POLYGON

DEWESoft®

SOFTWARE USER MANUAL

MODULE V23-2

1. Table of contents

2. About this document

This is the users manual for Polygon module.

2.1. Legend

The following symbols and formats will be used throughout the document.

Important
It gives you important information about the subject.
Please read carefully!

Hint
It gives you a hint or provides additional information about a subject.

Example
Gives you an example of a specific subject.

2.2. Features

- Platform for all kinds of vehicle dynamic and other moving objects tests
- Supports multiple vehicles and other moving and/or static objects
- 3D visualization with easy adaptable viewing angle
- Freely definable outputs
- Easily performed 2D calculations

3. Installation

Polygon works as a DewesoftX plugin. Plugin is included in the installer, but if you don't have it, this is how you install the plugin. To install it, please copy Polygon.dll, to the Addons folder of DewesoftX. When this is done, the Polygon plugin will appear in the Extensions plugin list. Enable it and the polygon icon will appear in Channel setup.

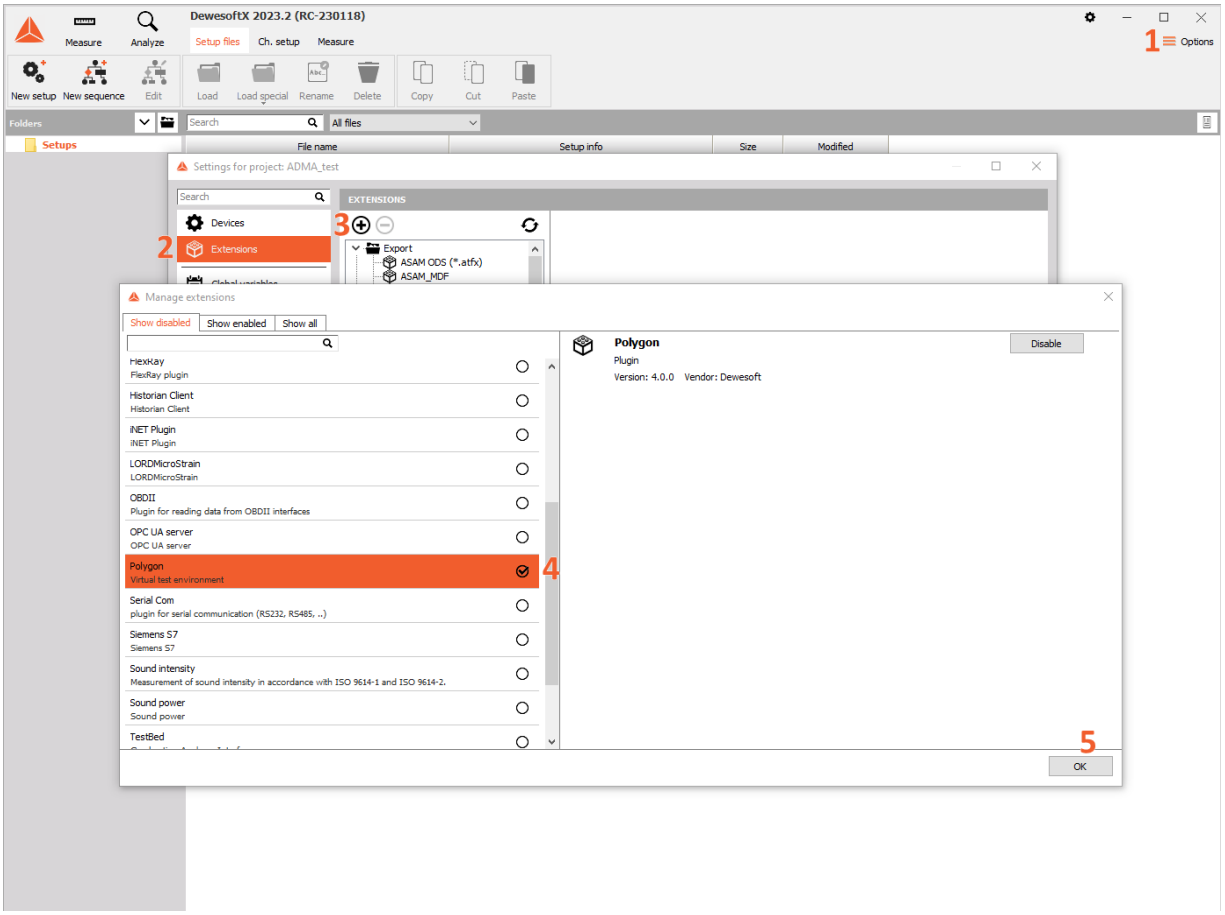


Image 1: Enabling of Polygon plugin

4. Introduction

Polygon module in Dewesoft is a tool for transforming the geodetic position (GNSS position) into a local coordinate system and for simplifying the calculations between objects with different 2D geometries. This becomes helpful for various applications such as:

ADAS testing - calculate the distances between vehicles, pedestrians, static or dynamic objects etc.

Validation - calibration of different devices where the distances are important

Geofencing - monitoring and validate the referenced area

Vehicle dynamics testing - hitting cones, going over lines, calculating the parameters of lane changing etc.

