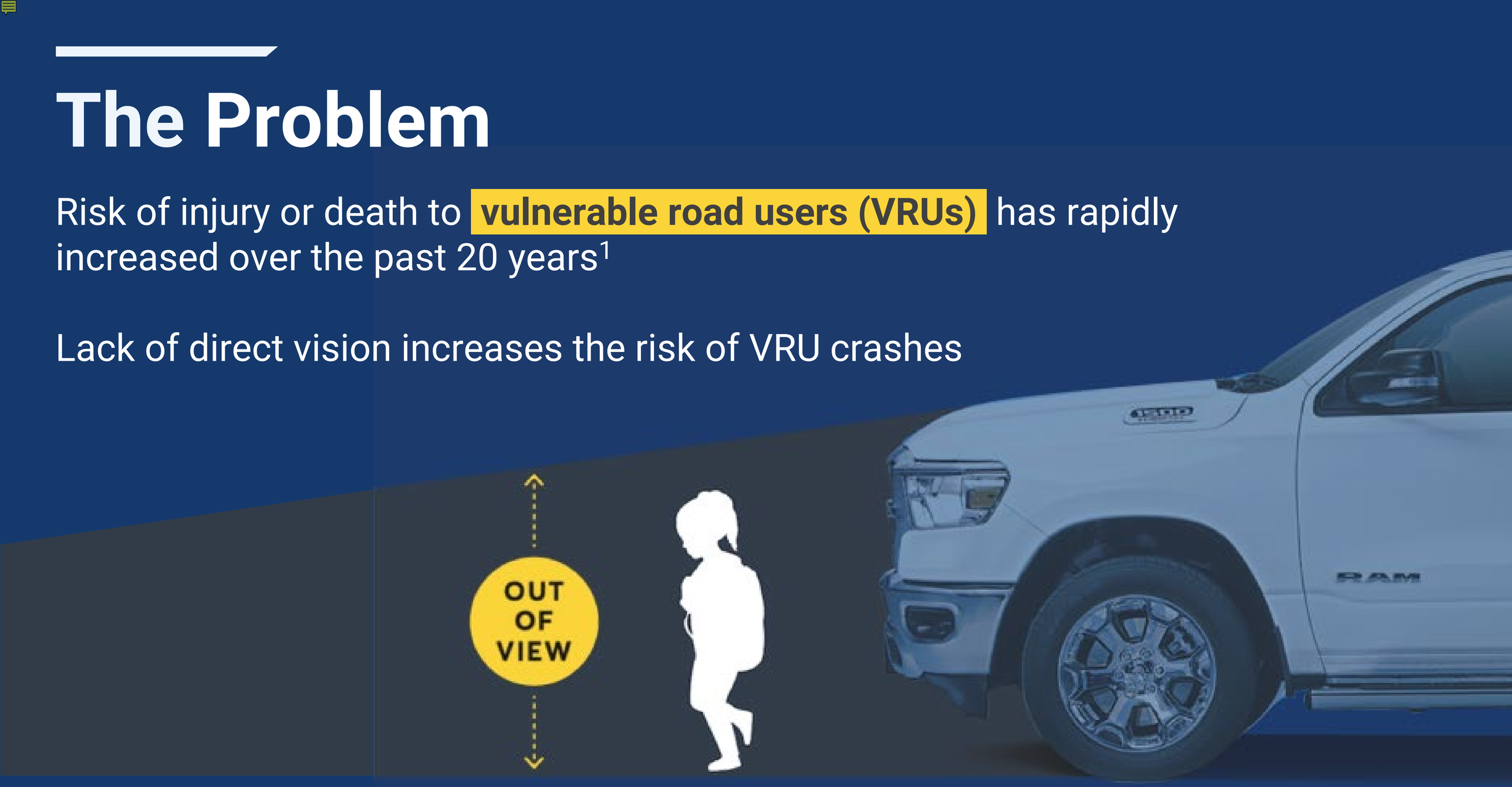
- Background
- VIEW 2.0 Ecosystem
- Data Collection Experience
- Site Walkthrough
- Impact

BACKGROUND

The Problem

Risk of injury or death to **vulnerable road users (VRUs)** has rapidly increased over the past 20 years[1]

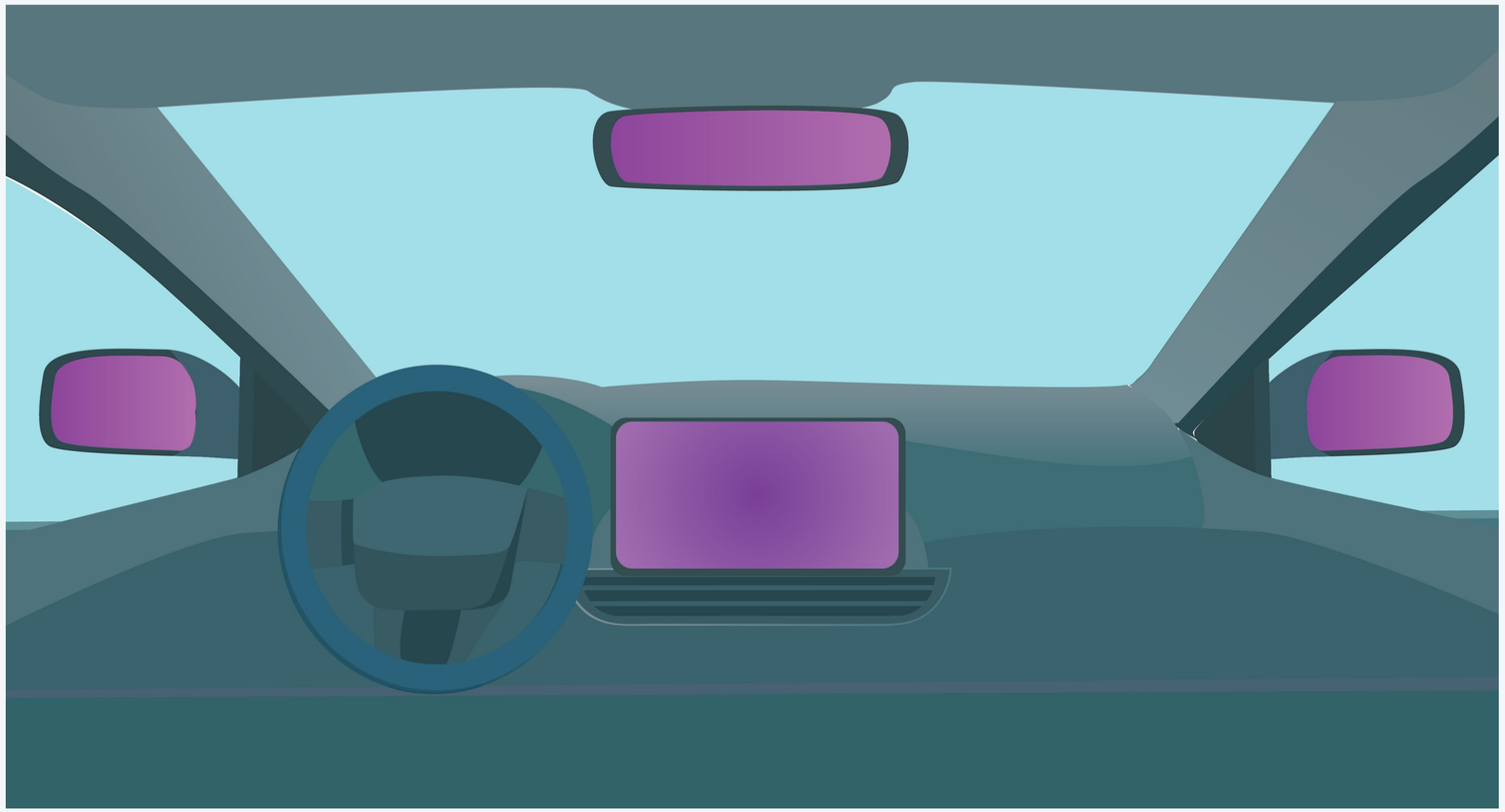
Lack of direct vision increases the risk of VRU crashes



[1] US DOT FHWA: Pedestrian and Bike Safety
Image - Consumer Reports (2021): The Hidden Dangers of Big Trucks

What is Direct Vision?

INDIRECT VISION



DIRECT VISION

BLIND ZONE

Why is Direct Vision Important?

