VRU-Proxi-11-11

Definition and testing of a Direct Vision Standard for HGVs – Physical testing method

Loughborough University Design School: Design Ergonomics Research Group

Research Sponsored by Transport for London

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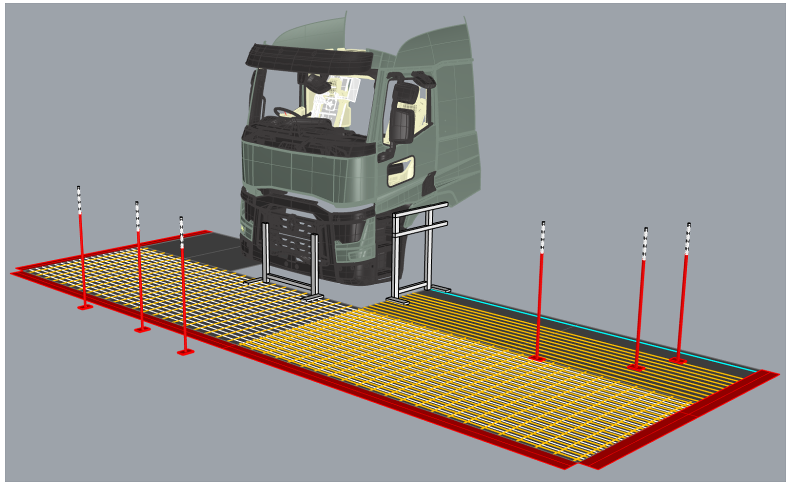
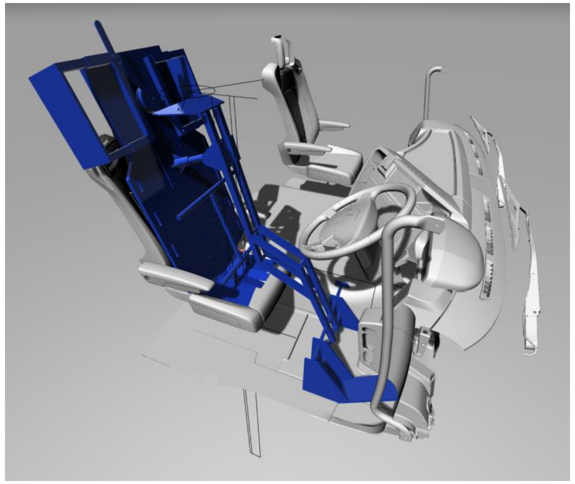
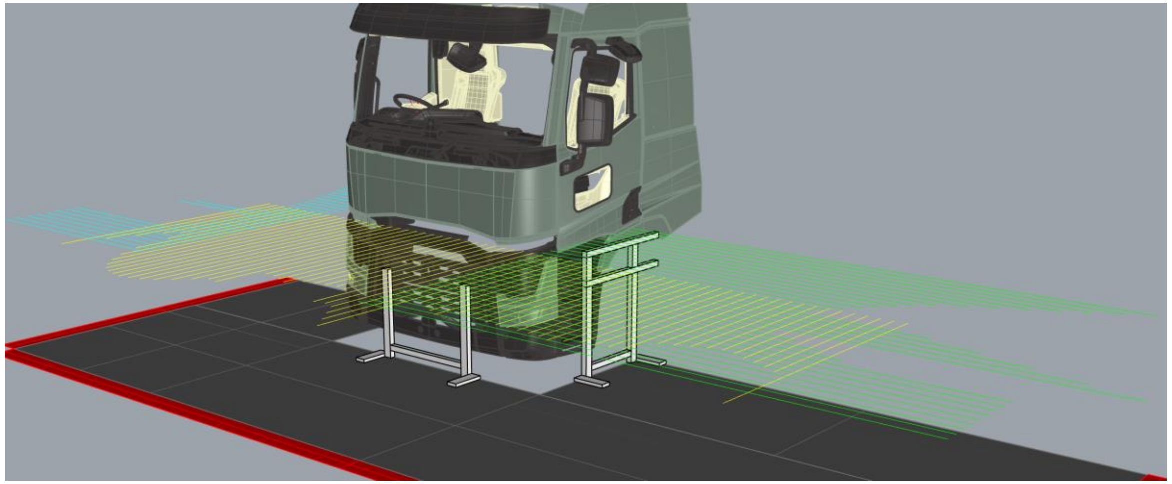






Contents

Update on physical testing development

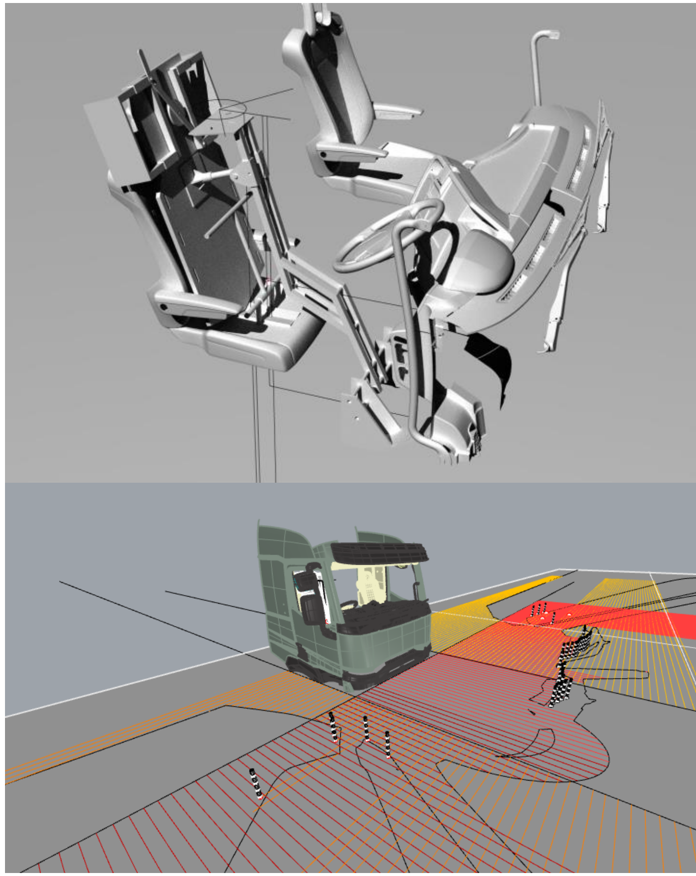
- Progress since last meeting
- Virtual testing to help in the design of the physical
- How will the test be performed?

The definition of a 'real world' test that can be used for 'on the spot' checks

- At the last VRU Proxy meeting our proposal for physical test method which automates the process using cameras and QR markers was rejected as this would require bespoke software which would be difficult to implement in legislation

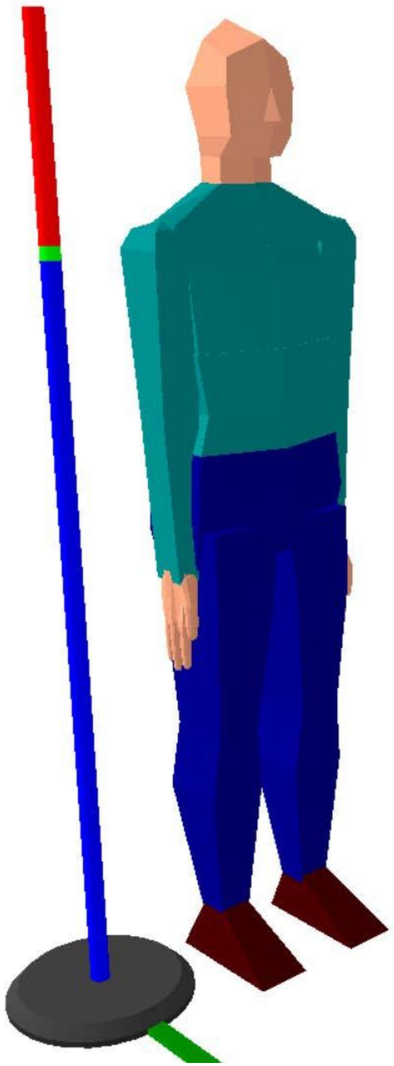
- We have therefore produced a test method prototype which is much more simple to implement and would not require bespoke software

- The following presentation outlines this new proposal and the work done so far to define and validate the new test



What is the visual target that is used?

