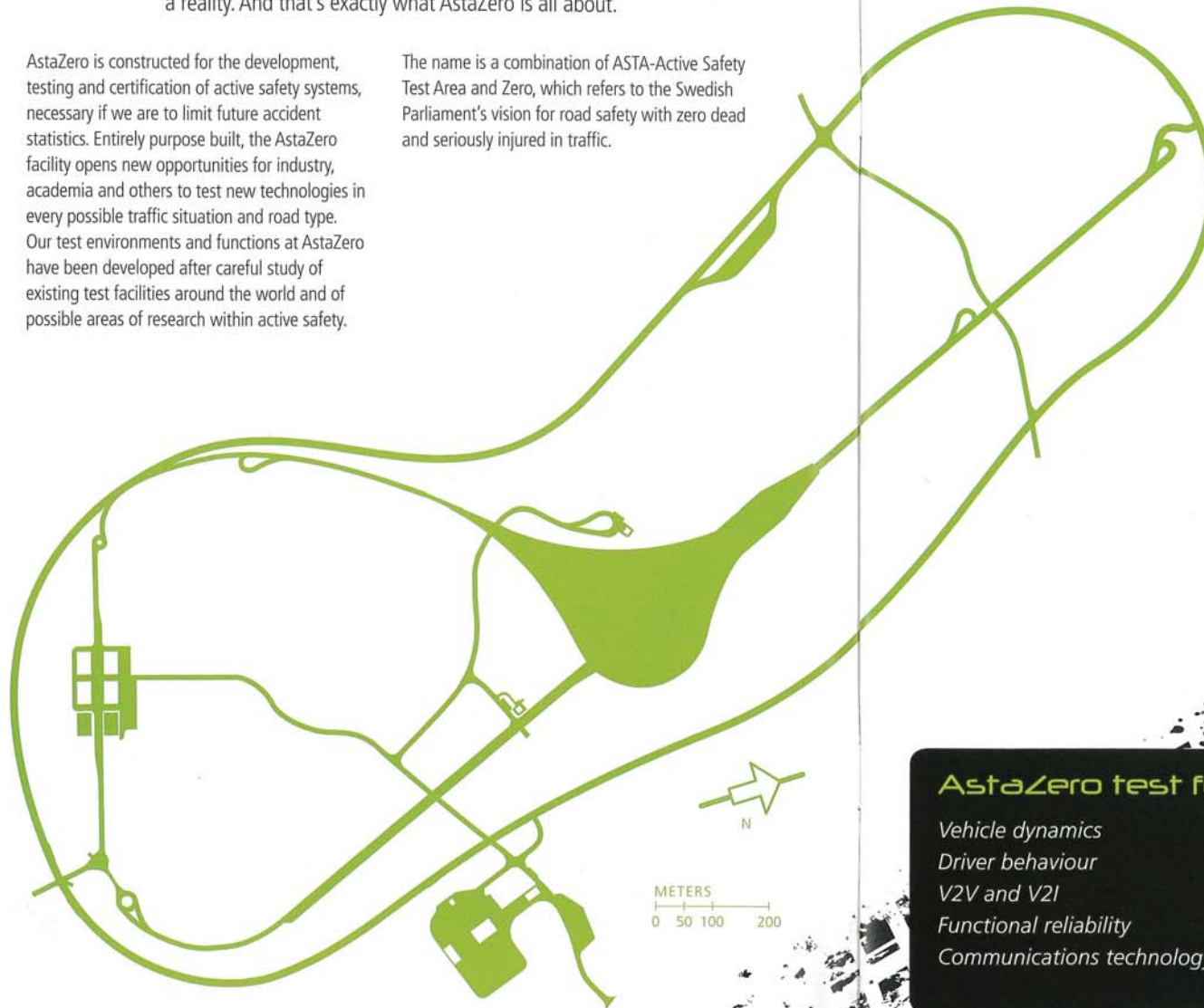


# At the heart of zero

Imagine a world free from traffic-related fatalities and serious injuries. It can happen. Continuous developments in active safety systems are helping to make this zero vision a reality. And that's exactly what AstaZero is all about.