Drivers respond **0.7 seconds faster**

Drivers react up to **50% faster** to hazards

Related Work

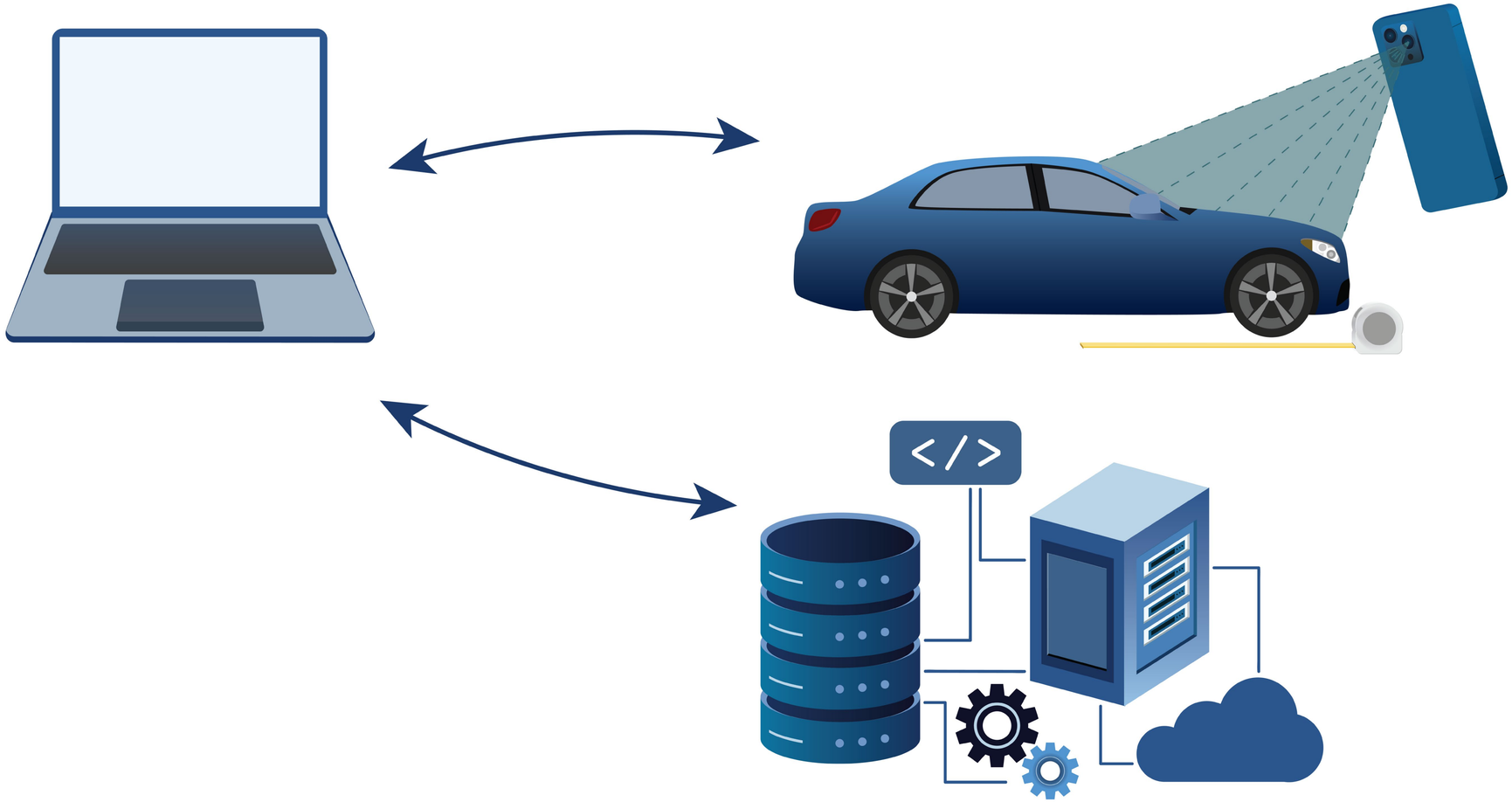
- 2017-2018 SCOPE team developed VIEW 1.0 (panorama photo, measurement pole)
- Insurance Institute for Highway Safety (IIHS) developing 'Markerless' method (multiple photos, calibrated camera & rig)
- UN adopted direct vision regulations
- Transport for London implemented truck visibility regulations

VIEW 2.0

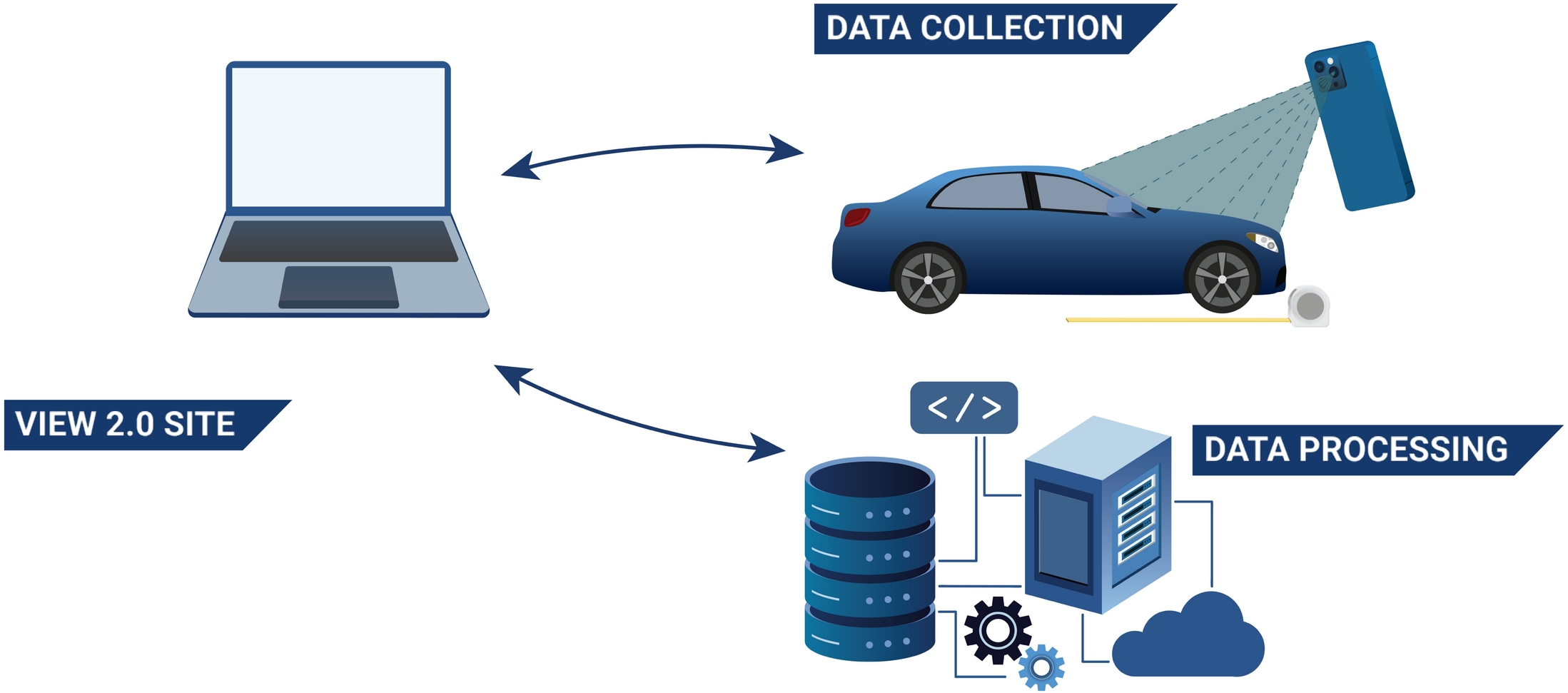
- Accurate and robust measurement method
- Intuitive user experience of website and data collection
- Increased long-term site stability

VIEW 2.0 ECOSYSTEM

VIEW 2.0 Ecosystem

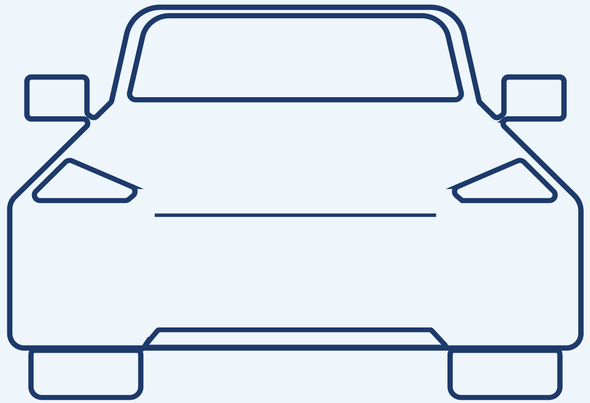


VIEW 2.0 Ecosystem



VIEW 2.0 Use Cases

Vehicle Buyers



Compare vehicles to inform purchasing decisions

Fleet Managers

Evaluate current fleet vehicles for safety

Make informed replacement decisions

Organizations

Advocacy – Evaluate data to inform the public

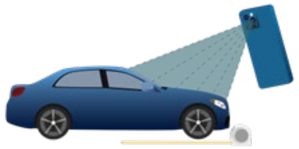
Research - Contribute new data for analysis

DATA COLLECTION & PROCESSING

LiDAR

- LiDAR – Light Detection and Ranging
- Generate a 3D model of the vehicle
- Compatible with iPhone Pro Cameras

Why LiDAR?



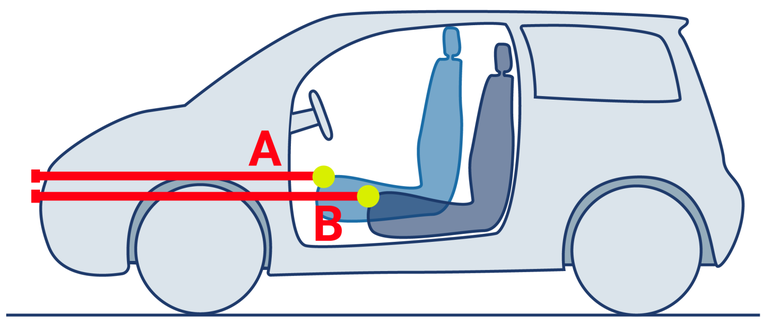
- More accurate than other methods
- Small setup area
- Customizable to multiple eye heights

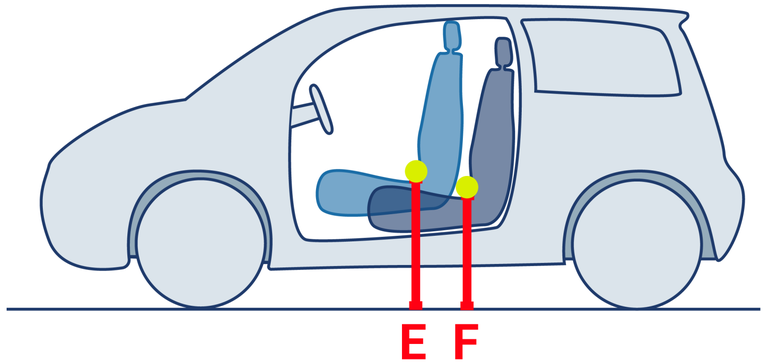
Method	Blind Zone Area (sq ft)	% Error
Ground Truth	530.8	N/A
VIEW 1.0	710.8	33.9%
IIHS Markerless	454.5	-14.4%
LiDAR	556.0	4.8%

