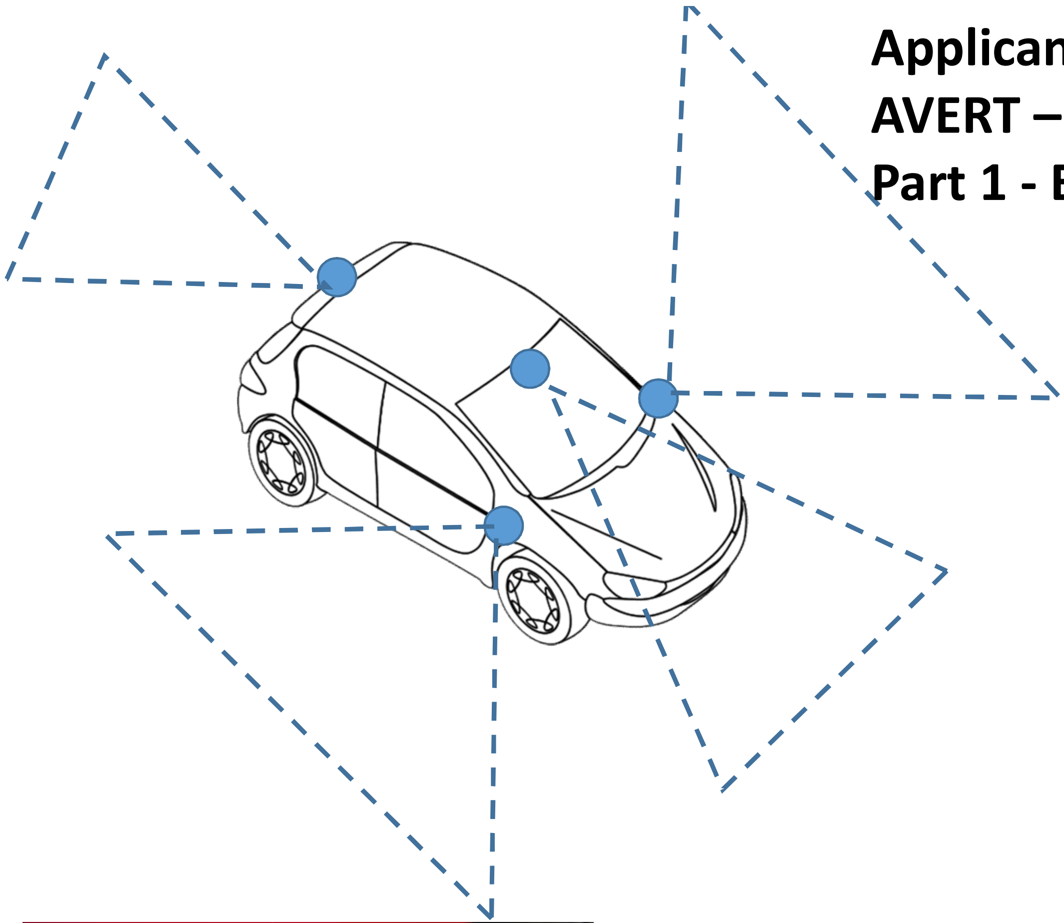
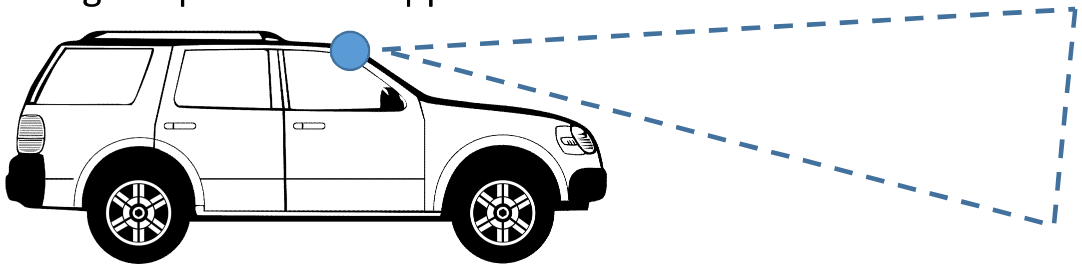
Applicant number 85193-530154
AVERT – Appendix A
Part 1 - Exploration of the problem this FS aims to address.