- We need a test that is analogous to the digital TfL DVS technique
- Therefore we have defined a test object that is the same height as the DVS VRU (5th%ile Italian female)
- We have also explored how much of this visual target should be visible during the testing
- The red section shown in the image is equivalent to the head and shoulders being visible
- In the first instance we have defined a test method where the top or bottom half of the test object can be acceptable as visible to the driver (more on this later)



Using the data from the DVS definition to test the number of visual targets required

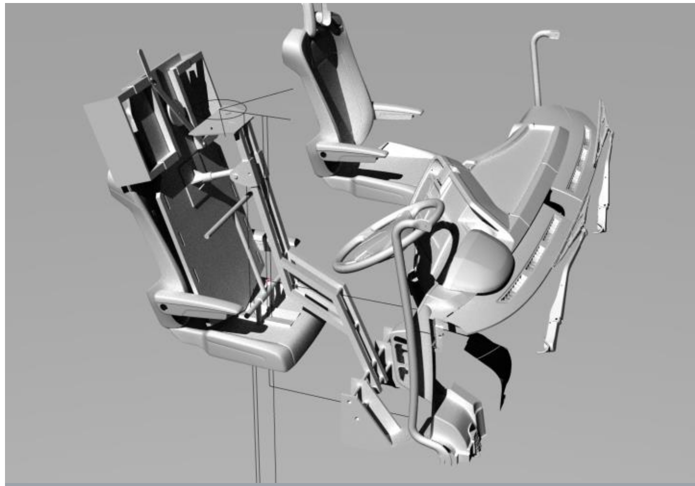
- Before attempting any physical testing we have used the data that we have from the TfL DVS definition to test the 'Stick' based approach with the following aims;

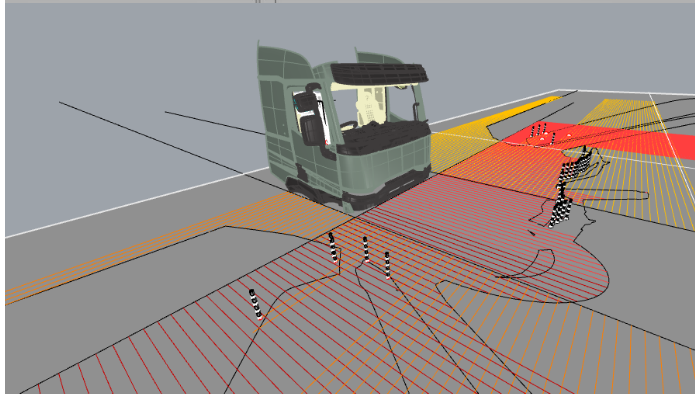
    - We have a digital sample of 56 HGVs (volumetric projections) which can be used to test different versions

    - To remove variables that will exist in the real world testing which would reduce the ability to diagnose issues with the pilot testing

    - To determine the number of 'Sticks' (or measurement points around the vehicle) that should be used to allow a good correlation with Digital DVS volumetric scores, as few as possible

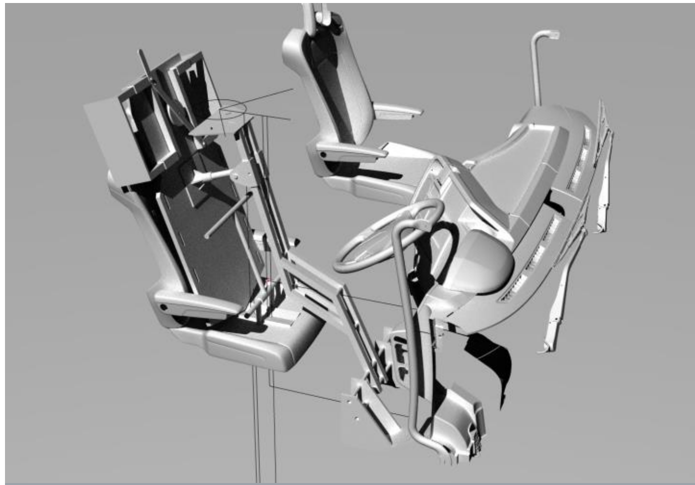
    - To perform a virtual dry run of the methodology that is required in the real world

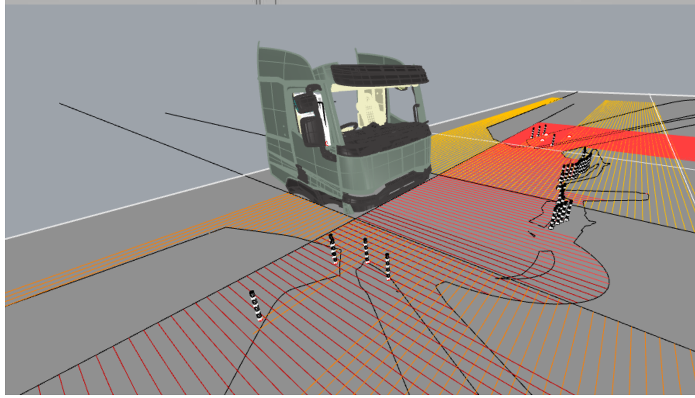




Test requirements

- The real world test needs to produce results that are equivalent to the digital results
    - For example being able to differentiate between a vehicle that achieves Zero star, or 1 star and better using the Digital volumetric approach
- Therefore the real world test is being designed with some of the parameters of the digital DVS test in mind



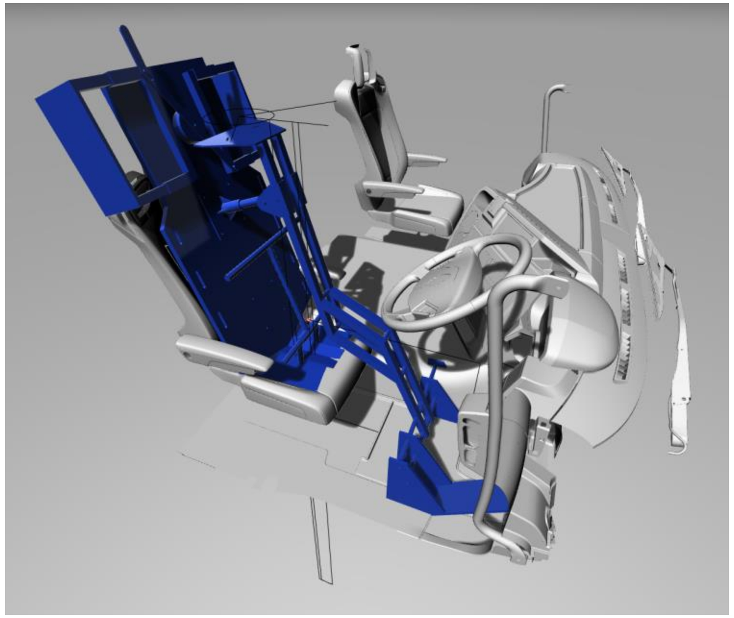


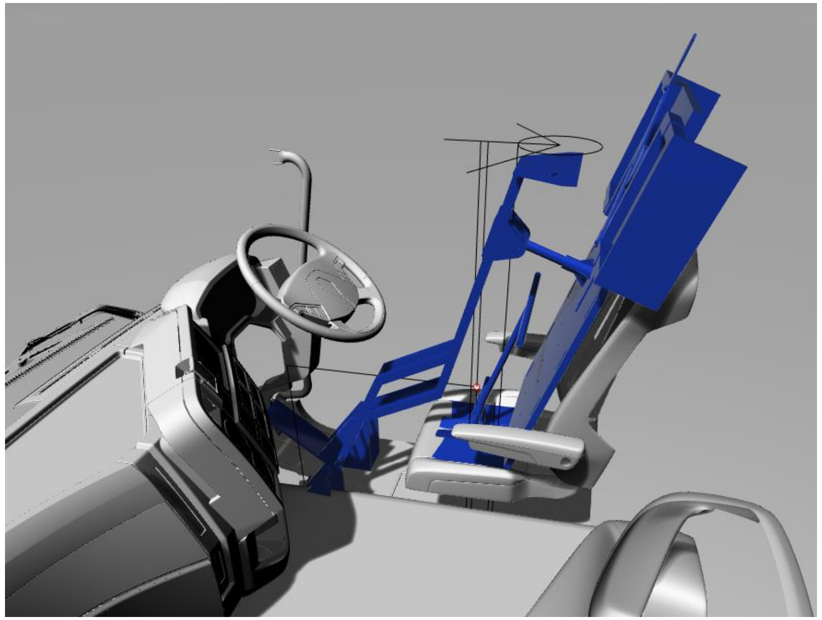
Recreating the virtual eye points in the DVS in the real world

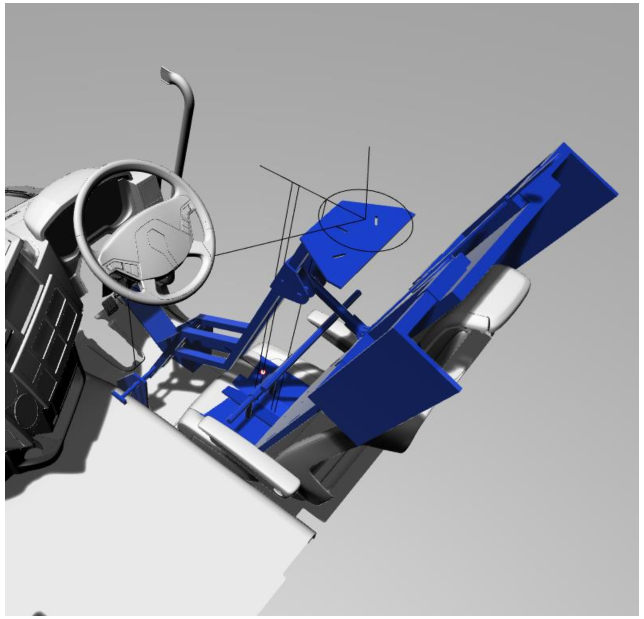
- One of the key elements of the digital DVS is the eye point rig to provide 3 repeatable eye points