Pass by noise - measuring the distance between start and end position and the lateral distance to microphones

Brake test - distance measuring and lateral deviation of vehicle

The geometries in Polygon are defined by the user and aren't specifically predefined. With this possibility, every object can be defined more accurately in the virtual environment. Objects are made from simple geometries such as points, arcs,lines, polygons. Various distance calculations are available and also Time to collision (TTC) calculation defined by Euro NCAP is added.

All of the calculations in Polygon are made in the local XY coordinate system, also all of the objects defined in Polygon have a SAE coordinate system. The local XY coordinate system is defined by the local plane and the center of the plane is defined by GNSS position. Orientation of the coordinate system is defined with the X axis which is represented by a GNSS heading. The Y axis is perpendicular to the X axis.

When defining the local plane there are two options, static local plane or dynamic. When measurements are done on the local test track, the static local plane should be used. But when all of the objects are defined with GNSS position, the dynamic local plane can be used and it will move around with the measured objects.

5. Setup

The setup screen of Polygon is split in 2 panels. The left panel is the setup of the module and on the right side there is a visualization window. Setup panel has three tabs where different parts (Objects, Origin Calculations) of the setup are edited.

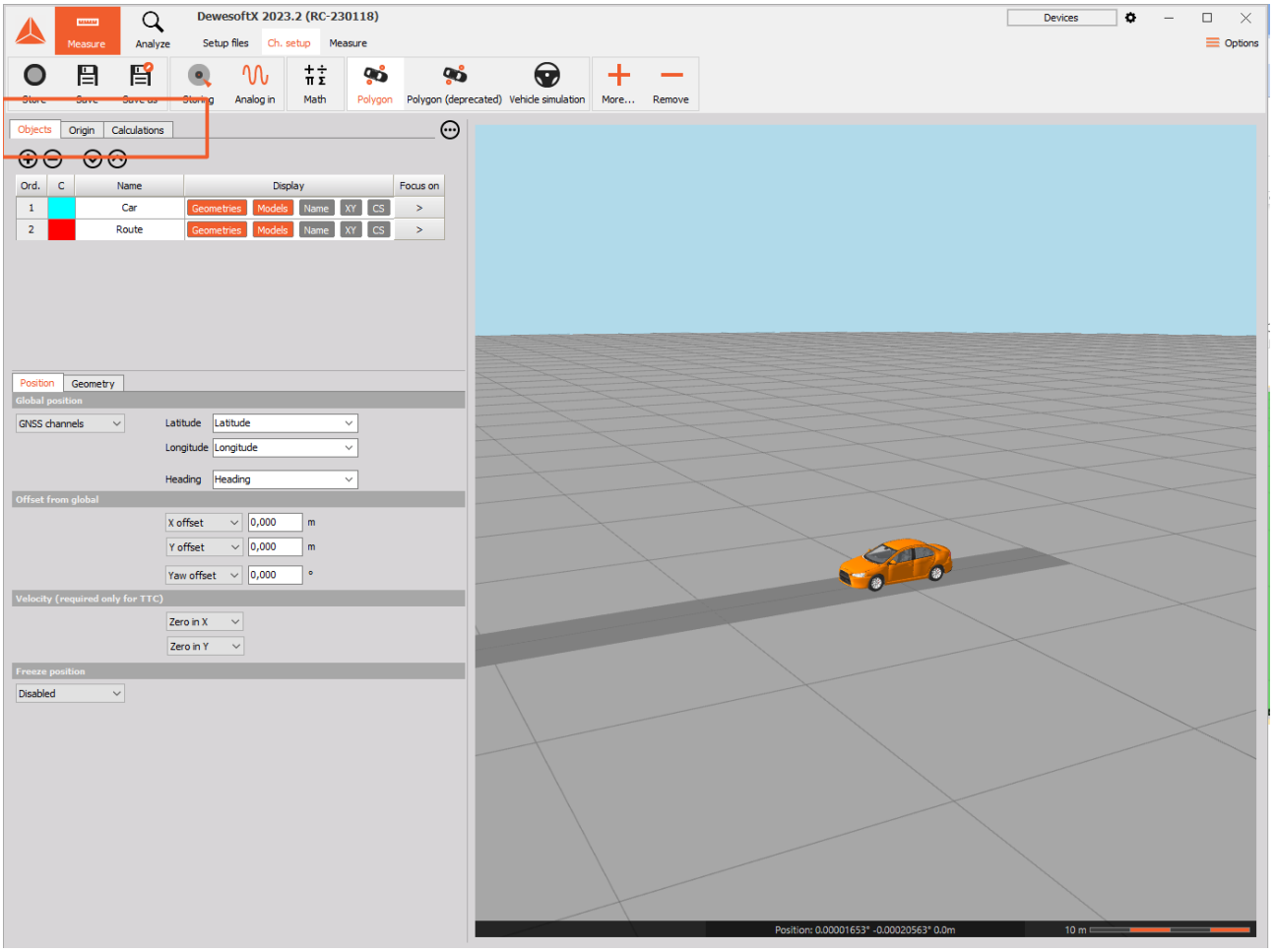


Image 2: Setup window

5.1. Objects

Objects in polygon are used for calculations and also for positioning. Objects are defined with position and the geometry. Position can be measured, predefined or related to another object. Geometry of an object can be defined by multiple primitive geometries such as points, lines, polygons and arcs. With the defined position Polygon can make calculations between geometries of different or same objects.
They can also be visualized with a model.