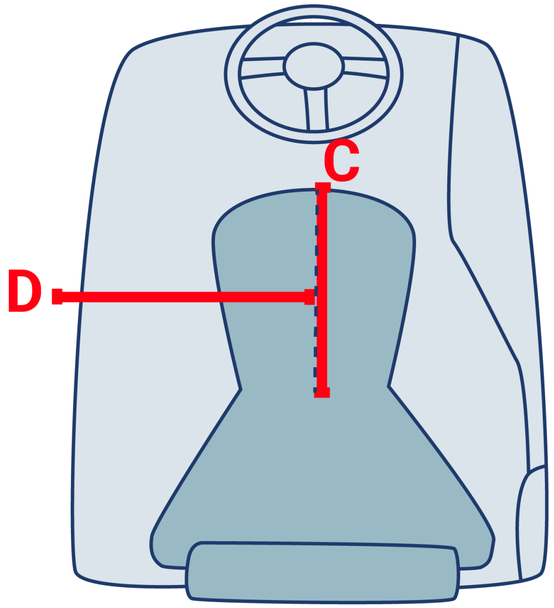
Seat Measurements

- Drivers of different heights have the seat positioned differently
- Seat position (height and track position) impacts driver eye height
- Measure seat positioning bounds in vehicle

Seat Measurements







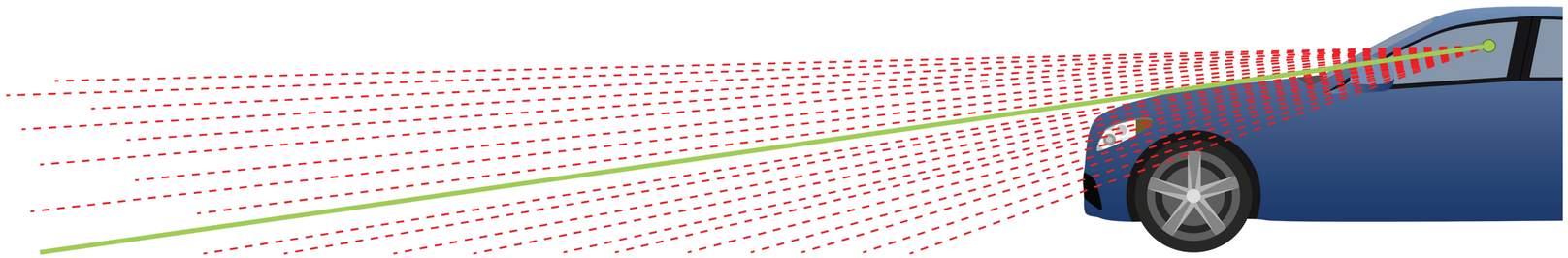
Centerline

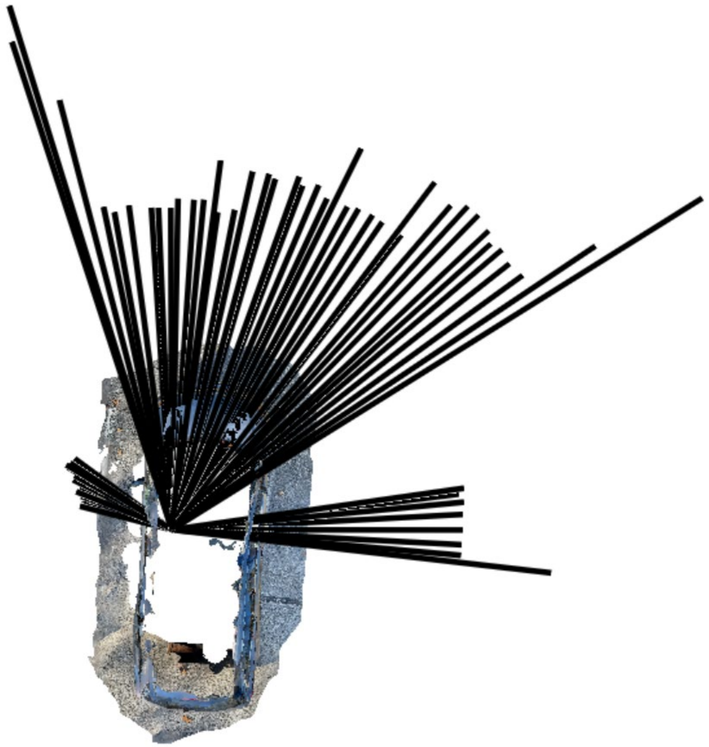
Highest and farthest front driver's seat position

Lowest and farthest back driver's seat position

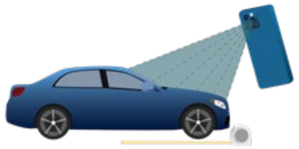
Calculating Blindzones

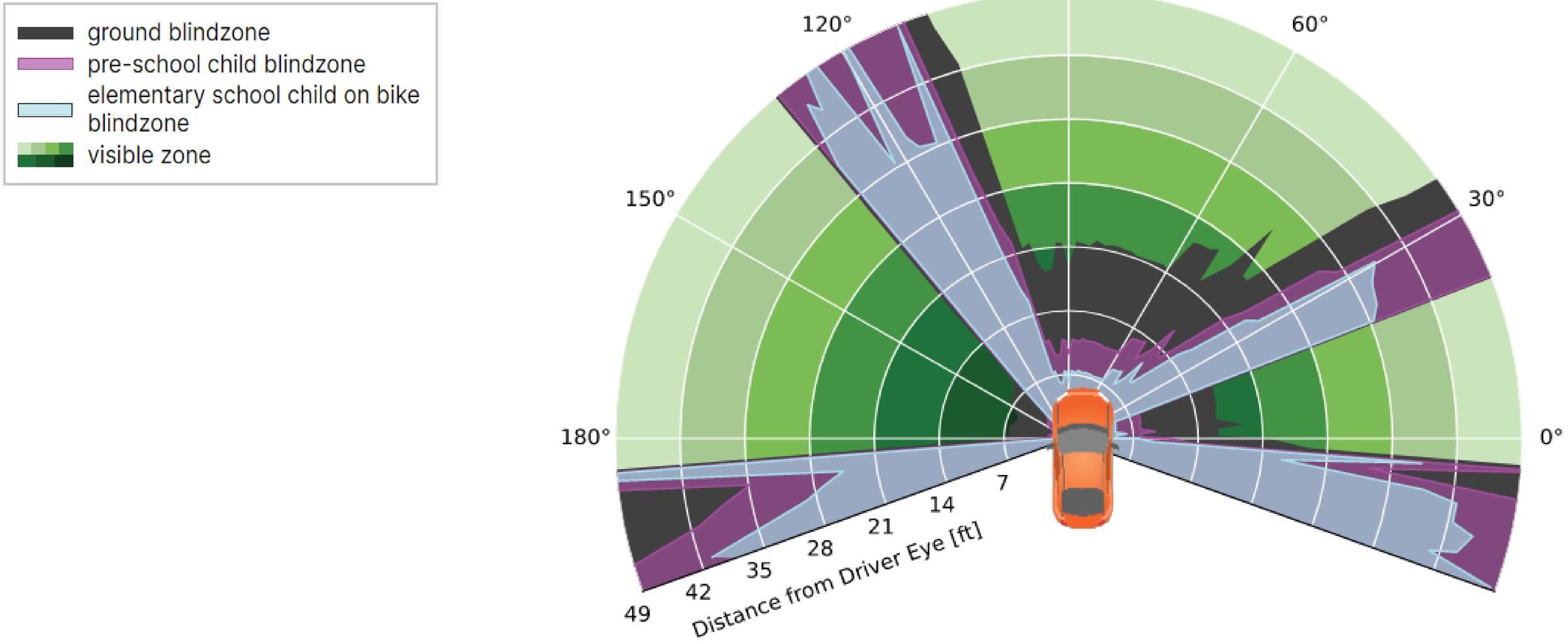
- Identify eye height
- Create rays that hit the ground outside of the vehicle through removed windows and windshield





Visualizing Blindzones





*vehicle not shown to scale

SITE WALKTHROUGH

VIEW Blind Zone Calculator

Home | Vehicle Database | FAQ | Add Vehicle

SAFER VEHICLES, SAFER STREETS

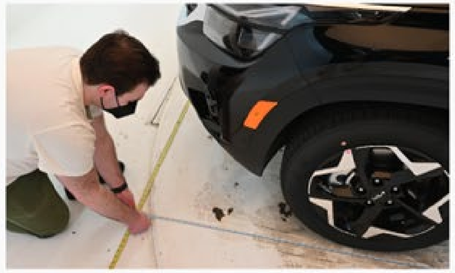
See the hidden dangers of your vehicle with our blind zone visualizer

Add Vehicle

About VIEW

A free blind zone measurement tool

VIEW is a measurement tool and crowd-sourced database with visualizations of blind-zones for many types of vehicles. It uses LiDAR technology and seat measurements to calculate what space around the vehicle is visible from the driver's eyepoint.



Who It Helps

VIEW is designed to help all kinds of people

Vehicle Buyers

Discover blind-zones to help make purchase decisions.

Fleet Managers

Measure and address blind zones in vehicles on the road.

Organizations

Access blind-zone information to raise awareness.

Why This Matters

Research shows that drivers respond 0.7 seconds faster to hazards seen through direct vision than indirect vision. In addition, according to a study conducted at the University of Leeds, drivers react up to 50% faster to hazards in their direct vision compared to indirect vision.