- A rig has been built to allow these eye points to be created in a real cab (see real rig during presentation)

- It is positioned in the vehicle cab, adjusted using the screw thread until the top plate is horizontal, and then 3 cameras are placed on the rig to create the eye points in the same location as the digital version, these cameras can transmit their images wirelessly to a screen that an external operator can view

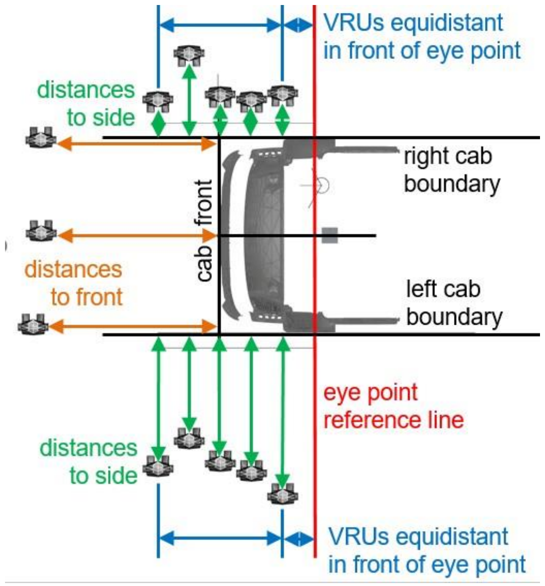


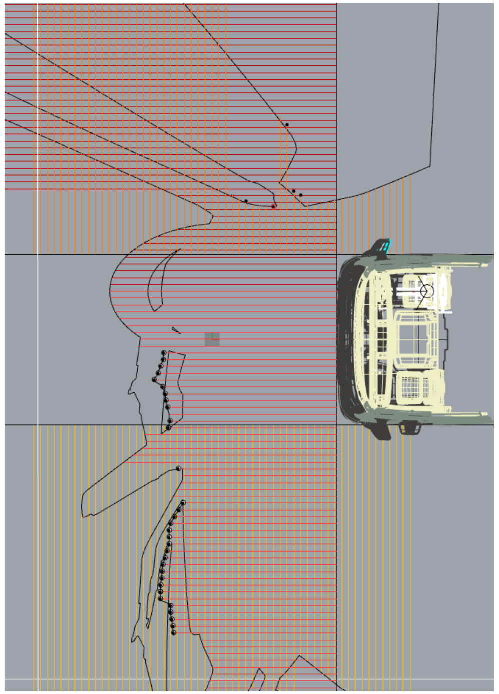




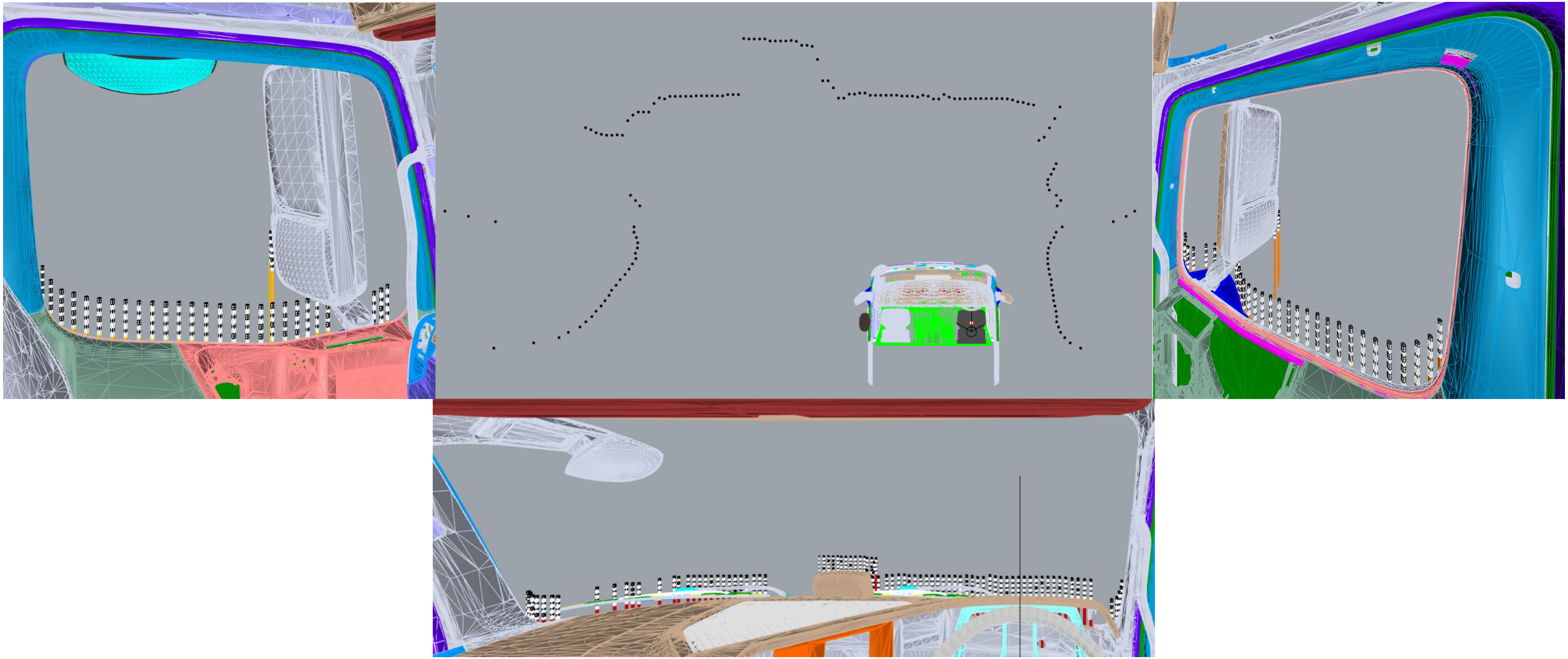
Positioning the stick arrays

- The digital DVS was validated using 13 VRU simulations and these were used in a specific manner
- The ‘Sticks’ have been used in the same manner but we have increased the resolution to over a hundred measurement locations in the first instance
  - The ‘Sticks’ are moved away from the sides or front of the cab until the top section is visible
  - In constrained locations such as the wiper blade, or under mirrors, we have allowed either the top half or the bottom half of the stick to be visible
  - Only ‘Sticks’ that are in front of the eye points have been used for the current analysis



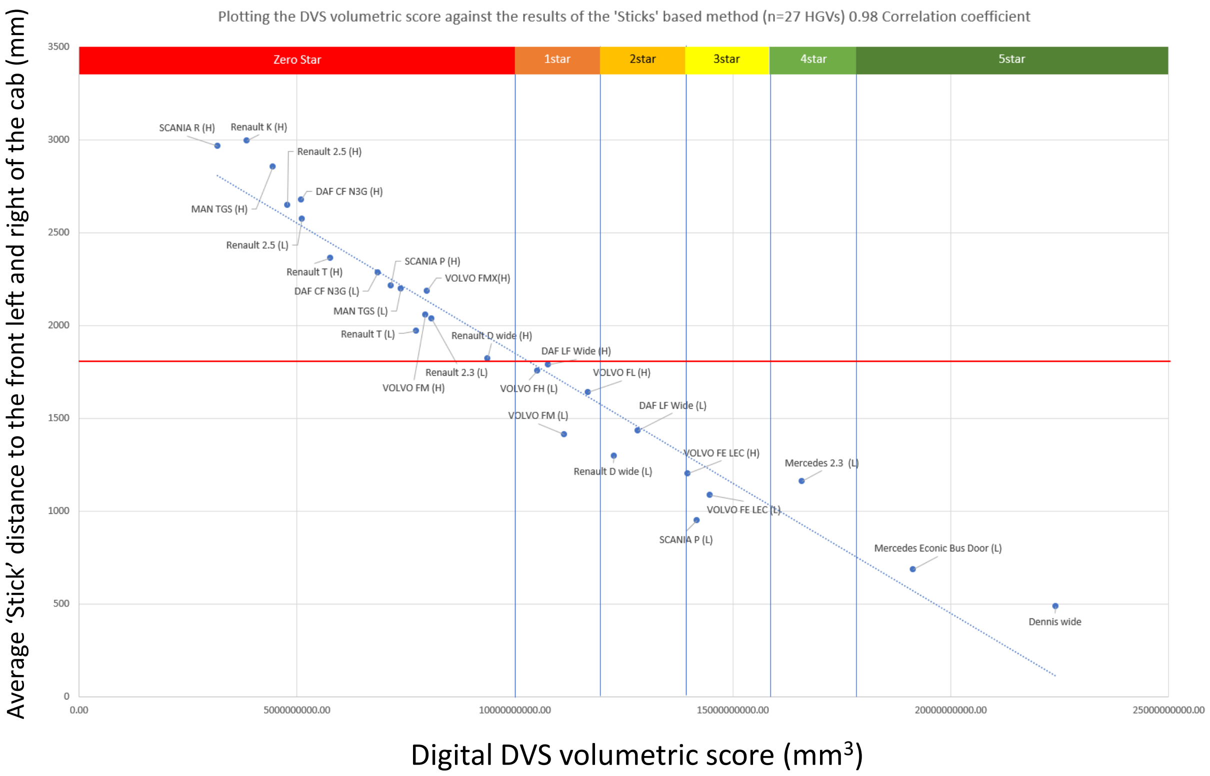


The positions of the ‘Sticks’ when they are visible (head and shoulders of 5th%ile Italian female)