Object is added with a click on a + icon and deleted with a click on - icon, the arrows pointing up and down are used for moving objects order.

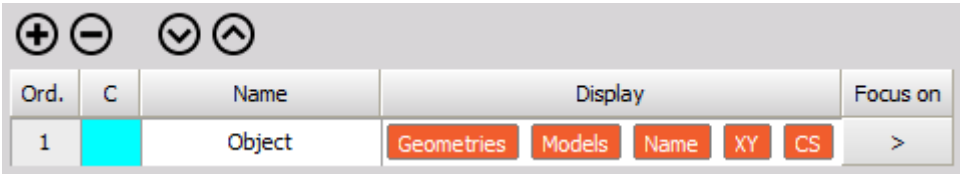


Image 3: Object tab

On the top, the table which contains objects, has the column named 'Display'. In this column, the user is choosing (with a click) the properties of the object that are visible in the preview (orange color means that property is visible). Also the name of every object is edited here. One other Column is 'Focus on'. When pressed, the object is positioned in the middle of your preview window. Every object has additional two tabs in the lower part of the Objects tab. These are editing tabs for Position and Geometry.

5.1.1. Position

5.1.1.1. Global position

You can choose between:

- **Static origin** - used for static objects with known position on the test track
- **Constant position** - used for static objects with known GNSS position (Latitude, Longitude and Heading)
- **GNSS Channels** - for measured GNSS position with Latitude, Longitude and Heading channel
- **Navigation channel** - for measured position with Navigation channel
- **Other object** - used for objects that are offset from another object that has a known geodetic position (used with all, except static origin)

With this you define the coordinate system of the object.

5.1.1.2. Offset from global

With offset from global, you can offset a local coordinate system of the object. X,Y and Yaw are relative positions regarding the global coordinate system of the object. Relative offset can be defined with static value in meters (X and Y offset) and in degrees (Yaw offset) or channel (X/Y/Yaw channel). The offset is applied by strict order, first the translation is applied and then rotation.

5.1.1.3. Velocity (required only for TTC)

Velocity channels are required only for calculations for Time To Collision. Channels that are used for TTC calculations should have the velocity in m/s. Time to Collision means the time before a collision happens between involved vehicles/objects/subjects if their speeds would not change and taking into account their paths. If no velocity channel is defined, the zero is assumed, which can also be defined explicitly.

$$TTC = \frac{DISTANCE_{1,2}}{V_1 - V_2}$$

5.1.1.4. Freeze - unfreeze position

Objects have an additional “Freeze position” option. If it is set to freeze or freeze - unfreeze then additional channels have to be assigned to define when the object should freeze (Freeze input) and when it should unfreeze. You can choose between Positive and Negative crossing and the Level when the object freezes. If only Freeze is selected, the object will remain frozen till the end of storing, otherwise the input for unfreeze should be used to unfreeze the object. The freeze - unfreeze function is convenient for more consecutive brake tests in one datafile.

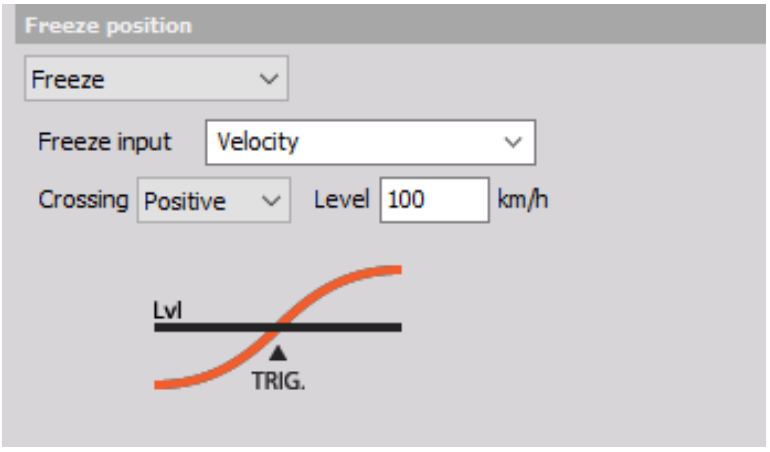


Image 4: Freeze position window

5.1.2. Geometry

With + button you can add the Geometry. There are various geometries that can be selected. Every object can have more geometries.