AstaZero is constructed for the development, testing and certification of active safety systems, necessary if we are to limit future accident statistics. Entirely purpose built, the AstaZero facility opens new opportunities for industry, academia and others to test new technologies in every possible traffic situation and road type. Our test environments and functions at AstaZero have been developed after careful study of existing test facilities around the world and of possible areas of research within active safety.

The name is a combination of ASTA-Active Safety Test Area and Zero, which refers to the Swedish Parliament's vision for road safety with zero dead and seriously injured in traffic.



## AstaZero test focus

*Vehicle dynamics*  
*Driver behaviour*  
*V2V and V2I*  
*Functional reliability*  
*Communications technology*

## BASIC INFORMATION

### Core Services

- Unique environments to build any scenario in order to develop, test or certify new traffic safety solutions; making it possible to test literally all aspects of active safety in one place.
- Centre of Excellence in development of methods and test equipment.
- Proving Ground cooperation.
- Simulation of the entire facility to run pre-tests or for the early stages of research and development.
- Demonstration facility and assistance with product launches, conferences and corporate events.

### Complementary services

AstaZero will provide a range of services that clients may need during their stay, like:

- Hotel booking.
- Catering.
- Organisation of events.
- Shuttle traffic to and from the test site.
- Car rental.
- Shipments.
- Repairs.
- Loading and unloading client's materials.
- Special fuel purchasing.
- Weather information.



### Location

The AstaZero facility is located close to Gothenburg in the south western part of Sweden, where the climate allows all-year-round testing with warm summers and cold winters. The test site is only half an hour drive from Landvetter International Airport, and accessible by motorway.

# A part of a Swedish network

AstaZero is the result of a successful Swedish private-public collaboration. The unique involvement of governmental institutions, industry and academia is mainly due to the fact that Sweden is a world leader in many areas of road safety, and that considerable expertise has been developed by the automotive industry, their subcontractors and related research institutions. This strong national focus on traffic safety aspects has resulted in a major interest in further development of the new area of active safety.

An important part of the successful Swedish road safety work has been the development of intelligent transport systems, ITS. The Swedish Transport Administration conducts research and development in the field of ITS in collaboration with the automotive industry, academia and other stakeholders in the transport sector. Together they create cross-border solutions for monitoring, control and information. Solutions that cannot just be used in Sweden, but which are also available for international distribution.

### Several collaborations promoting traffic safety

An example of such cross-border cooperation is IVSS, where the Swedish Transport Administration, together with the automotive industry and the state-owned company Vinnova, is working to develop active systems to prevent accidents with different types of security inside and outside the vehicle. Focus areas are active safety, loss prevention solutions, development of handling and crashworthiness of passenger and commercial vehicles and the development of intelligent vehicles and traffic systems.

Another example of collaboration is the Vehicle Strategic Research and Innovation Program, (FFI), a partnership between government and the automotive industry to jointly fund research,

innovation and development activities focusing on Climate, Environment and Security. It has come about because development in road transportation and the Swedish automotive industry in general has a significant impact on the Swedish economy.

### A testbed to foster further development

AstaZero enables further collaborations to be pursued, where almost any conceivable kind of test is possible, whether to examine the functions of, for example, auto-nomous or connected vehicles, platooning or driver behaviour.

My belief is that this will not only strengthen the level of expertise within the Swedish vehicle cluster, but also be a major benefit for its European and international counterparts.



**Pether Wallin**, CEO AstaZero  
pether.wallin@astazero.com





# Offer

AstaZero guarantee a world-class Proving Ground; offer a range of services that will lead to great customer satisfaction and a customer interface that is characterized by highest levels of service, efficiency and professionalism. The test site has been specified to meet industrial needs, and at the test site, customers individual challenges and their solutions are the focus of the entire operation.