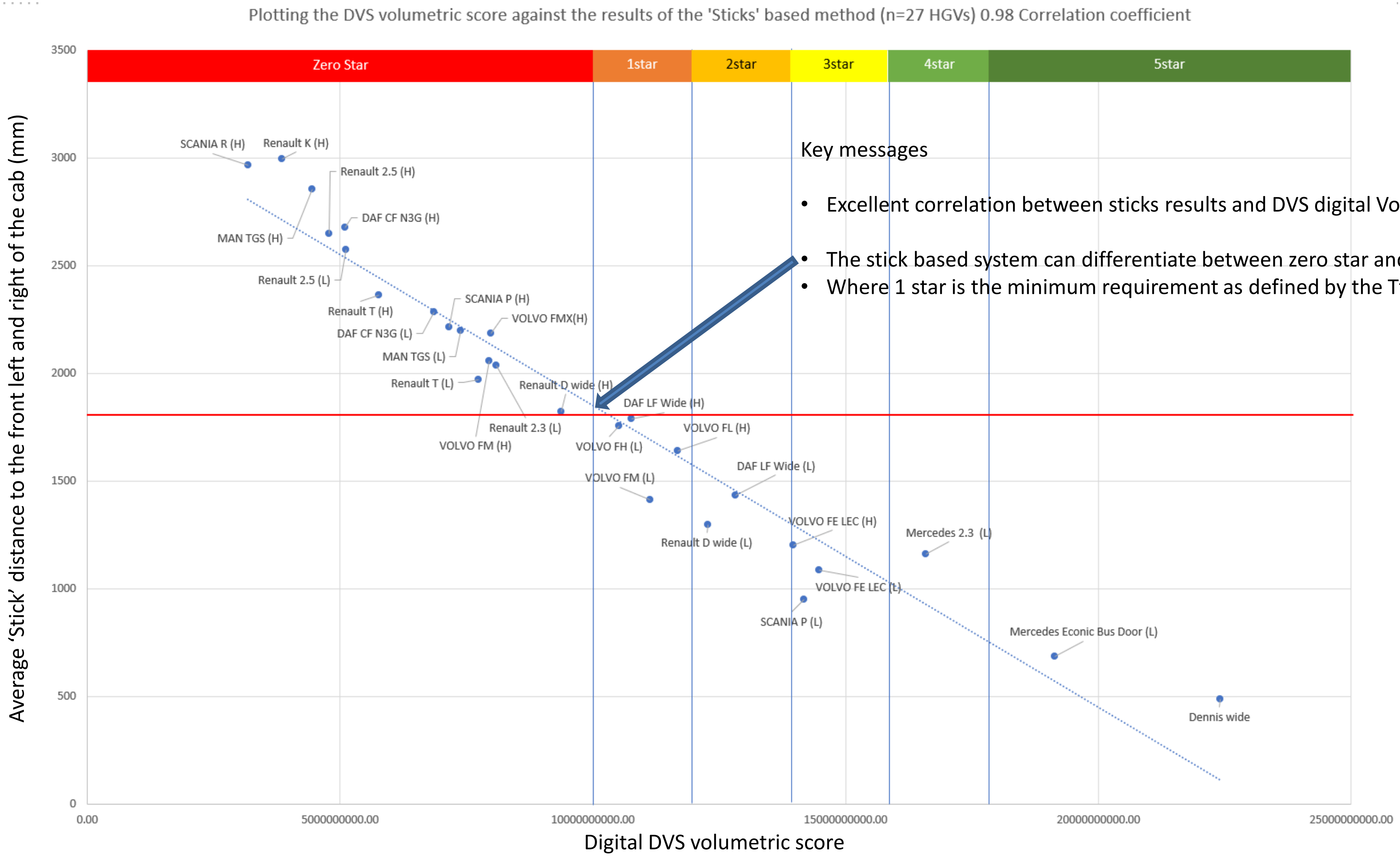


The results of the correlation between the DVS results and the 'sticks' method

- The digital simulation has been run on 27 of the 52 available vehicle sample at this point
- In the graph the average of all stick distances has been plotted against the Digital DVS volume score
- This has shown a good correlation between the Digital Volumetric DVS method and the 'Stick' based method (Pearson's correlation coefficient =0.98 where above 0.5 is considered to be strong, 1 is perfect)



Recreating the virtual eye points in the DVS in the real world



Key messages

- Excellent correlation between sticks results and DVS digital Volumetric results
- The stick based system can differentiate between zero star and one star vehicles
- Where 1 star is the minimum requirement as defined by the TfL DVS

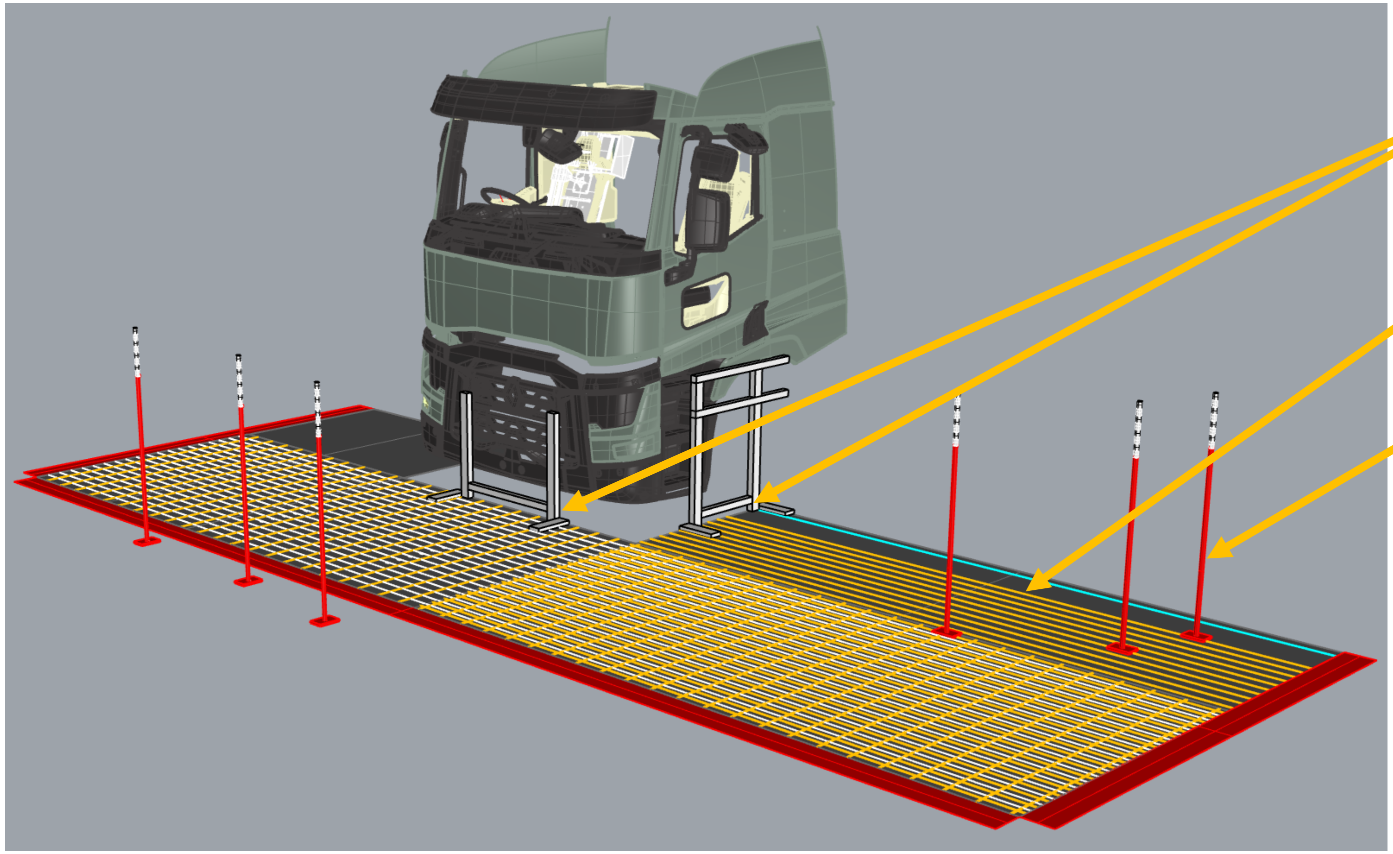
Virtual testing of a number of 'sticks'