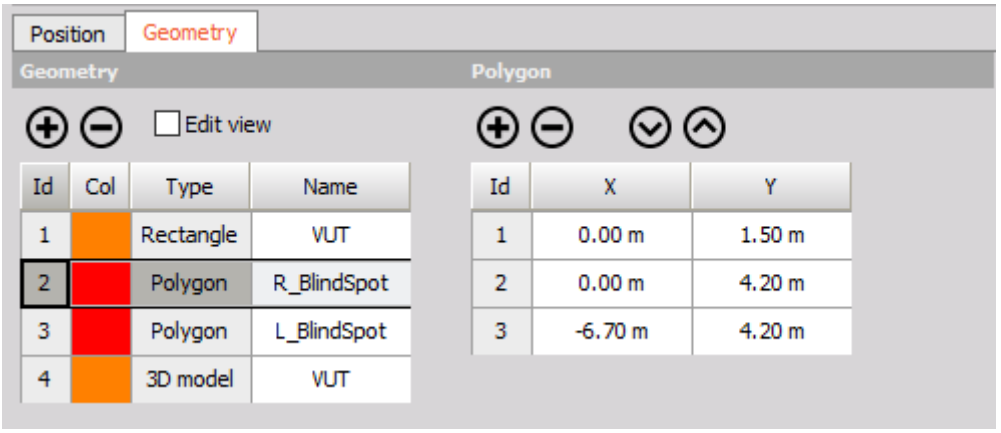


Image 5: Geometry tab of object

5.1.2.1. Points

Just simply add X and Y coordinates to create one or multiple points in one geometry.

Image 6: Point

5.1.2.2. Polyline

Just simply add more than one X and Y coordinates to create a polyline.

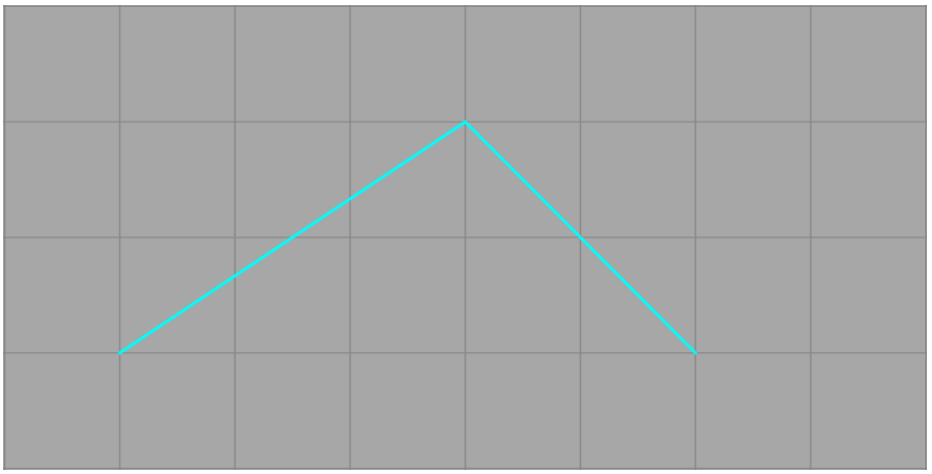


Image 7: Polyline

5.1.2.3. Rectangle

Choose the X and Y coordinates to define the position of the center of the rectangle. Also the size of the rectangle should be defined (length and width).

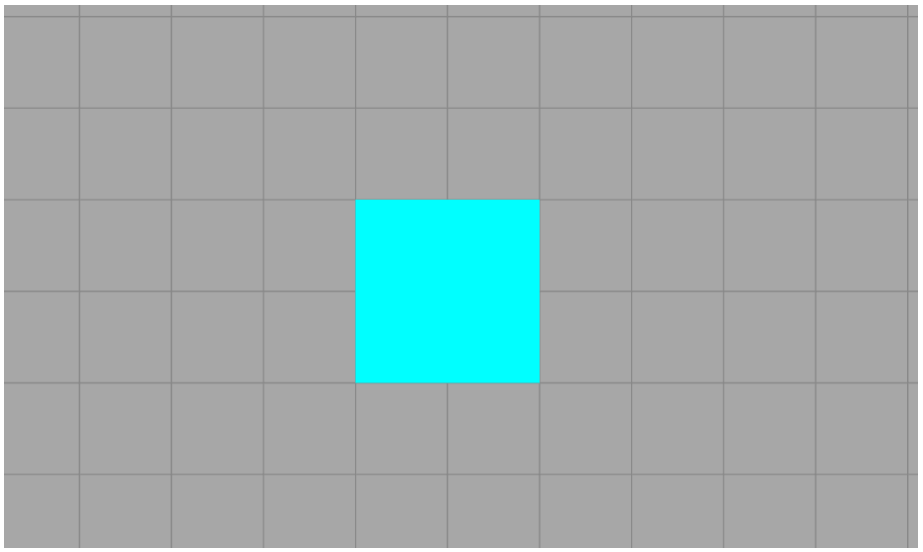


Image 8: Rectangle

5.1.2.4. Polygon

Polygon is defined with multiple points (X and Y coordinates) which are connected. The local coordinate system of Polygon is on the 1st point.