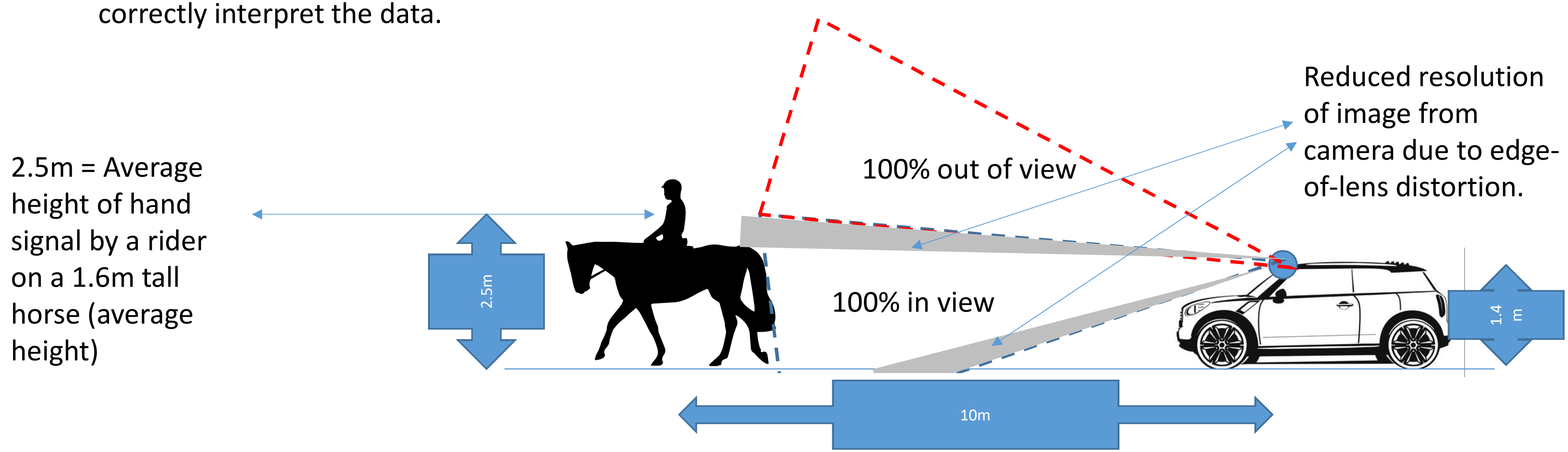
Pictured left – a typical camera layout used in camera-equipped vehicles. The blue dots represents a camera position, the triangle represents its approximate field of view.



Pictured above - Existing forward facing cameras are equipped with long focal length lenses, making close-by and high-angle image processing difficult.

Existing side-facing cameras are equipped with wide-angle lenses, reducing resolution and mounted low on the car to aid parking systems (see right) alongside ultrasonic sensors, near the wheel arch (see left), making them incapable of perceiving objects at high angles.

The focal height (i.e. its vertical range from bottom to top of picture) of front facing cameras means that, at distances below 10 metres, when a vehicle would typically begin its manoeuvre to pass an equestrian road user, the car is unable to perceive or appropriately react to any hand signals made by the equestrian road user. While the camera might see the horse, the edge-of-lens distortion may further reduce the systems ability to correctly interpret the data.



This problem does not exist with pedestrians and cyclists, who both interact with vehicles at a lower height, or road signs, with which the CAV interacts at a greater distance and are fixed in one location.

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This image demonstrated numerous additional problems we wish to investigate.