- For the initial virtual testing of the prototype the sticks have been placed every 100mm
- This has produced a result where for most vehicles this would require approx. 110 measurement locations
- This is most likely too many locations for a real world test and so the next step is to explore increasing the spacing between the measure locations (less locations) to see what the minimum number of measure locations are without affecting the quality of the correlation coefficient between the digital DVS result and the physical DVS result
- We will then validate the prototype with real world testing

Right of Driver	Left of Driver	Driver Side	Passenger Side	
2733.821101	2733.821101	1014.80057	5483.680541	
2724.964164	2734.691194	816.823391	4489.570935	
2698.281145	2707.132591	733.987007	4058.674749	
2652.751228	2661.341073	657.01897	3691.138618	
2586.011071	2594.932456	580.207148	3327.192507	
2494.880597	2501.64455	504.32104	2969.275843	
2372.894689	2378.338555	488.29984	2650.784385	
2206.99138	2210.130384	491.382905	2635.994305	
1964.143317	1967.713714	489.142586	2633.325002	
1900.072994	1897.177756	510.358089	3071.963658	
1868.449926	1866.609488	583.03539	2648.989812	
1833.279118	1833.087564	678.999373	2646.320609	
2010.331387	1796.712782	598.03539	2665.15525	
2255.121065	1757.37872	694.798516	2698.418762	
2501.58511	1716.060903	548.19026	2674.994131	
	1692.044081	530.169376	3762.185118	
	1692.925676	490.77462	4073.477799	
	1693.762154	457.784758	4414.071478	
	1694.295094	453.158719	2627.636556	
	1694.828033	433.752461	2799.761192	
	1695.348158		5166.266004	
	1695.707887			
	1697.013068			
	1753.476312			
	1776.153232			
	1812.522514			
	1815.318747			
	1810.788458			
	1797.226996			
	1782.976855			
	1779.783085			
	1761.612337			
	1762.609377			
	1763.606417			
	1752.856988			
	1716.169462			
	1703.126942			
	1688.374319			
	1677.928971			
	1675.003959			
	1671.569303			
	1668.122275			
	1664.152412			
	1660.182548			
	1655.054741			
	1649.569809			
	1643.656237			
	1637.525317			
	1630.510052			
	1623.236041			
	1647.227917			
	1685.324278			
	1726.360526			
	1769.889127			
2320.238553	1853.233565	587.752021	3389.946536	2037.793
16	55	20	21	112

How will the real world test be performed?

- Floor matts are produced which can be located around the cab using reference structures
- Floor matts contain markings to place the reference sticks and markings to show distances



Reference structures from the vehicle side to the mat

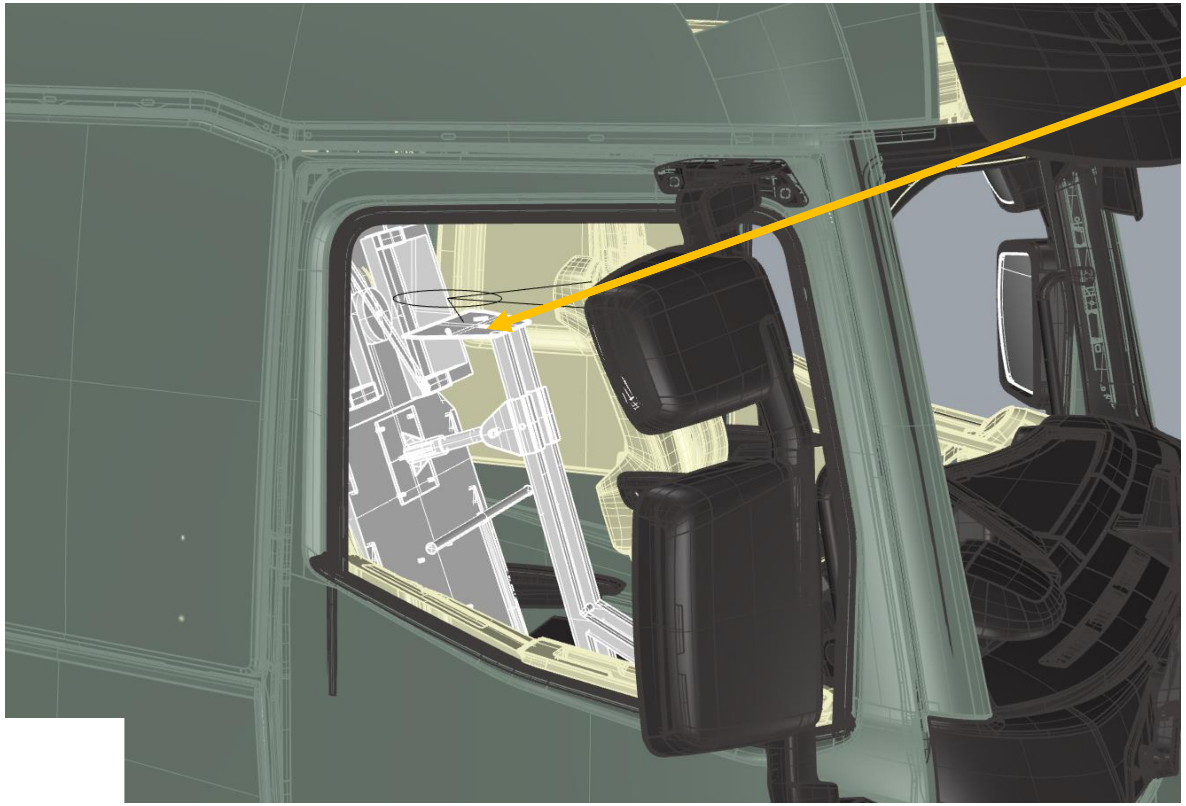
Measure mats

Assessment ‘sticks’

How will the real world test be performed?

- The cab rig will cameras will transmit the camera view to the experimenter using a laptop/tablet to view the camera view allowing them to align the assessment stick

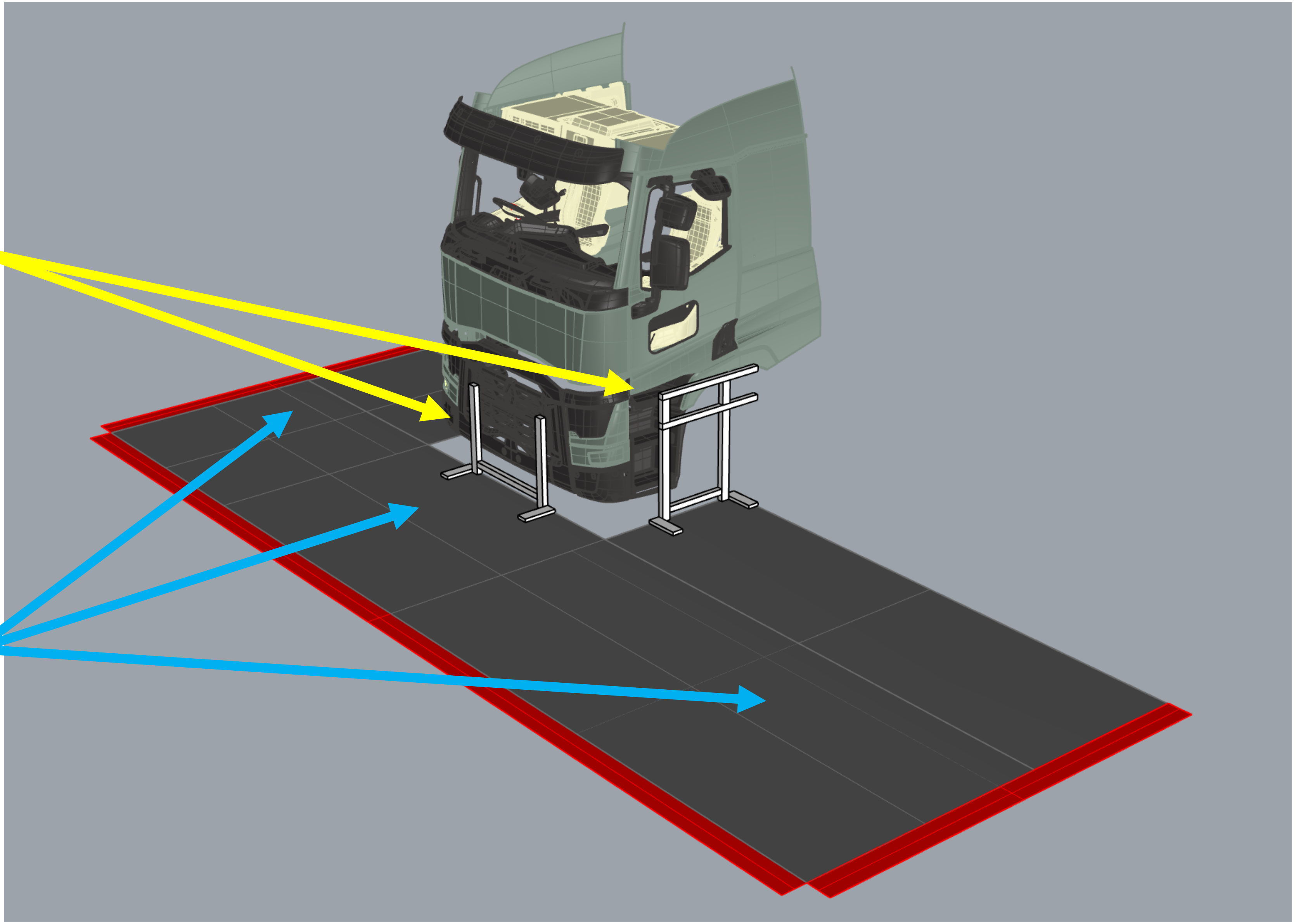
Cameras on the assessment rig mounting plate



How will the real world test be performed?