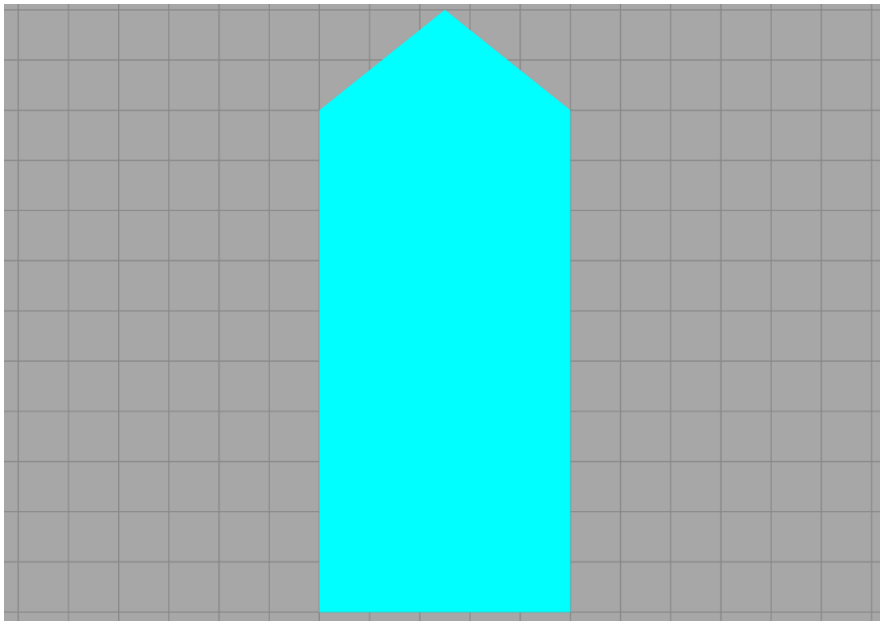


Image 9: Polygon

5.1.2.5. Arc

Arc is defined with X, Y coordinates of the center, the starting angle, angle and radius.

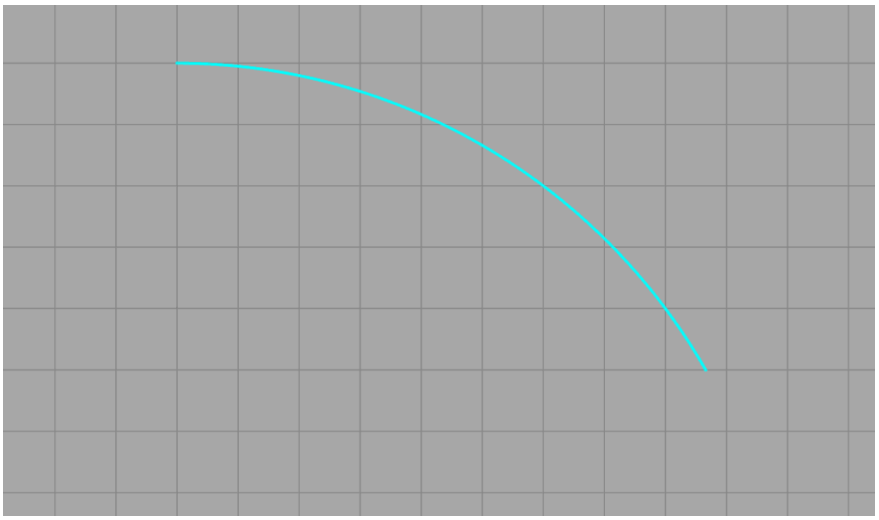


Image 10: Arc

5.1.2.6. 3D model

A 3D model is added just for visual effect. It doesn't have any effect on the calculations. Your own 3D model can be added in Map.

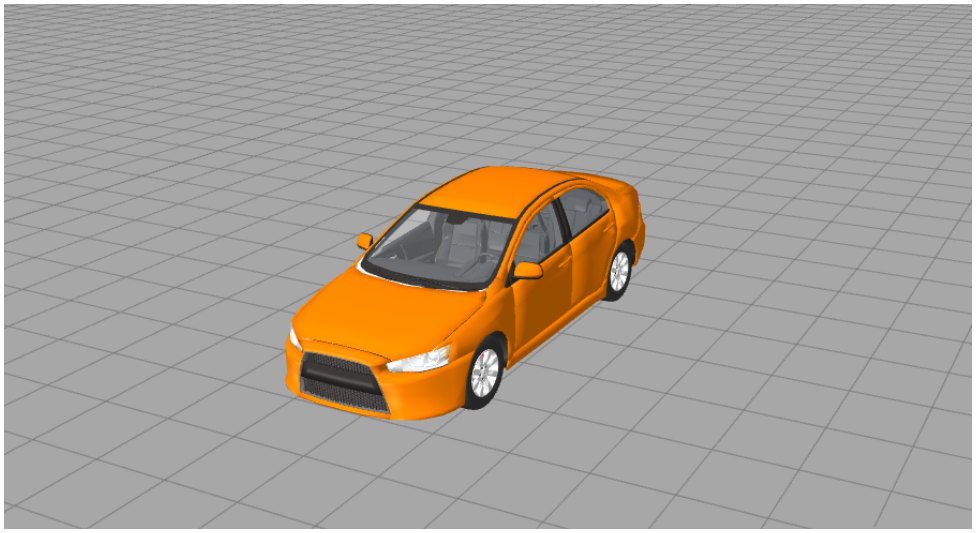


Image 11: 3D model

5.1.2.7. Route

Route is a predefined path (track, road...). It can be made out of lines and curves. If we define it manually we have four elements we can use: Straight, Straight to, Curve and Curve to.
Routes can also be imported. Just record Dewesoft file while driving the route, export it to GoogleEarth .kml file and then import it in polygon. After that you can modify it manually if you want. If origin is not set then import of the route will set it automatically to route start and set direction to the start direction of the route. It doesn't have any effect on the calculations.