## Proving Ground offer

AstaZero always adapt its offer based on the varying customer needs. Customers choose if they want their tests to be carried out in secret or not, and if they want to rent the entire facility or just one or a few of the different track sections:

- Simply hire the test site or parts/part of facility.
- Hire the test site and available expertise (different options depending on requirements).
- Hire the test site, expertise and subsequent execution of test analysis.

## Technician offer

Research engineers and other technicians employed by AstaZero are available to provide support and assistance during testing and development work and participate in research projects by:

- Developing and contributing tests and testing methods and measurement equipment.
- Developing and maintaining equipment, devices and aids.
- Functioning as a resource for customer company's development and test projects.
- Contribute to the design/development and creation of prototypes for different functions as assigned by customers.

## Open environment

AstaZeros open environment means that anyone is welcome to test different scenarios and functions at the facility. In addition to the opportunities for testing, research and development, AstaZero also host demonstrations and assist with product launches, conferences and corporate events.

## Under constant development

AstaZero is under constant development in order to provide a most comprehensive range of testing and research environments involving active safety.

The test site will always be possible to develop in order to constantly be at the forefront of development, maintaining its unique customer offering. One part of this unique offer is to continuously give customers the opportunity to influence the facility's design for their individual requirements.

### BOOKINGS AND RFQ

For RFQ or booking inquiries, please contact Minna Lehtonen; phonenumber +46 (0) 70 670 6145 or email address [minna.lehtonen@astazero.com](mailto:minna.lehtonen@astazero.com)



## GENERAL DESIGN

### All paved surfaces are designed for:

- 60 tons maximum vehicle weight.  
(tonne if 1000 kg = 1 tonne)
- 12 tons axle load.  
(tonne if 1000 kg = 1 tonne)
- Maximum vehicle length of 25.25 meters.



### All internal roads are designed for:

- Bi-directional traffic.
- Right-hand traffic.
- Road width of 7 meters.

### Areas for calibration:

- 3 by 15 meters.
- Made out of concrete.
- Flatness better than 0.1 degrees in all directions.

### Roadside infrastructure:

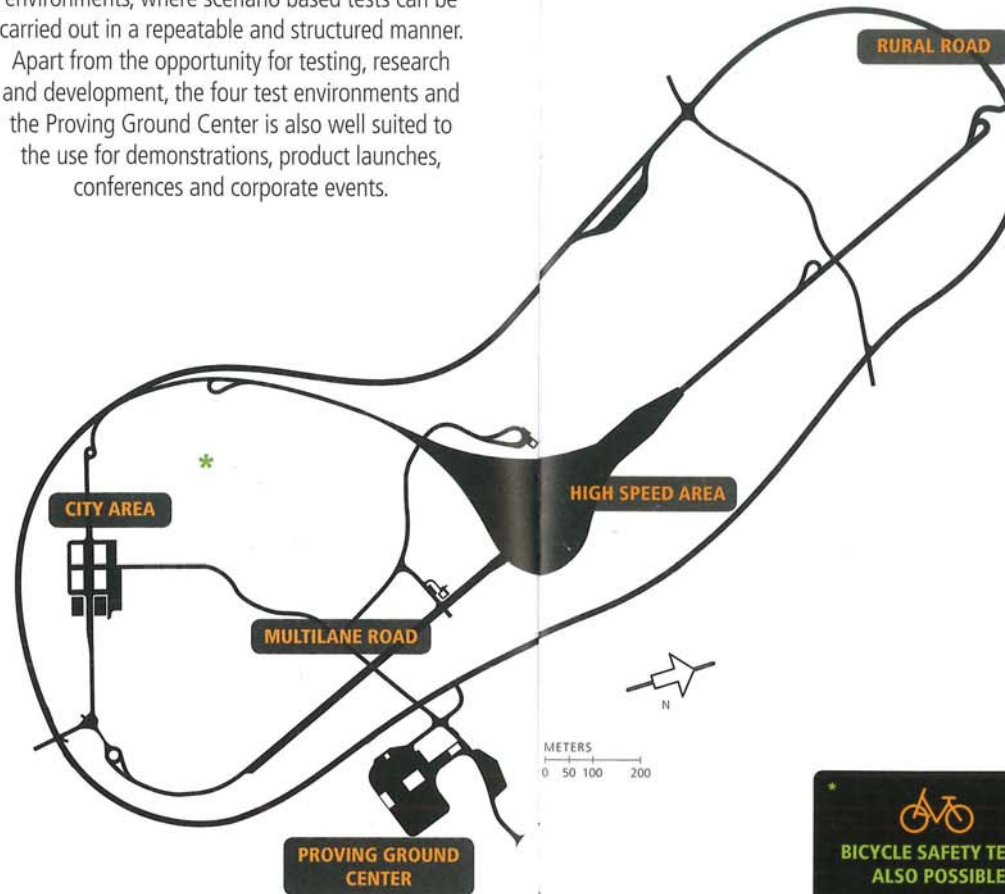
- Conduit for electric power, fibre and communication/control. Installed along the full length of the accelerations roads, the Multilane Road and the Rural Road.
- Access points every 150 meters.
- Underpasses to the remote side at each access point.
- V2V and V2I.
- Conduit to appropriate control rooms for future installations.