1) Systems may need to interact with horses on either side of a rural lane and still adjust behaviour to ensure safety. The British Horse Society recommends a 2m width and 15mph maximum speed for a passing manoeuvre. How can this be done on a road which does not allow that width?
2) Once outside the camera range of front and side facing cameras, as this horse is, how would the CAV know when to change behaviour if the horse reacts to the vehicle?
3) if ERU's hand signals are in light conditions in strong contrast to the vehicle perception systems (camera), will it still work? Horse riders are often head and shoulders above the hedge line on rural roads, increasing the likelihood that they might be exposed to sun when the vehicle is not, increasing the chance of glare and a reduced signal quality to the decision-making system.

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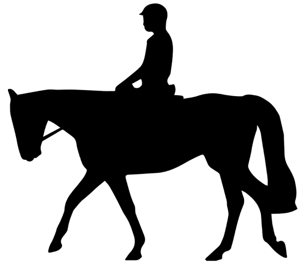
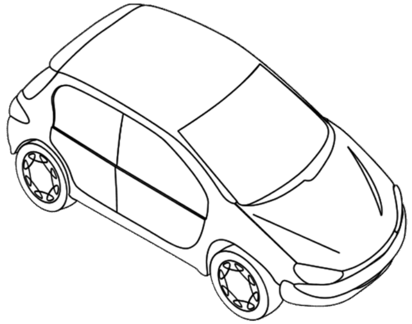
Part 2 - Exploration of the solutions this FS aims to explore.



1) How can CAV vehicles appropriately detect and interact with equestrian road users? This could include: camera systems, vision processing algorithms, sensor systems to detect carious horse types, uses and behaviour, method of interfacing with a human driver if system unable to cope.

Use of mapping data to alter behaviour, i.e. automatically restricting speed around known equestrian areas, such as those near bridleway/road junctions.

This is the greatest challenge and creates three further problems, which are explored in the 3 other themes of the FS.



2) How can wearable technology or other connected devices interact with vehicles or infrastructure to increase visibility and safety?

This could include smartphone apps, use of accelerometers to monitor horse behaviour, use of temporary geospatial data (i.e. GPS and a connection to grid) to record location of riders, novel uses of 5G connectivity, automatic recording and reporting of incidents based on telemetry data.

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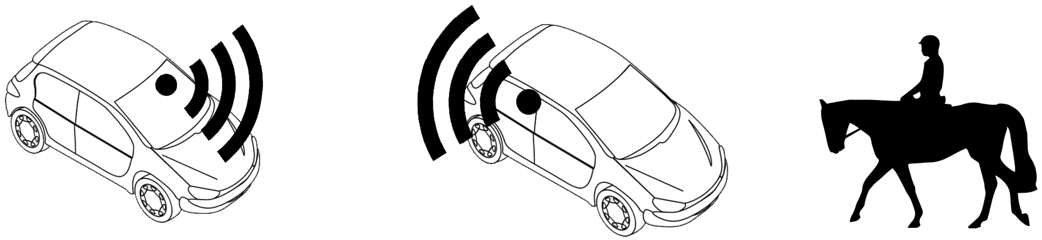

3) How can CAV with future AVERT technology interact with other non-CAV and infrastructure on the presence and safety around correctly detected ERUs? This could include communication protocols between vehicles, from vehicle to infrastructure, could data be misused or used to negatively affect vehicle behaviour, what is an appropriate signal from vehicle to driver, how is data sent to vehicles in rural / low use areas (i.e. how is data sent to infrastructure and relayed to later vehicles), and asking if this is the most cost effective route to increasing safety to ERUs?

4) How can any resulting technologies be tested? This may include investigation of physical and virtual testing models, recommendation or R&D of different approaches for each to improve safety to ERUs interacting with CAVs, but with a very beneficial added value of creating a completely new area of crash science for the UK. The UK is currently market leader in creation of ADAS testing devices such as cyclists and pedestrians on remote and robot platforms (top row) as well as training devices for riders (bottom right) and emergency services (bottom left) but only the Swedish Road Safety Institute provides an Animal test model, referred to as “Mooses III”, for the ‘elk test’ (see right), common in northern countries for physical impact testing only.