Front and side rigs used to determine extremes of cab and align mats

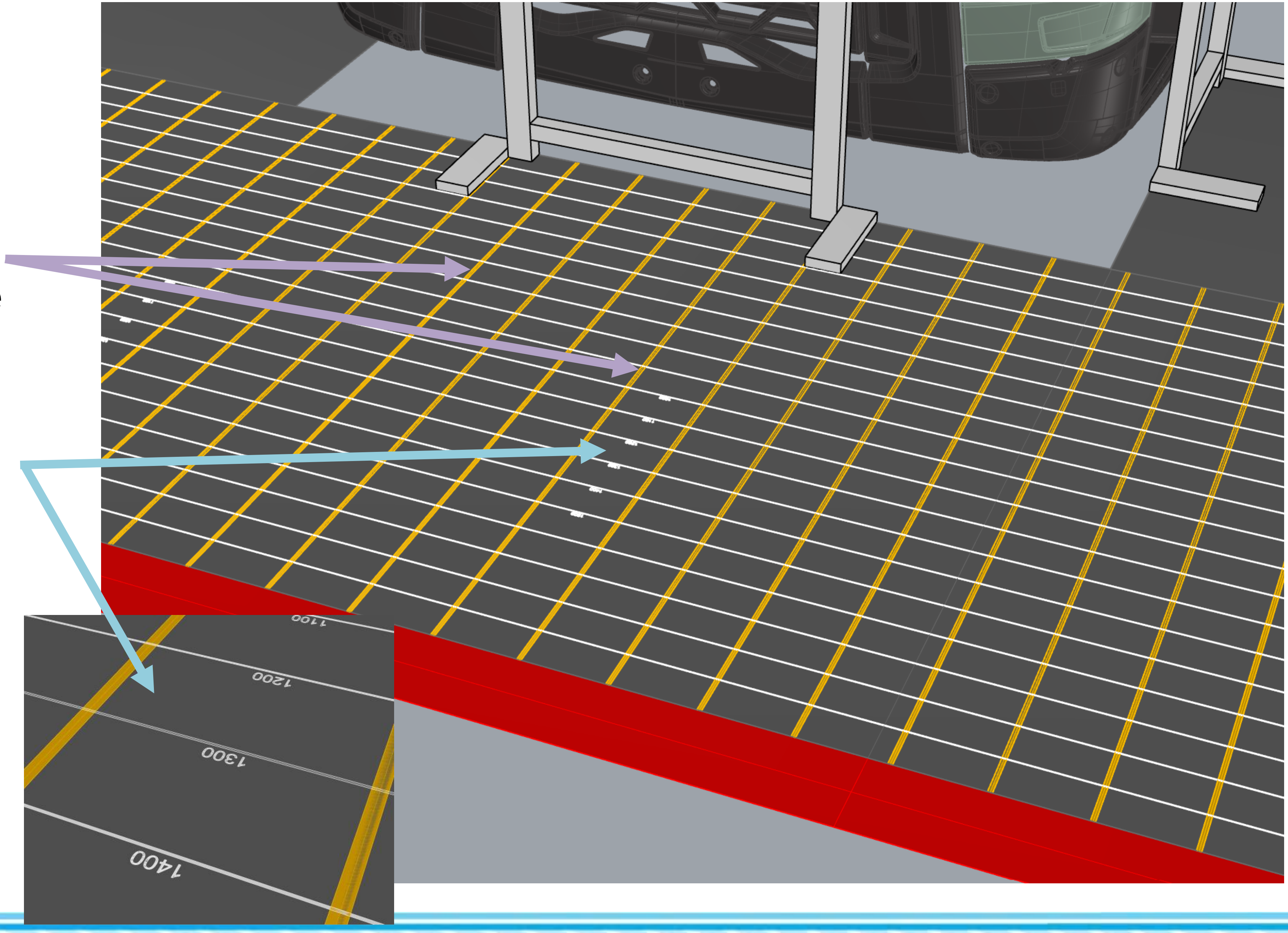
Three mats: front, left and right placed around vehicle



How will the real world test be performed?

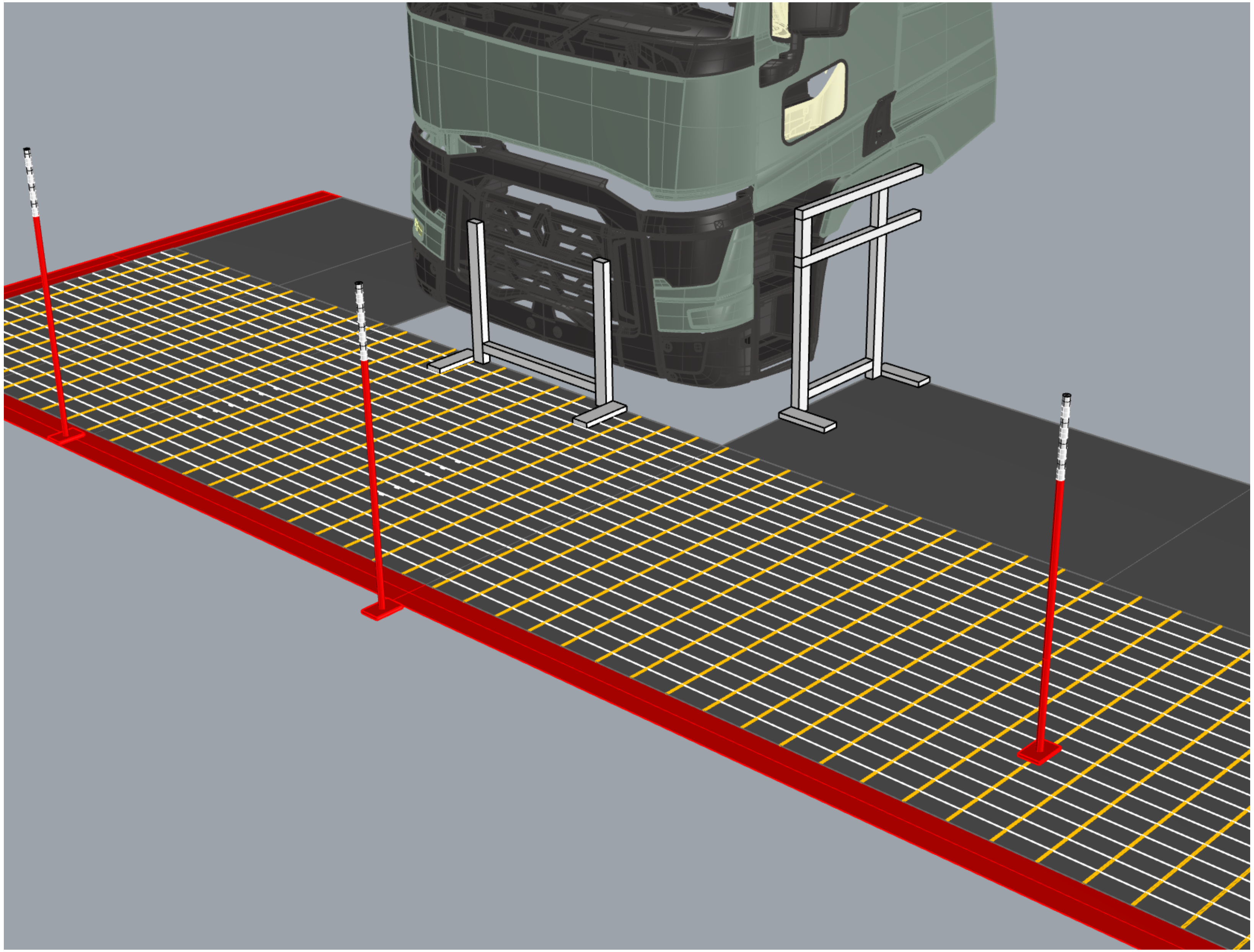
- Each mat is marked with a series of parallel marker lines to guide the measuring sticks

- For ease of measurement each marker line has a scale



How will the real world test be performed?