### Differential GPS:

- Base station which covers the whole area.
- Target – Hunter systems with Real Time Kinematic (RTK).
- Video system synchronized to position.

# The test site

The AstaZero facility consists of four test environments, where scenario based tests can be carried out in a repeatable and structured manner. Apart from the opportunity for testing, research and development, the four test environments and the Proving Ground Center is also well suited to the use for demonstrations, product launches, conferences and corporate events.



  
**BICYCLE SAFETY TESTS ALSO POSSIBLE**  
Cyclists are a growing group of road users, and injuries among them are on the increase. AstaZero has therefore created a straight 400 meter section so that it is also possible to conduct bicycle safety projects at the test site.

## GENERAL DESIGN

### Dummies:

- Pedestrians.
- Balloon cars.
- Animals.
- Material to make new targets.
- Remote control of balloon cars and test vehicles.



### Garages

- Garages for passenger cars, 6x8 meters.
- Garages for trucks, 7,2x25 meters.
- Garages at control rooms, 5,8x10 meters.

### Communication resources:

- Wi-Fi coverage for the area.
- High-speed Internet connection in all control rooms and garages.
- Mobile phone coverage in the area.
- Video conferences.
- V2V and V2I – installation prepared.

### Communications technology (V2V and V2I)

An important aspect of active safety is based on new and advanced technologies which allows vehicles to communicate with each other (V2V) and with their surrounding environment (V2I). At the AstaZero facility, customers will be able to test the very latest in communications technology.

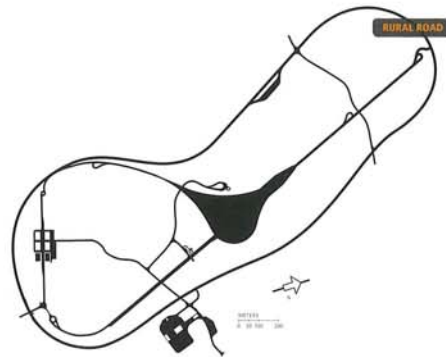




### FEATURES

- Normal road standard/safety.
- NOT for advanced driving.
- Slightly hilly, max 4.5 % incline.
- For Bi-directional traffic.
- Normal setup = right-hand traffic and one-way traffic.
- Foundation for traffic signs.
- Hidden access to public roads.
- Traffic signs showing:
  - Distance.
  - Name of the place.
  - Curve radius.
- Electronically controlled signs, 4 pcs.
- Prepared places for testing with different targets like pedestrians, cyclists, crossing vehicles, bus stops etc.