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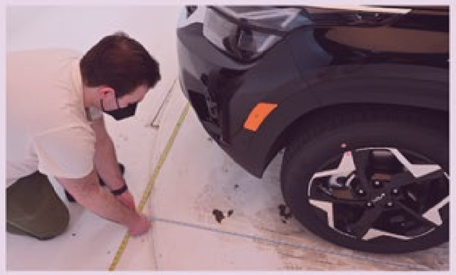

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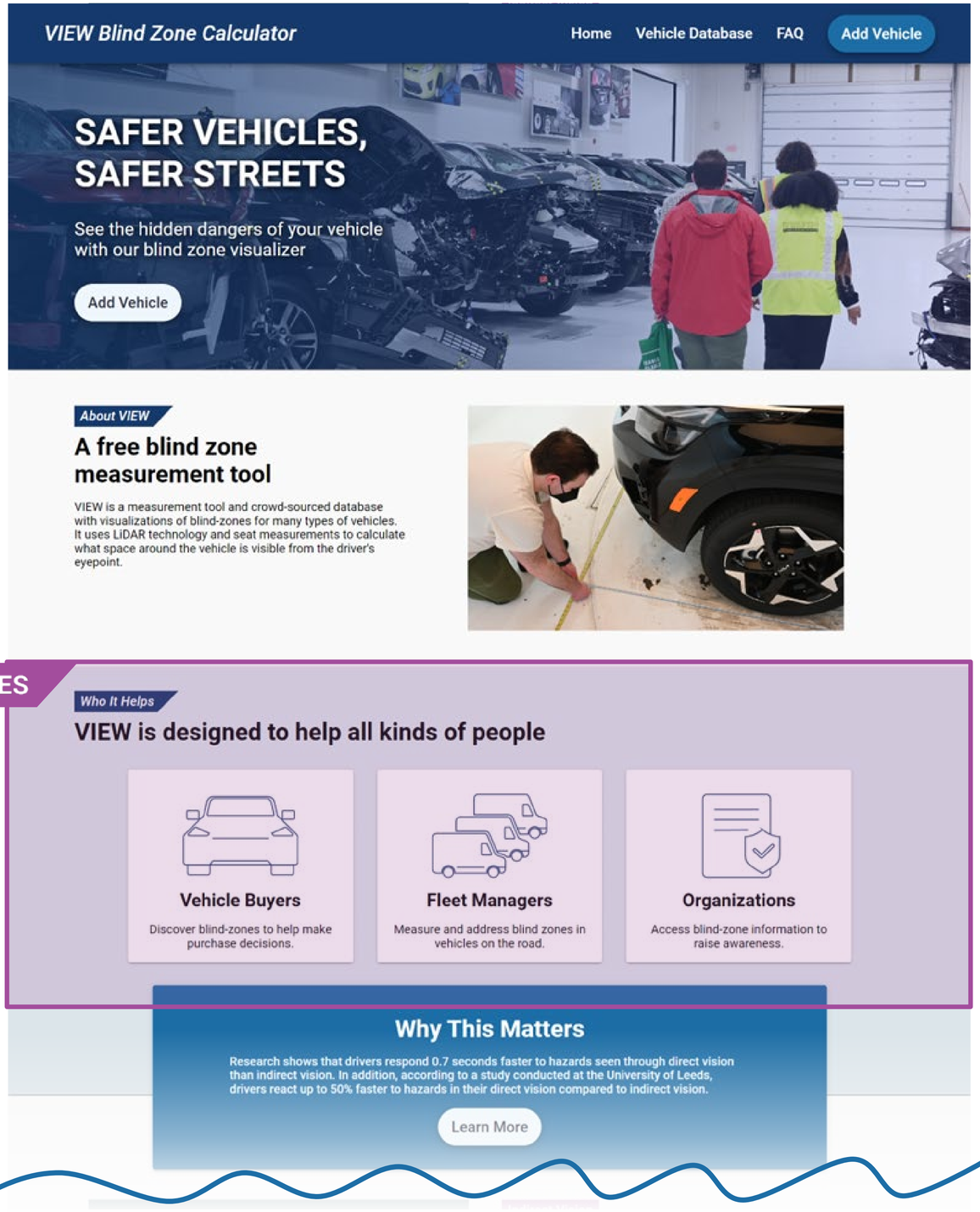
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WHY VIEW

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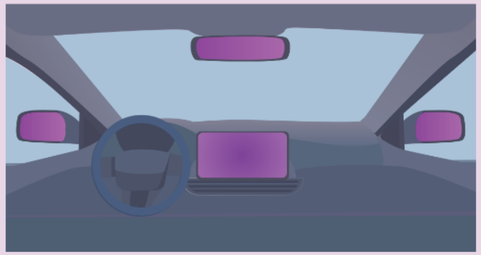

Indirect Vision

What a driver can see with the aid of devices such as mirrors and cameras.

Blindzone

Where visibility is blocked by solid components of the vehicle.

Direct Vision

What a driver can see directly with their own eyes.

Who We Are

About Us

We are a group of safety researchers and professionals focused on addressing the rising number of pedestrian and bicyclist fatalities.

In partnership with Federal and non-Federal stakeholders, we aim to quantify and understand the safety impacts of large blindzones and to inform Safe System Approach solutions to save lives.

Curious to learn more?

Find answers to frequently asked questions about the work we do, vehicle blind-zones, and how to use the site.

FAQs

Contact Us:
blindzoneapp@dot.gov

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Add a Vehicle

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To add a new vehicle, you will need access to the vehicle, a LiDAR-capable (Pro) iOS device, and a tape measure. Before taking a measurement, please download Polycam from the App Store.

Collect Data

Take measurements of the seat position and scan the exterior of your vehicle using LiDAR in the Polycam app.

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Once you've collected measurements, add your vehicle information, measurements, and LiDAR scan for processing.

Get Started

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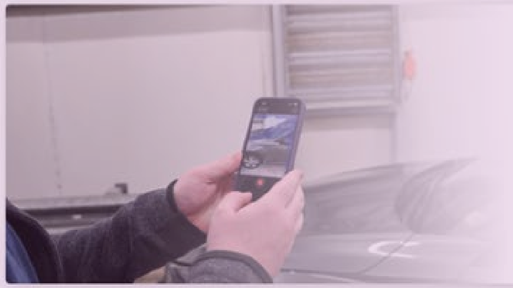

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< Add a Vehicle

Measurement & Scanning Instructions

Instructions PDF

MATERIALS

ials Needed

- Pro iOS device (iPhone 12 Pro/iPad Pro 4th gen or newer)
- Polycam app (download on the App Store)
- Selfie stick (optional, only required if measuring vehicles larger than vans)
- 8+ foot tape measure (2x recommended)
- Removable tape (ex: painter's or masking tape, sticky notes)

Note General Vehicle Information

When adding a vehicle to the VIEW database, you will be asked to provide general information about the vehicle:

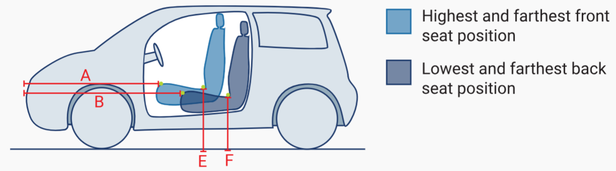
- **Make**
- **Model**
- **Year***
- **Body class****
- **Weight class*****

If you do not know the make, model, or year of your vehicle, you can find this information in the manual or by looking up the vehicle's VIN or license plate number.

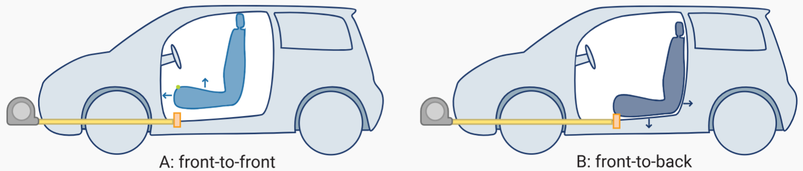
**Vehicle year refers to the model year, not the year of manufacture/purchase. Vehicles may be sold with a model year beyond the year of sale (ex: a 2012 model year sold in late 2011). Confirm the model year of your vehicle before submitting an entry.*
***Body class refers to the US Federal Highway Administration (FHWA) vehicle body classification system. (https://www.fhwa.dot.gov/policyinformation/tmguide/tmg_2013/vehicle-types.cfm)*
****Weight class refers to the US Federal Highway Administration (FHWA) vehicle weight classification system. Passenger vehicles are generally class 1. (https://afdc.energy.gov/data/10380)*

Measure Vehicle

The first step of collecting data to create visualizations using the VIEW blind zone measurement tool is to measure the upper and lower bounds of the driver's seat adjustment in relation to the front of the vehicle and the ground. Having two people and an extra tape measure will simplify the measurement process.



Part 1- Front of driver's seat to the front of vehicle hood



1. Adjust the driver's seat to the highest and farthest forward position
   - Use tape to mark the location of the front of the seat on the side of the vehicle
2. Adjust the driver's seat to the lowest and farthest back position
   - Use tape to mark the location of the front of the seat on the side of the vehicle

MEASUREMENT DIRECTIONS

- Body class**
- Weight class

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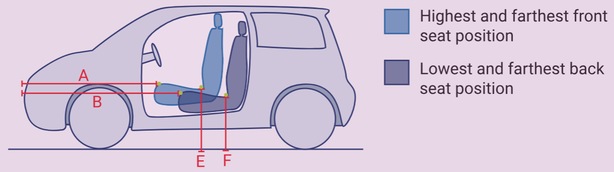

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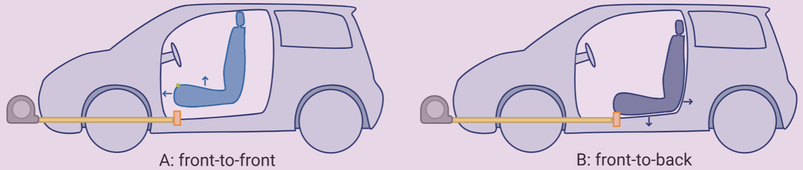

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   - Use tape to mark the location of the front of the seat on the side of the vehicle
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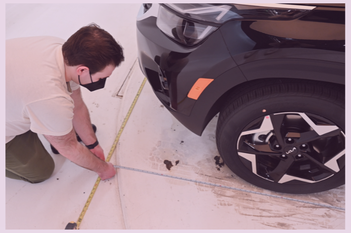
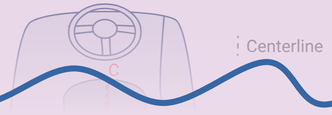
3. Using a tape measure, measure the distance along the side of the vehicle between the front of the hood and each tape marking. If you have a second tape measure, it can be used as a guide to aid in finding the front of the hood when measuring along the side of the vehicle. Run the second tape measure along the width of the vehicle in line with the hood, then run the first tape measure to the guide.