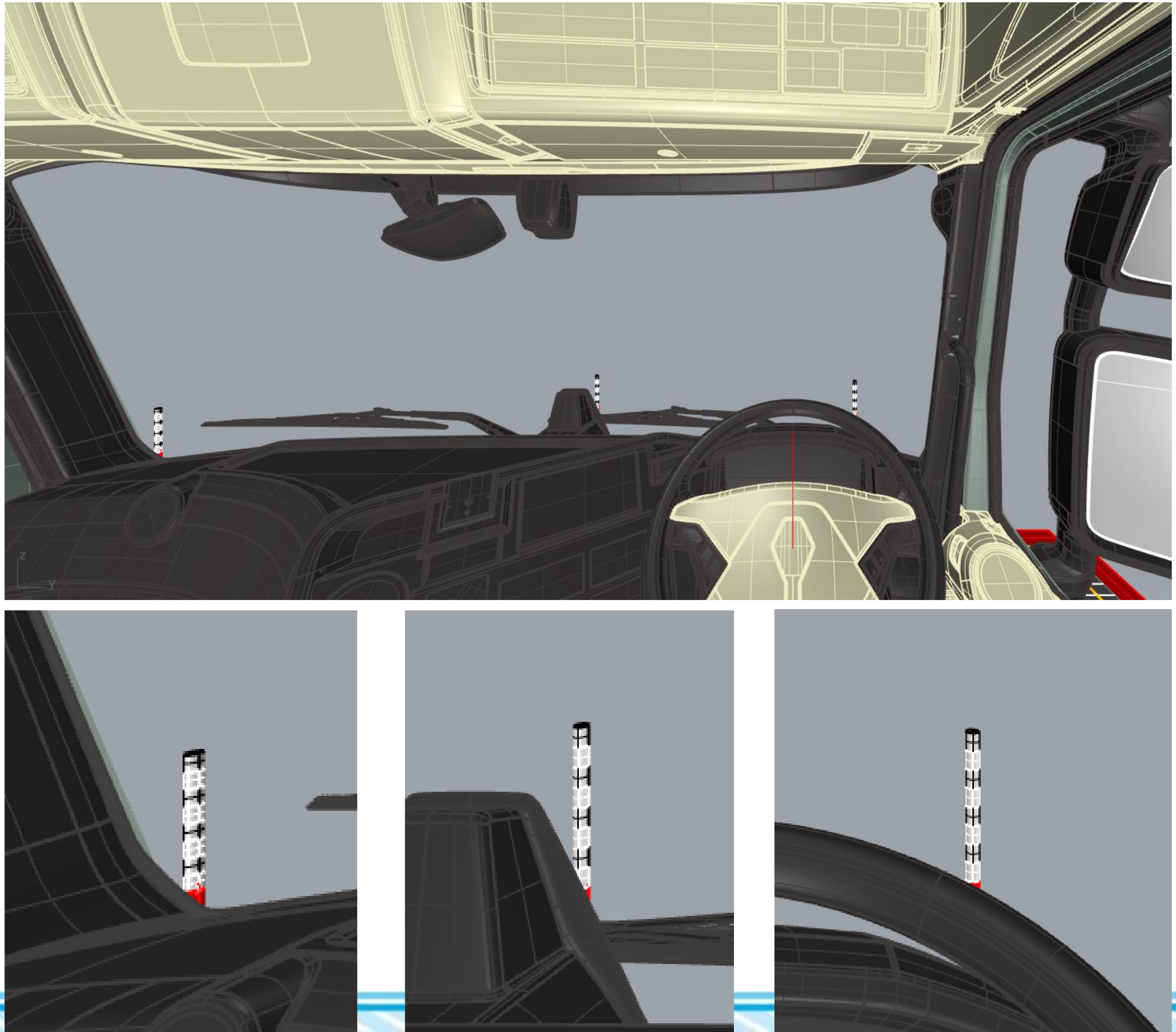
- Marker sticks used in two stages
- Place three sticks in predetermined extreme positions on each side
- Slide sticks along marker lines, away from the vehicle until top section is visible in the camera
- If all sticks are in the red zone, vehicle is zero star – no need for further analysis



How will the real world test be performed?

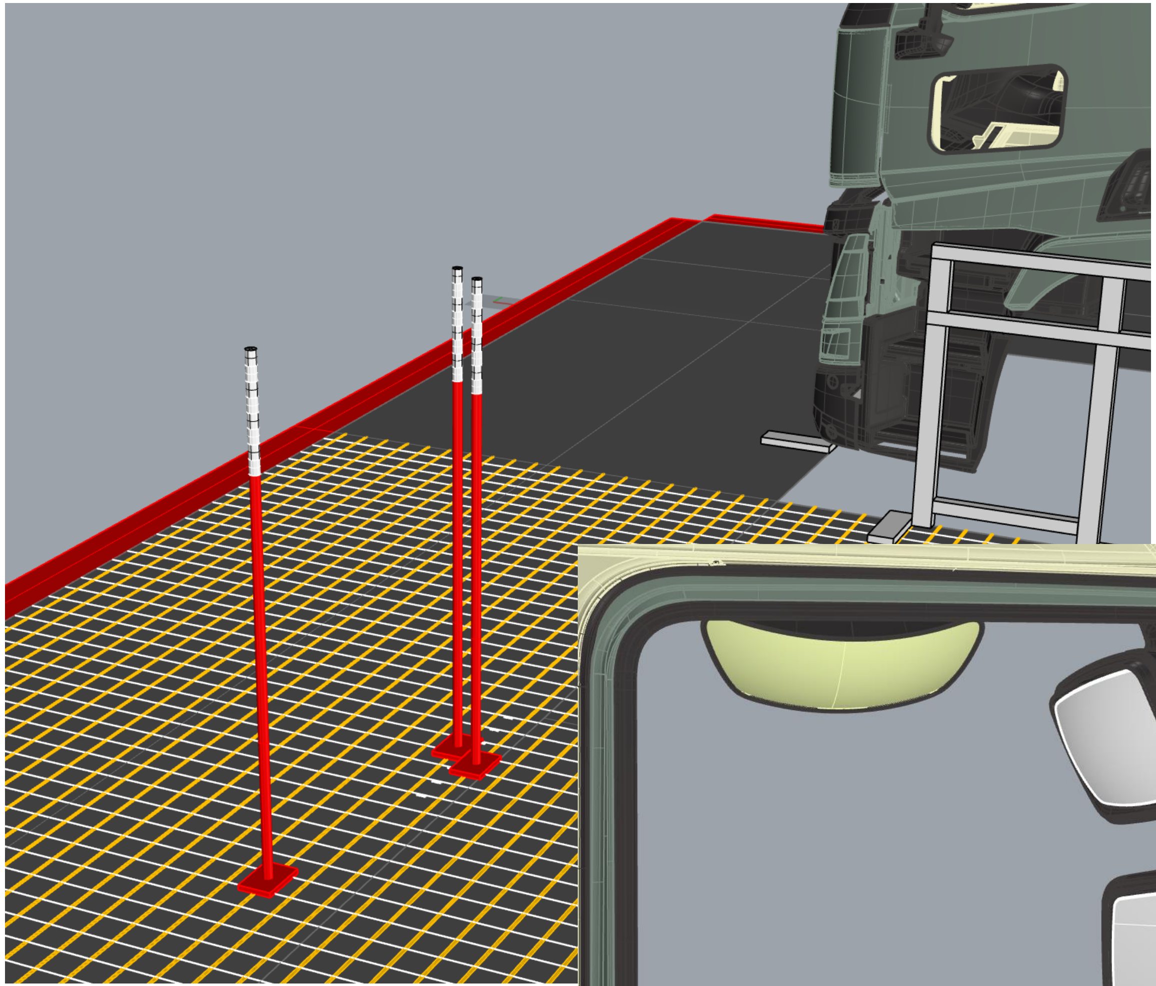
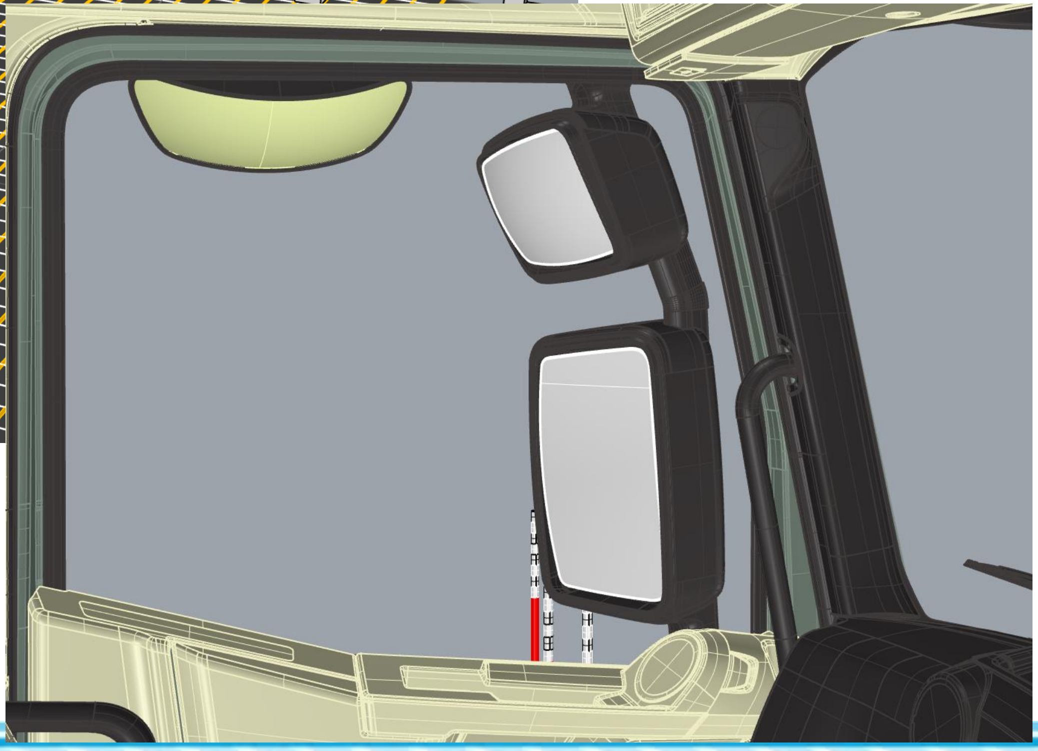
- Each stick is moved until 4 consecutive segments of the top eight segments are visible