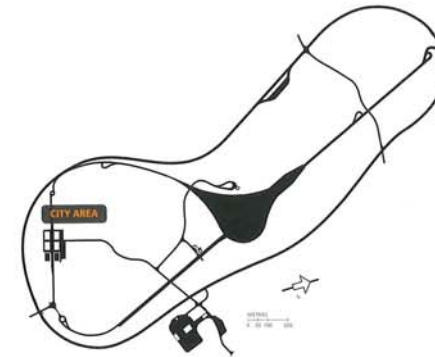
A rural environment with focus on testing human reactions and behavior. This area includes hidden obstacles, such as wild animals, slip roads and highways.



### FEATURES

A city environment where interactions with dummy pedestrians, cyclists, buses and other road users can be carried out. It includes varying street widths and lanes, bus stops, pavements, street lightning, building backdrops. The road system includes roundabouts, a T-junction, a return loop and a lab area.

- Each Block 40 by 25 meters, approx. 4 meters high. Streets have a 2.0% incline for good drainage into sewage drains.
- Acceleration roads, longer than 150 meters before the intersection.
- Lab area approx. 100 by 30 meters.
- Loading dock for trucks; 10 by 1.5 meters.
- Main street equipped with "Portals" with traffic signs.
- Pavements, bike lanes and lane markings.
- Crossing street, 7 meters wide plus pavements.
- Pedestrian crossing with signs.
- Prepared foundations for additional traffic signs.
- Outlets to charge electric vehicles and batteries.
- Simple garage for weather protection.
- Equipment to generate various scenarios.
- Refuge, traffic signs, curbs and traffic lights.
- Platform for visitors.



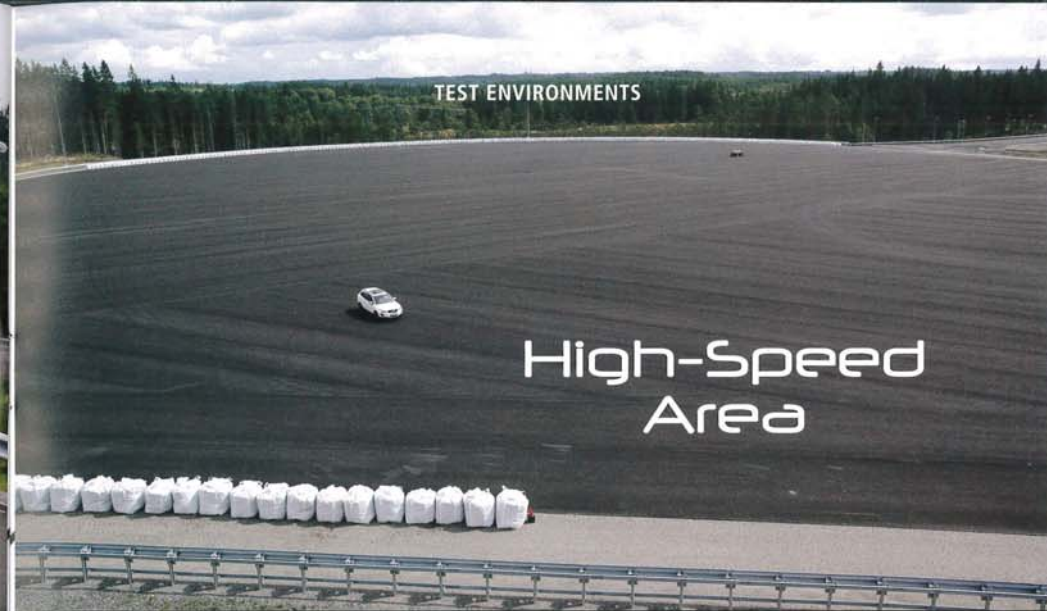
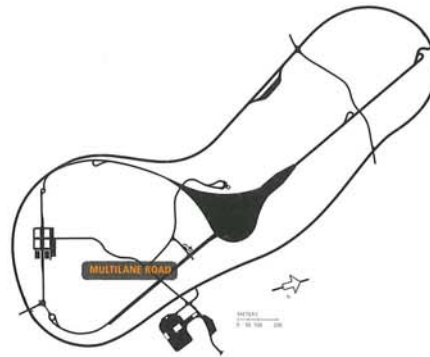