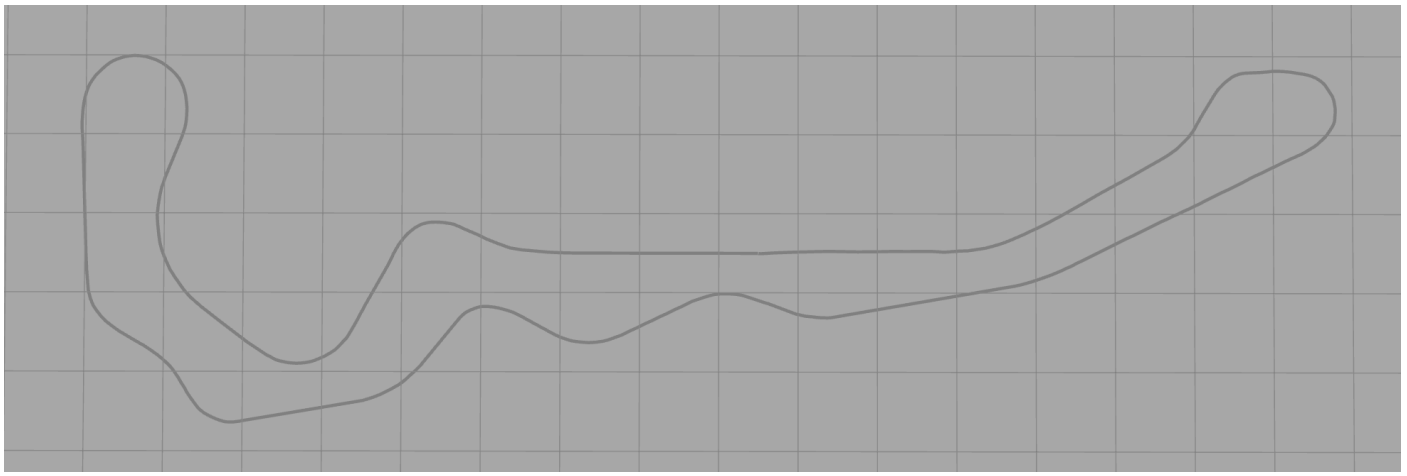


Image 12: Route

5.2. Origin

Origin defines zero point and orientation of the coordinate system on the local plane. All X and Y positions of objects are relative positions regarding origin. There are two ways to define origin. Dynamic or static. If you choose dynamic, the origin will move with the measured object (useful for vehicle to vehicle testing), meanwhile if you choose static origin, you have also two different options which are described under here. If the static origin is selected, there are offset windows available for X, Y and Yaw. The main purpose of these offsets is to make the small adjustments while analyzing, to help correct the small measurement errors with recalculation.

5.2.1. Origin with Point and heading

Defining the static origin with point and heading, is very quick and simple but not very precise. It is defined only with the position and heading of the selected object (It can be put in manually or with the current position of an object with the Setup from... button). It can for example be used for placing virtual tracks on the proving ground, where small deviations are not important.