- Note these measurements as "**A: front-to-front**" and "**B: front-to-back**"



LiDAR SCAN INSTRUCTIONS

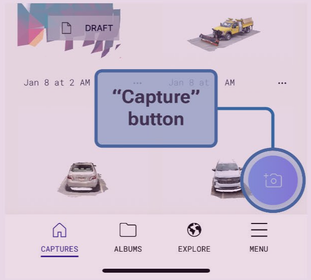
- Note this measurement as "E: seat high"

2. With the seat at its lowest height, measure from the top of the seat, at its deepest point, to the ground. You may need to shift the seat forward to reach the back of the seat cushion for this measurement. If you have a second tape measure, it can be used to help by lining it up with the seat cushion and any plastic components of the seat.
   - Note this measurement as "F: seat low"

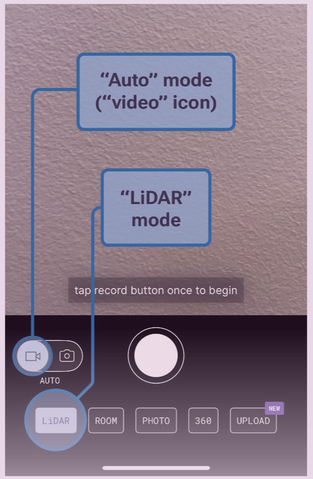
Collect a LiDAR Scan

The second step of collecting data is to use your mobile device to create a 3D scan of your vehicle using Light Detection and Ranging (LiDAR).

1. Download the Polycam app from the App Store
2. Open the app and hit skip on anything that asks you to pay for a subscription (you may need to set up an account, but you can do this for free)
3. From the home page of the app, press the camera button on the bottom right (if you are already in the camera section, ignore this step)



4. In the camera, make sure both video mode and LiDAR mode are selected



5. Align the phone with the axes of the car with the screen facing you. The easiest way to do this is to set it up against a rear wheel, making sure that the phone is still vertical (see the LiDAR Scan Process video for reference)

VIEW Blind Zone Calculator

Home | Vehicle Database | FAQ | Add Vehicle

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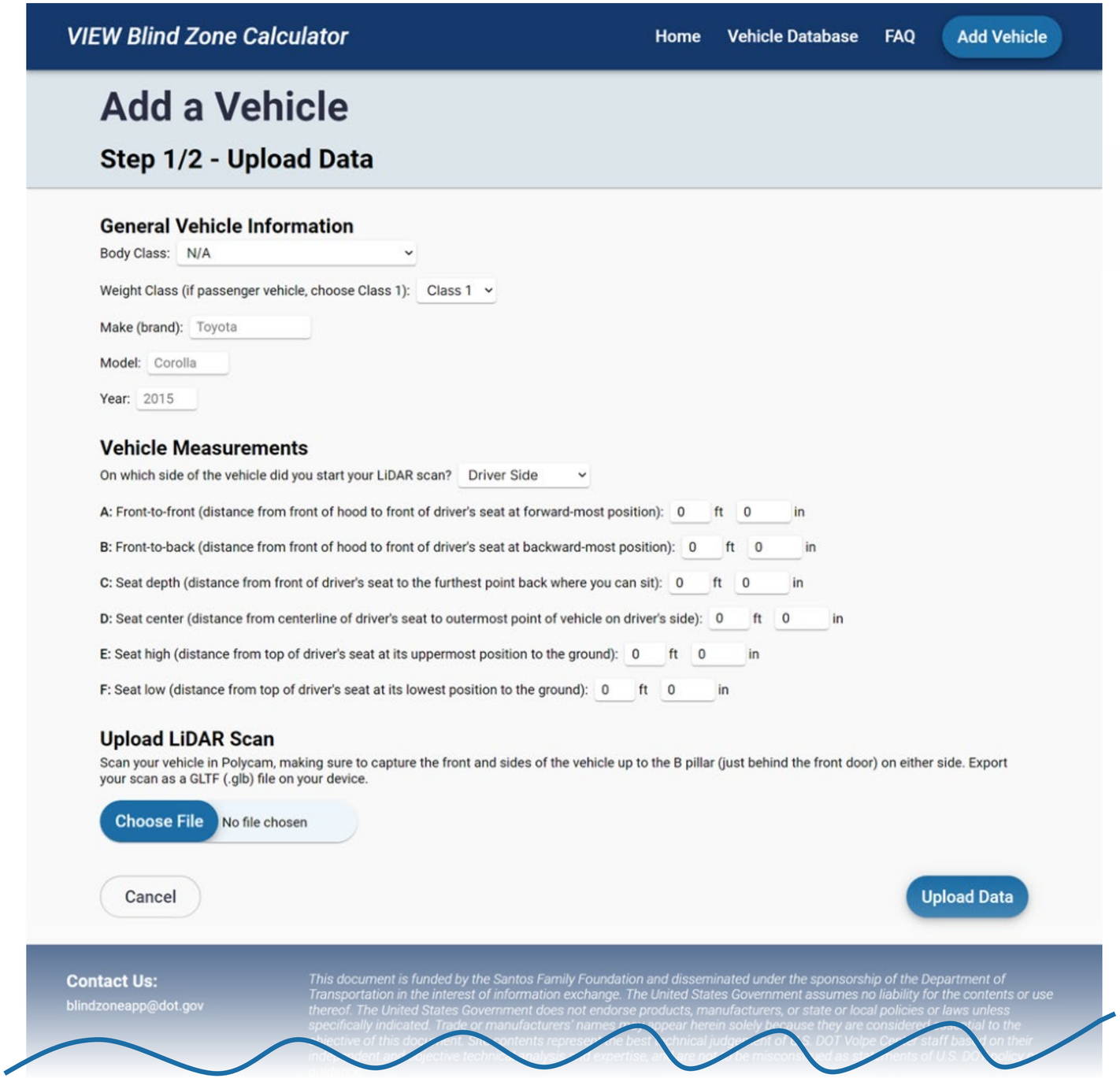
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Home
Vehicle Database
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Add a Vehicle
Step 1/2 - Upload Data
General Vehicle Information
Body Class: N/A
Weight Class (if passenger vehicle, choose Class 1): Class 1
Make (brand): Toyota
Model: Corolla
Year: 2015
Vehicle Measurements
On which side of the vehicle did you start your LiDAR scan? Driver Side
A: Front-to-front (distance from front of hood to front of driver's seat at forward-most position): 0 ft 0 in
B: Front-to-back (distance from front of hood to front of driver's seat at backward-most position): 0 ft 0 in
C: Seat depth (distance from front of driver's seat to the furthest point back where you can sit): 0 ft 0 in
D: Seat center (distance from centerline of driver's seat to outermost point of vehicle on driver's side): 0 ft 0 in
E: Seat high (distance from top of driver's seat at its uppermost position to the ground): 0 ft 0 in
F: Seat low (distance from top of driver's seat at its lowest position to the ground): 0 ft 0 in
Upload LiDAR Scan
Scan your vehicle in Polycam, making sure to capture the front and sides of the vehicle up to the B pillar (just behind the front door) on either side. Export your scan as a GLTF (.glb) file on your device.
Choose File
No file chosen
Cancel
Upload Data
Contact Us:
blindzoneapp@dot.gov
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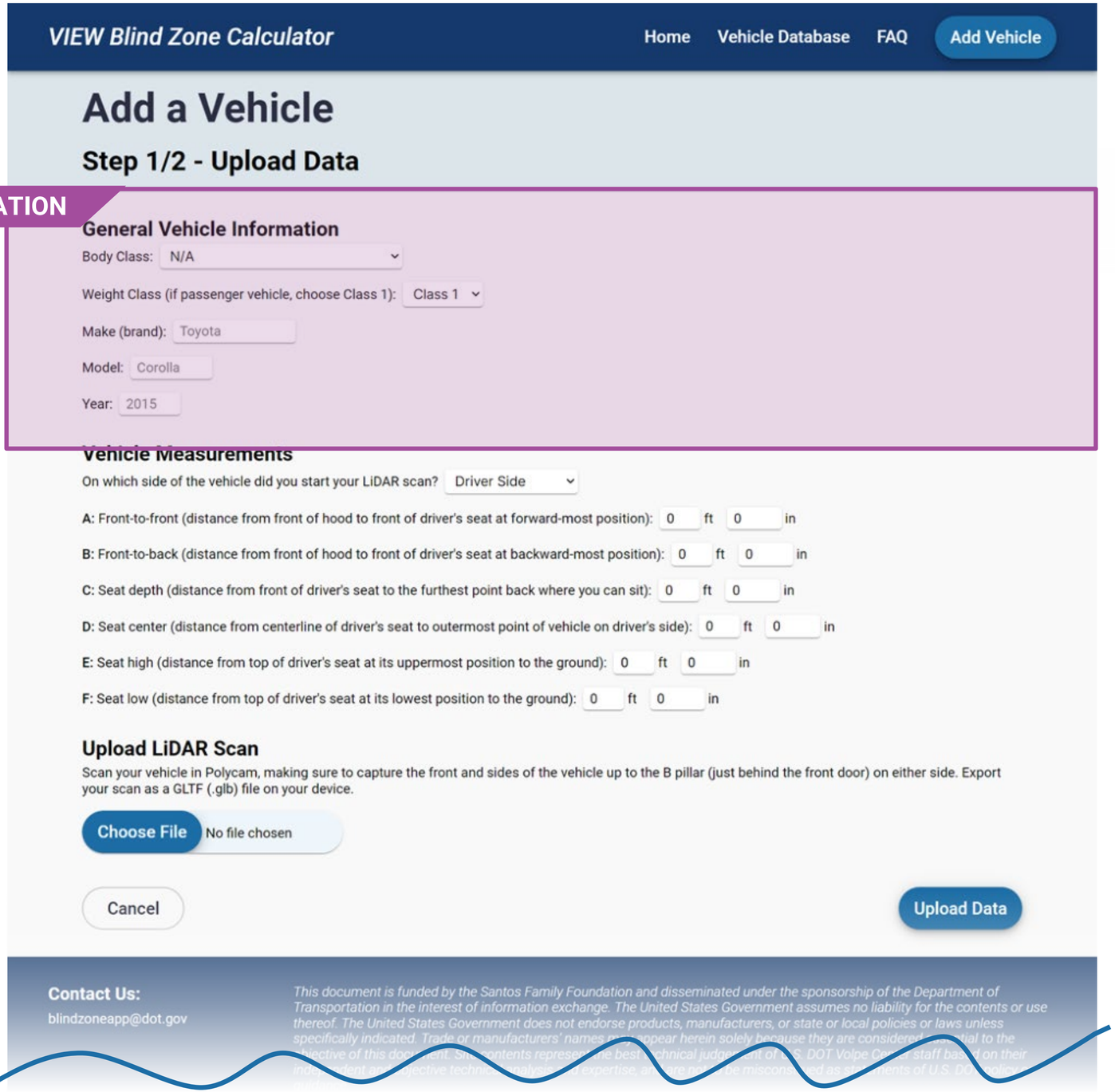
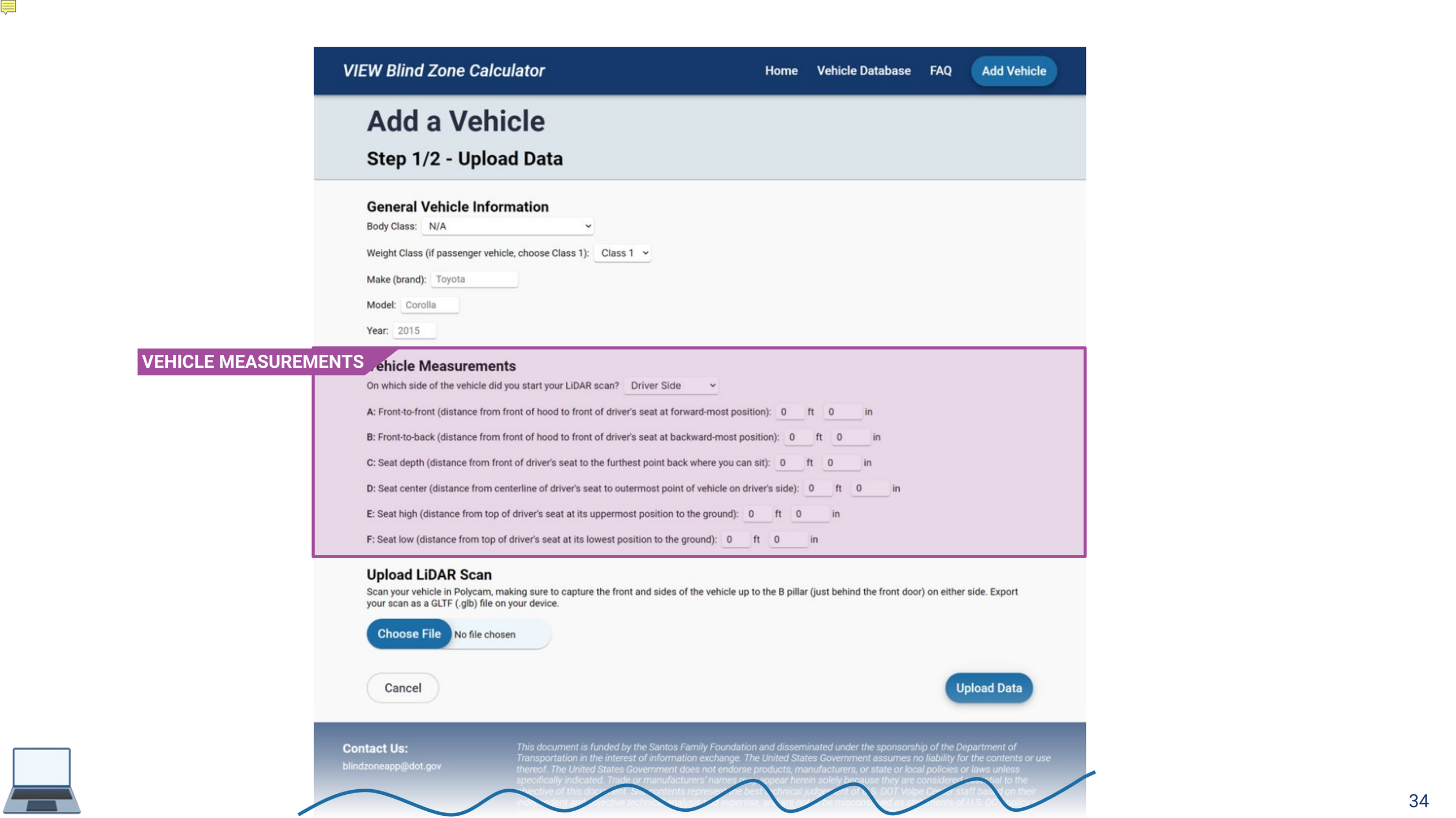
VEHICLE INFORMATION