- Unless partially obscured due to a wiper blade or mirror body, the bottom four segments take priority (i.e. must be seen)



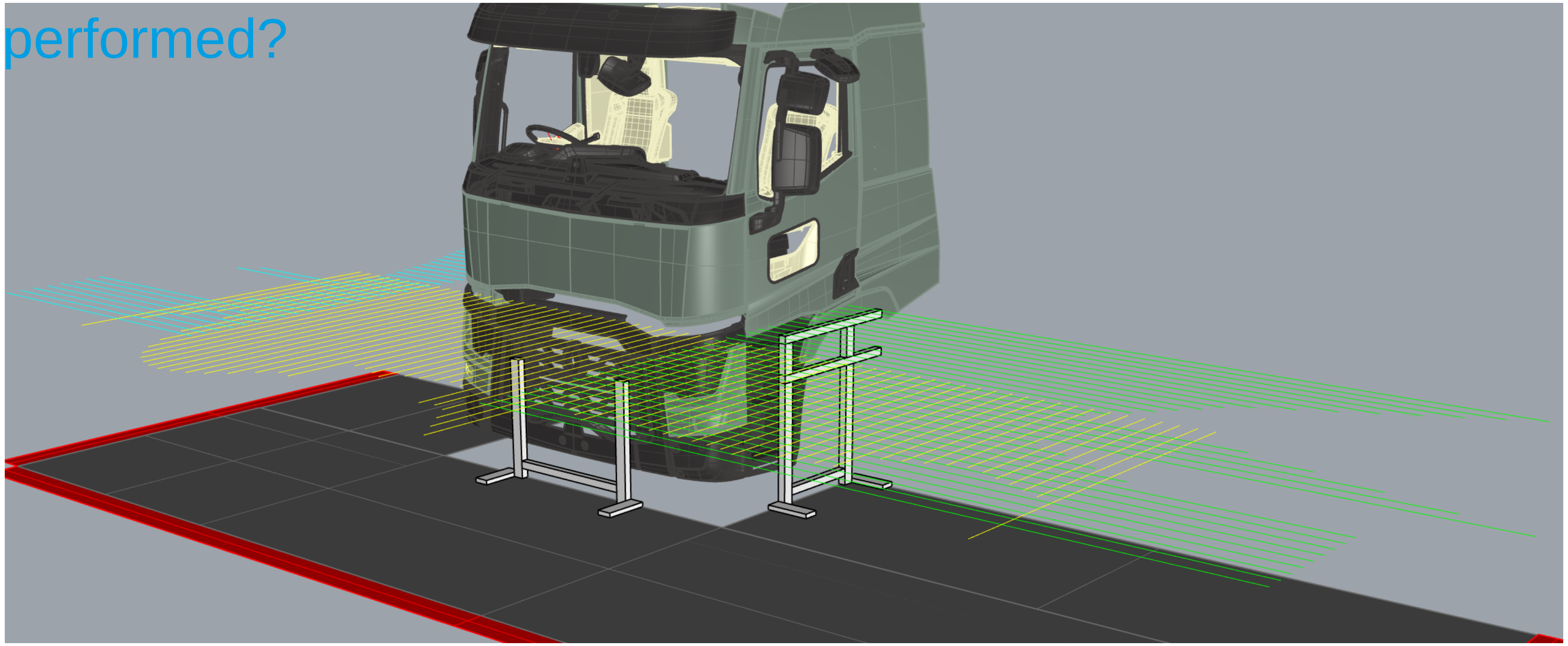
How will the real world test be performed?

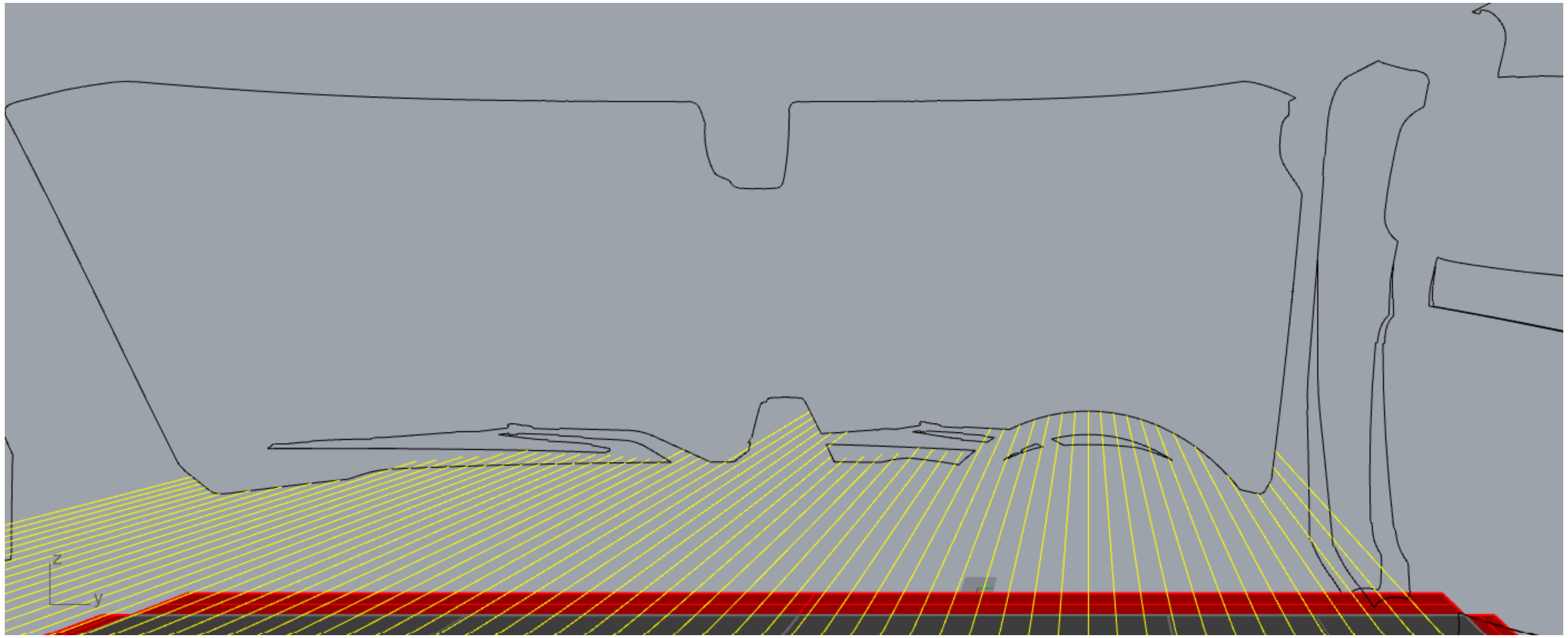
- If a second stage is required
- Each marker line must be assessed by moving sticks along it until the top section is visible and the distance recorded

How will the real world test be performed?

- The result is a form of visible area plot at the height of the shoulder point of the 5th %ile Italian female
- The average of the measurements provides a value that can be used to determine the rating of the vehicle





Summary

- We have defined a simple test method in CAD and virtual testing shows a good correlation with the TfL DVS scores

- This has validated the approach and we will soon be ready to pilot test the process with a sample of real trucks knowing that any inconsistencies will be easier to identify and account for

- We have built a physical rig to enable the eye point locations to consistently recreated

- This approach can distinguish between 1 star and zero star vehicles with ease and zero star vehicles can be identified in a short period with the defined test methodology

Next Steps

- Complete the analysis of the remaining vehicles in the digital version
- Commission the production of the floor mats and the assessment sticks
  - 3 required

- Attempt to test the new method and see how repeatable the results are a number of experimenters

- Produce a protocol for the test and the engineering drawings required for the rig production

Project information

Thank you for your attention, are there any questions?

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