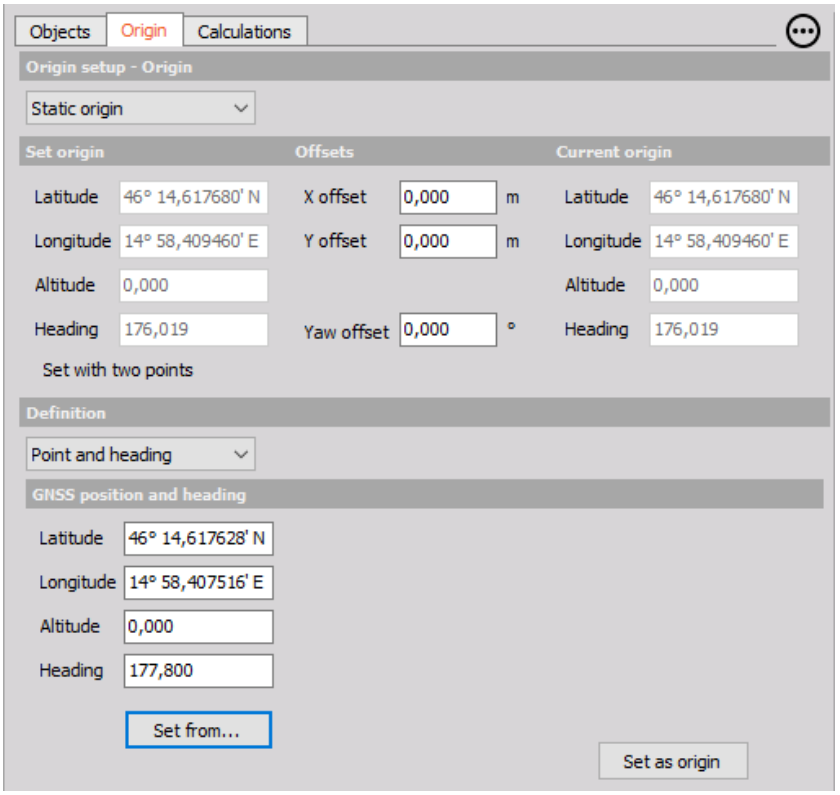


Image 13: Static origin - Point and heading

5.2.2. Two points

Origin defined with Two points is a little more complex, but is used when you have the objects fixed on track that are important for calculations (cones, points, lanes...). When defining origin with two points, you want to make sure that the distance between Point 1 and Point 2 is as long as it can be. For defining points, you have to input the GNSS position and the local position. The GNSS position can be typed in manually or inserted with the 'Set from...' button which opens you a list of objects which can define a GNSS position. The local position of the points is important, since it defines where the measured points are in real life so they can be transformed in the virtual world origin (the position of the origin is from point 1 and the orientation of the axis from point 2). So in the case below, we put in the coordinates of two points (both on the same straight line, separated for 85,5 m) and from this input, we get an origin on the start of the 1st point, with the X axis oriented directly in the direction of the 2nd point.

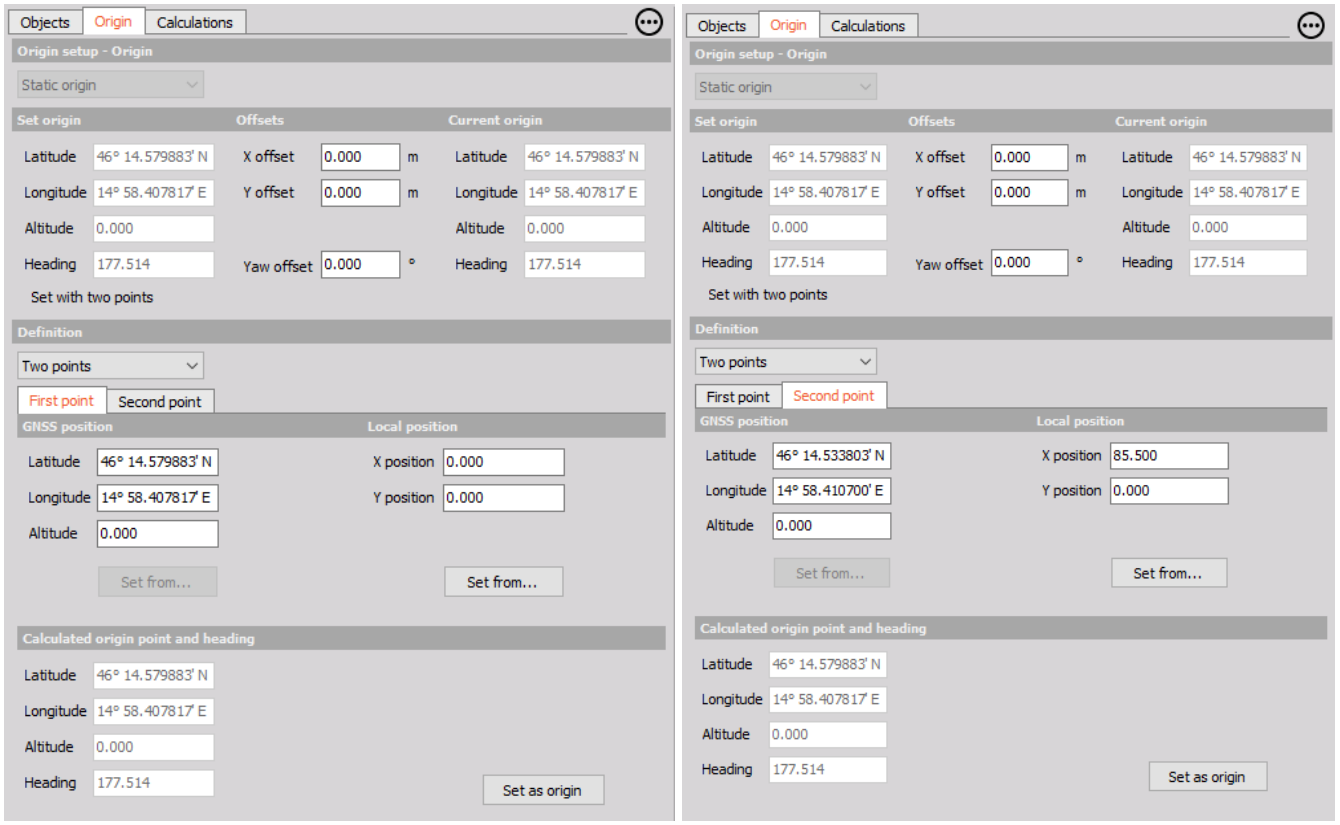


Image 14: Static origin - Two points

5.3. Calculations

Image 15: Calculations tab

In the tab 'Calculations', there are three additional tabs; Setup, Groups and Channels.

5.3.1. Setup

In the setup tab, the user chooses what kind of calculations will be done and between which groups. There are no default outputs. But there is a table where they can be defined. There are few buttons on the top of the table for adding, moving and deleting outputs. Each output results in one data channel, for which color and name can be defined. For Distance X, Y and Time to collision X, Y, there is also a channel created for alignment. Units are assigned automatically (meters and seconds).