VIEW Blind Zone Calculator
Home
Vehicle Database
FAQ
Add Vehicle
Add a Vehicle
Step 1/2 - Upload Data
General Vehicle Information
Body Class: N/A
Weight Class (if passenger vehicle, choose Class 1): Class 1
Make (brand): Toyota
Model: Corolla
Year: 2015
VEHICLE MEASUREMENTS
ehicle Measurements
On which side of the vehicle did you start your LiDAR scan? Driver Side
A: Front-to-front (distance from front of hood to front of driver's seat at forward-most position): 0 ft 0 in
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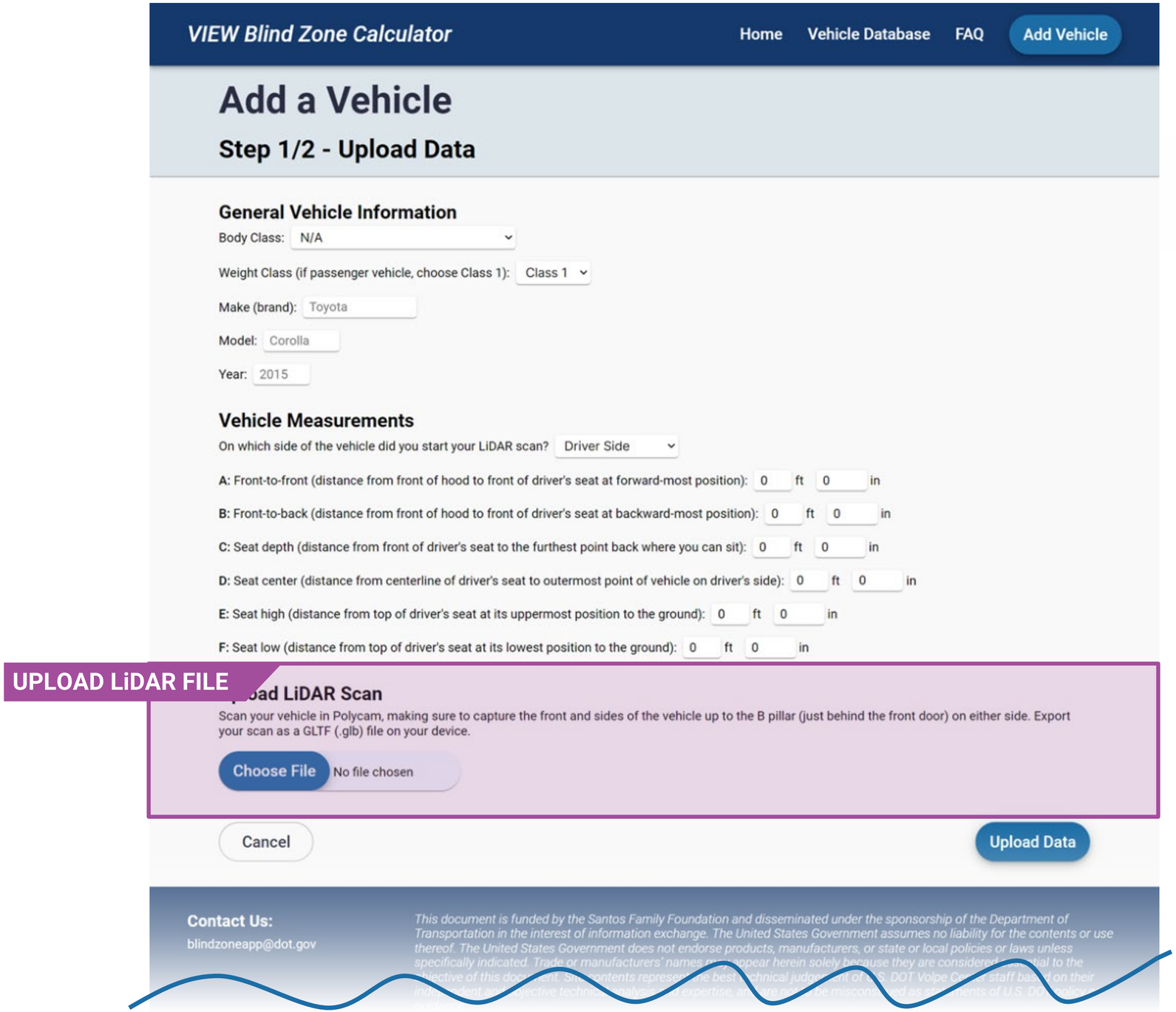
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UPLOAD LiDAR FILE
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VIEW Blind Zone Calculator

Home | Vehicle Database | FAQ | Add Vehicle

Add a Vehicle

Step 2/2 - Remove Windshield

Erase Windshield Instructions

In the 3D file viewer below, use the eraser tool to remove the windshield from your vehicle scan. Erasing the windshield requires a mouse or touchpad.