### FEATURES

- Four lanes with space for barriers.
- Acceleration road approx. 300 meters long, 7 meters wide with turning loop for long vehicles.
- 2 % lateral incline for good drainage, split between lane 1 and 2.
- Small intersection.
- "Portal" with road signs.
- Separate control tower.
  - Two stories high for good visibility.
  - Platform on the roof for visitors and prepared space for 100 spectators.
- Parking space with outlets to charge electric vehicles and batteries.
- Warehouse for equipment like traffic signs and cones.
- Remote control of targets, balloon cars and driving robots.

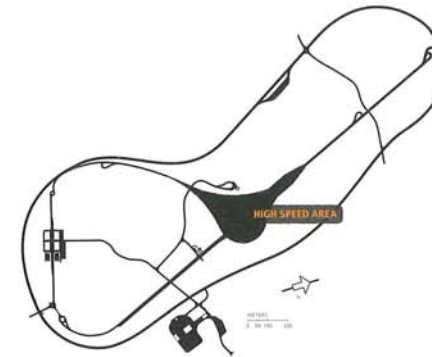
A multi-lane road system that focuses on collision scenarios such as lane changes and crossings. The vehicle dynamics, communications technology and functional reliability are tested in this area. It is possible to build temporary barrier railings and signal and boom systems within this area.



### FEATURES

High Speed testing is performed in this area. Avoidance maneuvers can be performed at a speed of 250 km/h. Communications Technologies, vehicle dynamics and functional reliability testing will be performed. To achieve rational testing, the High Speed Area will also have a return road.

- Slopes 1% laterally.
- Completely flat in the longitudinal direction, (flatness 1.0 acc. to IRI).
- Asphalt acc. to SN75-80.
- Basic illumination.
- Rigid fences around the whole area with cushions in front.
- Turning loop for long vehicles (25,25 m) at the end and halfway with a width of 7 meters.
- Separate control tower.
  - Two stories high for good visibility.
  - Platform on the roof for visitors and prepared space for 100 spectators.
- Parking space with outlets to charge electric vehicles and batteries.
- Space for 10 cars plus one bus.
- Warehouse for equipment, traffic signs and cones.
- Remote control of targets, balloon cars and driving robots.
- Calibration area at the first turning loop (for gyros).
- Conduit along the acceleration roads (for future needs).



For more information about the test environments, please visit the AstaZero homepage at [www.astazero.com](http://www.astazero.com)

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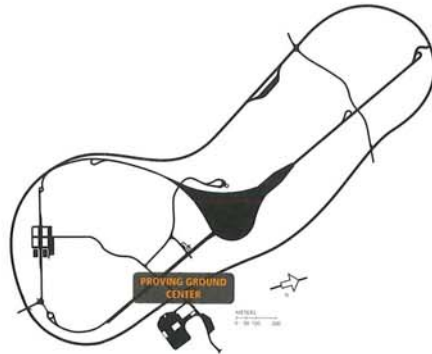
# Proving Ground Center



## FEATURES

- Garages for 10 cars (5 with lifts)
- Garages for 2 long vehicles, 25,25 m long
- Overhead crane for loading, capacity 2-3 tons
- Fuel depot
- Car wash
- Calibration surface (for gyros)

AstaZero's Proving Ground Center consists of several elements, including a guarded reception, a visitor's center, conference rooms, traffic control and separate working areas for visiting personnel.