Erase

Toggle Eraser Mode on and off by clicking the Erase/Move button. While in Eraser Mode, click and drag to erase.

Rotate Vehicle

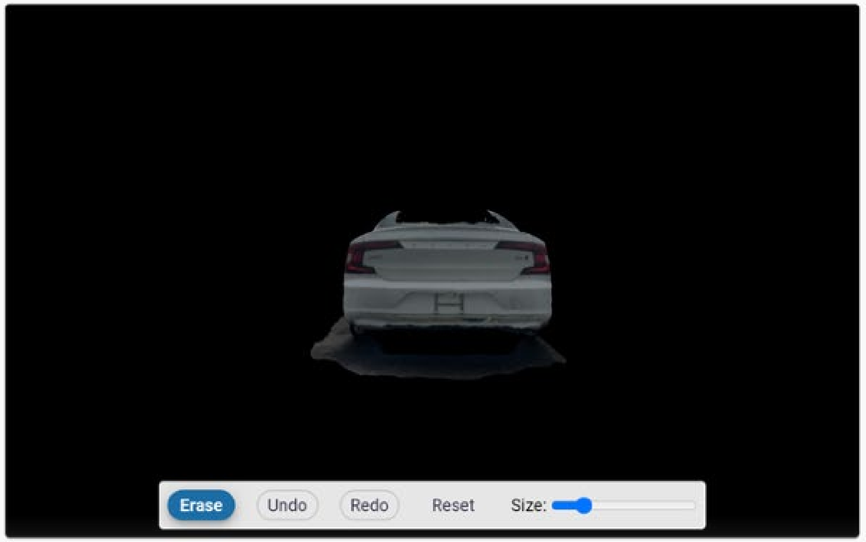
Make sure you are not in Eraser Mode. Click and drag to rotate vehicle.

Move/Translate Vehicle

Make sure you are not in Eraser Mode. Hold down the CTRL key while clicking and dragging to move the vehicle (left, right, up, diagonal, etc.).

Zoom In/Out

Make sure you are not in Eraser Mode. Scroll or pinch to zoom.



Back

Submit Entry

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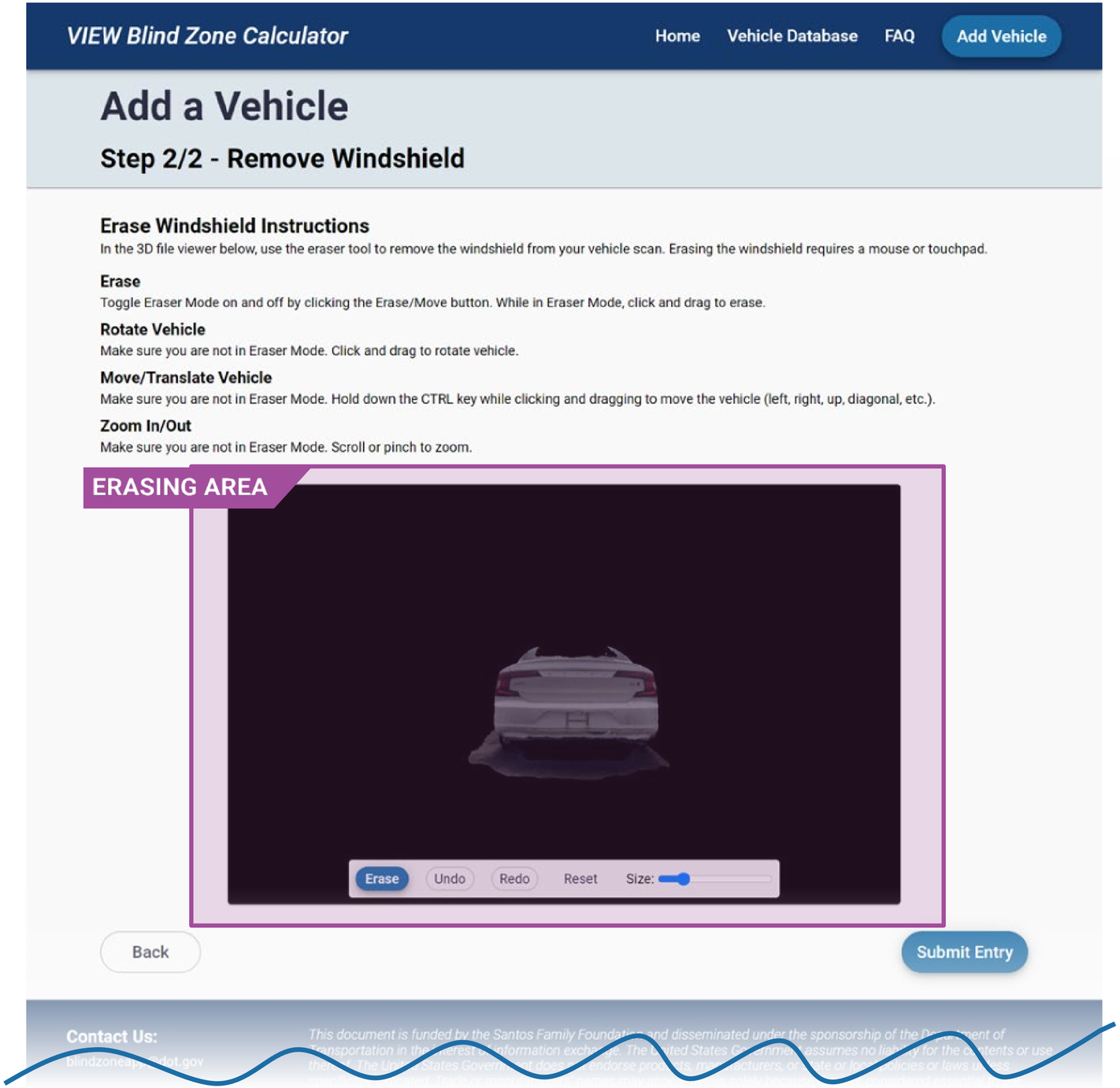
ERASER CONTROLS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ERASING AREA
Erase
Undo
Redo
Reset
Size:
Back
Submit Entry
Contact Us:

VIEW Blind Zone Calculator

Home | Vehicle Database | FAQ | Add Vehicle

Vehicle Database

Our database displays all vehicle entries on VIEW that are contributed by the public and by researchers. Explore the database to see all the vehicle information available and click View to see blind-zone visualizations and additional safety metrics.

Model | Search for Model | Clear

Entries Shown: 25

Sort By: Updated (New-Old)

Updated	Make	Model	Year	Body Class	Weight Class	Scan Details
2024-04-17	Chevrolet	Trax	2024	Passenger Cars	Class 1	2024-04-17 View
2024-04-17	Nissan	Altima	2024	Passenger Cars	Class 1	No Associated Scans
2024-04-17	Kia	Seltos	2024	Passenger Cars	Class 1	2024-04-17 View
2024-04-17	Honda	Odyssey	2011	Passenger Cars	Class 1	2024-04-17 View

Showing 1-4 of 4 entries

<< First < Previous 1 Next > Last >>

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SEARCH + FILTER

Model | Search for Model | Clear | Entries Shown: 25 | Sort By: Updated (New-Old)

Updated	Make	Model	Year	Body Class	Weight Class	Scan Details
2024-04-17	Chevrolet	Trax	2024	Passenger Cars	Class 1	2024-04-17 View
2024-04-17	Nissan	Altima	2024	Passenger Cars	Class 1	No Associated Scans
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Updated	Make	Model	Year	Body Class	Weight Class	Scan Details
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2024-04-17	Honda	Odyssey	2011	Passenger Cars	Class 1	2024-04-17 View

VIEW VISUALIZATION

Showing 1-4 of 4 entries

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VIEW Blind Zone Calculator

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< Vehicle Database

2024 Chevrolet Trax (April 17, 2024, 10:56 a.m. UTC)

Blind-Zone Visualizations

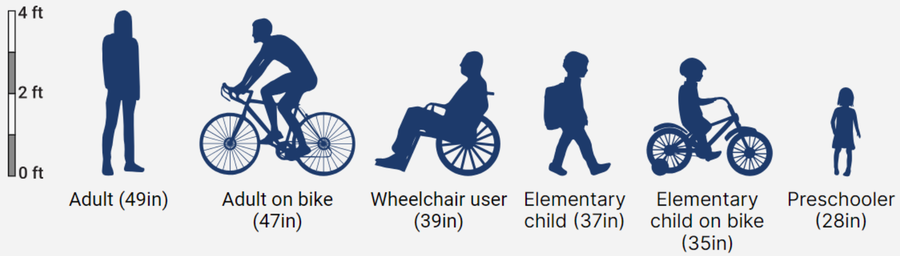
Choose a Driver Height

○ 5th-Percentile Female (60 inches) ◉ 50th-Percentile Male (69 inches) ○ 95th-Percentile Male (74 inches)

Choose a Vulnerable Road User (VRU)

☐ Preschool child (28 inches) ☑ Elementary school child on bicycle (35 inches) ☐ Elementary school child (37 inches)
☑ Wheelchair user (39 inches) ☐ Adult on bicycle (47 inches) ☐ Adult (49 inches)

*Vulnerable Road Users include pedestrians, cyclists, and people who use wheelchairs. A vulnerable road user is considered invisible if a driver cannot see their head. The calculations use the heights to the shoulders of 5th percentile United States female vulnerable road users.