## FEATURES

### Development Center

AstaZero is committed to being at the forefront of active safety – and at the heart of zero. Our Development Center includes well-equipped research facilities, office space and conference rooms to help lead the way.

### Garage facility

Our garage is an advanced, purposely designed facility for indoor testing, calibration work, car washing, fuelling and overhaul services. It also offers separate restricted access areas, offering privacy for each team, as well as for suppliers.

Only authorized personnel and users with an AstaZero security pass will be able to access the specific, designated area.

- Up to 4 separate test teams can work at the same time in complete privacy
- Suppliers and manufacturers collaborating on a project each have their own private and restricted access area to work from
- All garage facility users and visitors must first check in at the security entrance
- AstaZero does not monitor, gather or store any data unless the customer explicitly asks for the service







## Research and development

Research carried out in recent years has brought about great technological progress in the field of active safety. Some of the basic functions of active safety systems, such as autonomous emergency braking, are already being installed in new car models.

Several new autonomous functions are set to be developed in the next few years. Semi-autonomous driving with, for example, vehicle platoons is predicted to be just 5-10 years away from large-scale introduction.

Designing an active safety system to be in use for at least 10 years is a difficult task, and one of the main challenges is to make sure that we will be able to handle increasingly intelligent traffic systems in a holistic manner. Collaboration between academia and industry is therefore vital as there is a tendency for the challenge to be viewed from different perspectives.

While OEMs primarily focus on how to develop smarter in-car systems, academia tries to focus not only on vehicular systems but also on other traffic participants and integrated traffic management in general. These perspectives - how to equip vehicles (cars, trucks, buses etc.) and road users (cyclists, motorcyclists, pedestrians, the elderly etc.), and how mobility management in general affects active safety - are equally important and necessary if we are to enhance traffic safety in the future.

### NUMEROUS RESEARCH AREAS

Academia and industry have identified several areas of research that are essential if active safety systems are to be reliable at all stages throughout the lifetime of a vehicle. New research areas are continuously being identified, so the small number of areas described here are only to be regarded as examples, indicating rather than establishing what kind of research and tests might be conducted at AstaZero in the future. In this context it is important to stress that AstaZero as an organisation will not be performing this kind of research and development, but that the facility itself will enable research and development in all possible areas related to active safety.

As what AstaZero offers will always be adapted to customer needs, it is the industry and the academy in general that will define what areas will be most important at any given time.

## Some areas of possible interest

### AUTONOMOUS DRIVING

Autonomous driving could be described as active safety in its most advanced form. It will be accomplished when and if technology allows vehicles to be completely self-operating, independent of any input at all from the driver. In reality this requires vehicles to have driving capabilities comparable to those of an experienced human driver with the addition of being able to handle critical traffic situations reliably and that the systems are meticulously tested. There is a clear trend among prototype developers to create technology for self-driving vehicles, but an enormous amount of research and development is still required if the systems are to be sufficiently safe and reliable throughout a vehicle's lifetime.

### COMMUNICATION SYSTEMS (SATELLITE GPS, V2X)

Intelligent communications systems can be used to realize better active safety systems. The basis of these new systems is that they will make it possible both for vehicles to communicate with other vehicles and for vehicles and infrastructure to communicate with each other (V2V and V2I). Precise localisation with international satellite navigation systems such as the US GPS, Russian GLONASS and the forthcoming European Galileo in combination with communication capabilities can enable interconnected protective systems. Highly accurate positioning of test vehicles (initially via GPS and differential GPS) is required as reference on test-tracks in order to test and develop this technology.

### PROTECTION OF VULNERABLE ROAD USERS

Road users without vehicles such as pedestrians, cyclists and light moped riders are the most vulnerable to traffic accidents. As vulnerable road users account for a large proportion of global road traffic deaths, developing

safety systems to increase their protection is paramount. This is a complex area that relates to everything from integrated traffic management systems to how we can develop and improve warning systems that alert these road users. Hybrid buses, for example, are very quiet compared with normal car engines and can therefore be difficult to detect, not least for the blind. As people in traffic are trained to use their ears to detect danger, it might sometimes be necessary to create artificial noise for silent vehicles.