Visualize

Visualization Results: elementary school child on bike and wheelchair user

Overhead View

VIEW Blind Zone Calculator

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< Vehicle Database

2024 Chevrolet Trax (April 17, 2024, 10:56 a.m. UTC)

SELECT VRU(s)

Blind-Zone Visualizations

Choose a Driver Height

○ 5th-Percentile Female (60 inches) ◉ 50th-Percentile Male (69 inches) ○ 95th-Percentile Male (74 inches)

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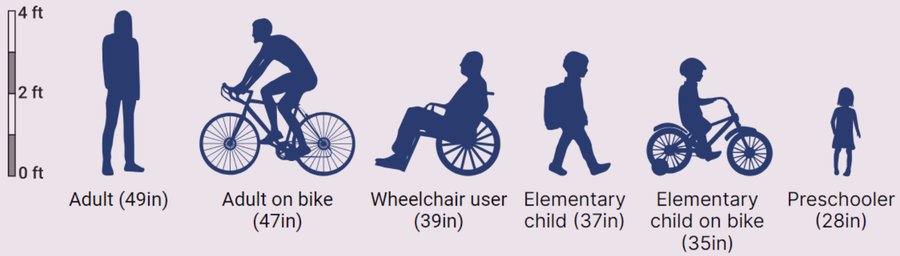


Visualize

Visualization Results: elementary school child on bike and wheelchair user

Overhead View

(47in) (39in) child (37in) child on bike (35in) (28in)

Visualize

VISUALIZATION

Visualization Results: elementary school child on bike and wheelchair user

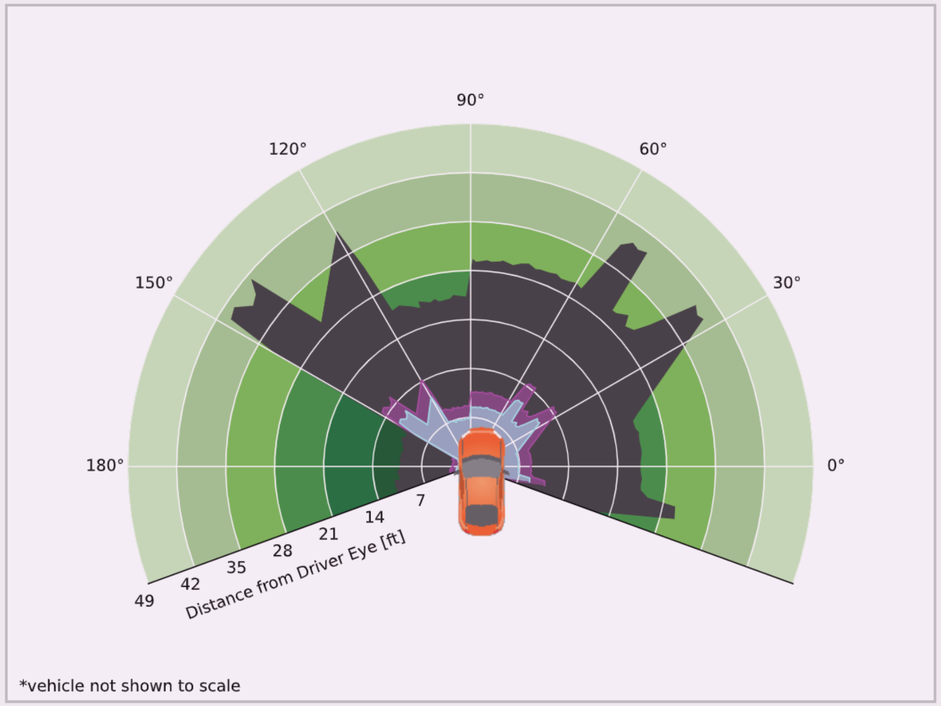
Overhead View

Birds-eye view of the vehicle and surrounding blindzones.

The closest forward-visible **elementary school child on bike** is **1 ft** in front of the vehicle.
There are **32 elementary school children on bikes** hidden in the blindzone.

The closest forward-visible **wheelchair user** is **0 ft** in front of the vehicle.
There are **15 wheelchair users** hidden in the blindzone.

- ground blindzone
- elementary school child on bike blindzone
- wheelchair user blindzone
- visible zone



*vehicle not shown to scale

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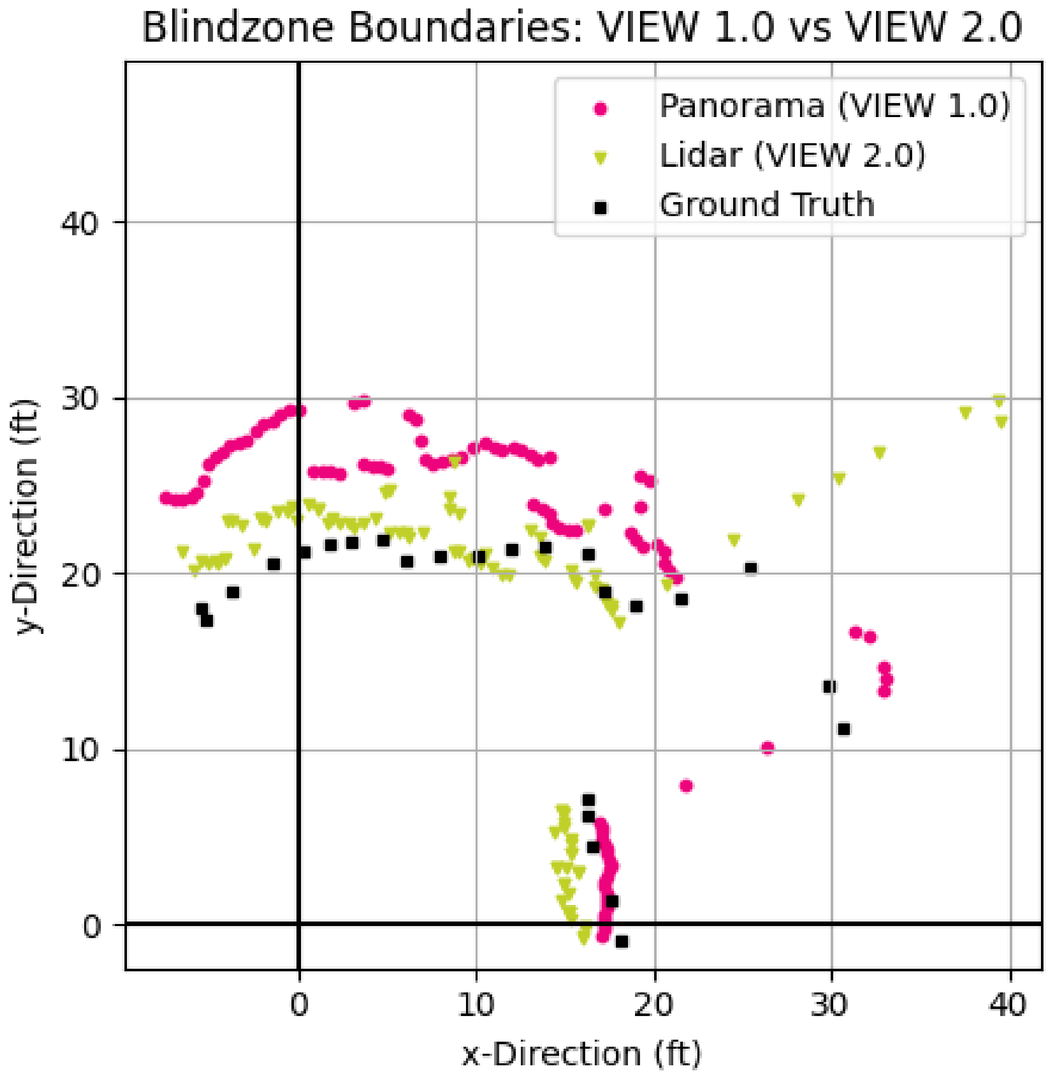
Key changes

- Highlighted site purpose and next steps on homepage
- Modernized site style and visuals
- Improved wording for clearer understanding
- Redesigned blind zone visualizations for clarity and comparison
- Indicate state of site through clear indicators

IMPACT

Increased Accuracy over VIEW 1.0

- VIEW 1.0 error: 33.9%
- VIEW 2.0 error: 4.8%
- Over 85% increase in accuracy



Improved site usability

Previous home page

- “To be honest, **I don’t really understand what’s happening.** I know it’s something about blind zones, some blind zone smartphone tool”

New home page

- “This website **shows the blind zone of your vehicle** so you can see and understand **how safe or unsafe** your vehicle is.”

Immediate Applications

- Volpe measures vehicles for government agencies
- Continued development and data entry

Future Impact

- Shift consumer preferences towards high vision designs
- Automakers interested in promoting high vision designs
- Potential to inform visibility policy

Acknowledgements

- **Santos Family Foundation**
  Paul Santos & Anne Stuart
- **Olin College SCOPE**
  Lynn Andrea Stein, Sarah Bloomer, Jessica McCarthy
- **US DOT Volpe Center**
  Alex Epstein, Eric Englin, Ali Brodeur, Juwon Drake, Don Fisher
- **IIHS-HLDI**
  Becky Mueller & Haden Bragg

Q&A

View our site at blindzonesafety.org