### DEVELOPMENT OF TEST TARGETS AND EQUIPMENT

Test targets for active safety need to be equipped with camera and vehicle to x-communication since they will be part of an interconnected system. For example, it must be possible to mount these targets on flat carriers and to link and connect them with GPS and localisation systems. They can thus be programmed for predefined trajectories. In turn it must be possible to equip the carriers with cameras in order to analyse nearby test collisions. Several different embodiments of test targets will be required, target vehicles with metallic surfaces of different vehicle sizes for example, and test targets for bicycles, motorcycles and pedestrians (children and adults).

### TEST METHODS FOR FALSE POSITIVES (FALSE ALARMS)

Together with researchers, AstaZero aims to build a catalogue of methods for how to provoke false positives in order to test the robustness of active safety systems, confirming whether the algorithm is safe and reliable enough. Here methodology needs to be suitable for the actual test performed as, for example, camera-based and radar-based systems have different characteristics of false positives.

### CREATION OF TEST SCENARIOS

Advanced tests require careful pre-planning in order to ascertain the

correct scenarios. Although some tests at the AstaZero facility can be standardised, most tests will probably need to be conducted first in an AstaZero 3D virtual environment. It is only then that the researchers will know which scenarios are most critical, and will then be able to focus more specifically on them. This is also a good way to guarantee the quality of the test, ensuring that the time spent at the test site is not wasted by selecting the wrong test scenarios or even technical problems, which can be ruled out with proper test preparation based on simulations.

### DRIVER BEHAVIOUR

Human factors such as distractions or tiredness are the main reason behind most traffic accidents. Modern cars will therefore increasingly have electric controls, including warnings that alert the driver to the risk of an accident situation. Advanced systems are under development that detect whether the driver is dozing off, stressed or under the influence of alcohol. When developing these systems, account must be taken of the fact that people react differently to specific situations, and extensive research and testing is therefore necessary to develop driver models that produce reliable systems.

### NEW POWERTRAINS

The introduction of electric vehicles has brought with it some new risks that have to be tested, not least for new active safety functions. Apart from the more common problem of how to store batteries in the car with respect to centre of gravity and weight, there are also several aspects related to how to heat vehicles sustainably. Furthermore, safety also has to be guaranteed for electrification in an accident situation, for instance due to a voltage drop or where there is an electric shock or a fire. It is important to test whether, and the extent to which, the safety systems still work if they are involved in an accident.



## Test Safety

All customers and test drivers must receive an introduction and undergo safety training before the test site is used. In certain studies involving complex traffic situations and at high-speeds robots will operate the test vehicles.

AstaZero also offers a simulation of the whole site, where tests can be pre-run in a virtual environment before real life testing begins. The Swedish National Road and Transport Research Institute (VTI) has developed the simulation system.

The traffic control centre at the test site has a precise overview of the position of different test vehicles around the site and can abort a test if necessary.

Apart from the central control station, the AstaZero test site has two control towers as well as several control rooms adjacent to the different environments. In addition to technical equipment like remote control of gates, traffic lights, targets, balloon cars and driving robots, all control rooms also include working space for two operators, a conference table for 6 - 10 persons, communication equipment with individual frequency, kitchenette for simple refreshments and bathrooms.

## A step towards zero traffic fatalities

AstaZero is constructed for the development, testing and certification of active safety systems, necessary if we are to limit future accident statistics.

### Bookings and RFQ

For RFQ or booking inquiries, please contact **Minna Lehtonen**;  
phonenumber +46 (0) 70 670 6145  
email address [minna.lehtonen@astazero.com](mailto:minna.lehtonen@astazero.com)