	Type	From group	To group	Values
1	Abs. distance	Car	Polygon	15,71 m
2	Distance X	Car	Polygon	-18,98 m - Aligned
3	Distance Y	Car	Polygon	-1,11 m - Unaligned
4	Overlap	Car	Line	Overlap
5	Time from overlap	Car	Line	
6	Time to collision X	Car	Polygon	
7	Time to collision Y	Car	Polygon	

Image 16: Setup tab

Absolute distance (D) gives the shortest distance between two groups. All types of objects are supported for distance calculation (if they have defined geometry). The absolute distance is always positive.

Overlap (OL) is calculating if 2 groups of objects are covering each other. It can be 0 or 1, No overlap or Overlap.

Time from overlap (TFO) is calculating the time between two overlaps over the same group (more objects can be selected in one group).

Time to collision X and Y (TTC) means the time before a collision happens between involved vehicles/objects/subjects if their speeds would not change and taking into account their paths (for the direction X and direction Y).

Distance X and Y (DX, DY) are calculating the distance in the X and Y direction. The distances in X and Y can be negative or positive, a calculation results are always in the 'From group' coordinate system. Another part of the result of this calculation is **alignment (AX, AY)**. Two groups are aligned, if the group that distance is calculated to, is in 'the corridor' of the group that distance is calculated from. The width of the corridor that is used for alignment calculation is the biggest dimension perpendicular to the X or Y axis. See the added pictures. On the first one, the objects are aligned and on the second they aren't.

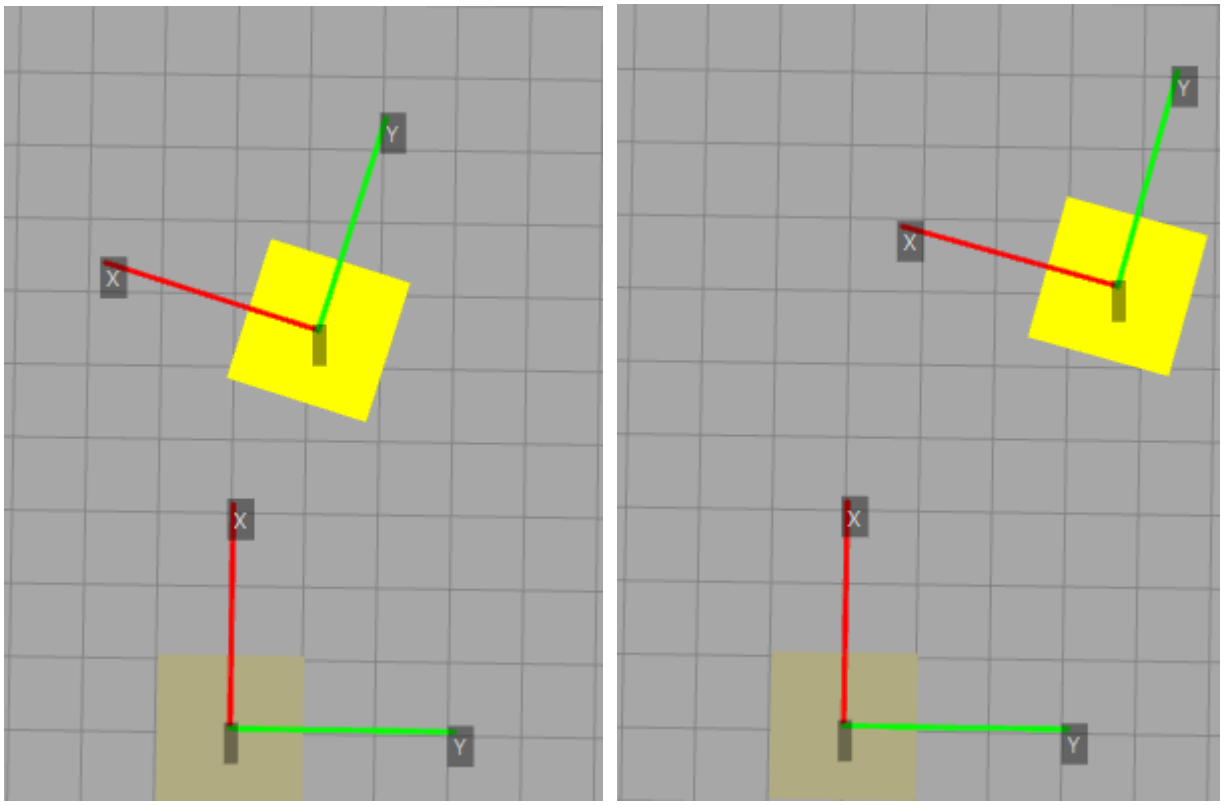


Image 17: Direction X and Y

Distance X and Y are especially useful for ADAS testing (automatic braking, lane departure, overtaking tests etc.) because the calculation will always give you the minimum distance between the groups in the desired direction. If the groups aren't aligned, the minimum value in the XY direction will be calculated, but when the groups are aligned, the minimum value in XY direction is calculated inside of the corridor.

5.3.2. Groups

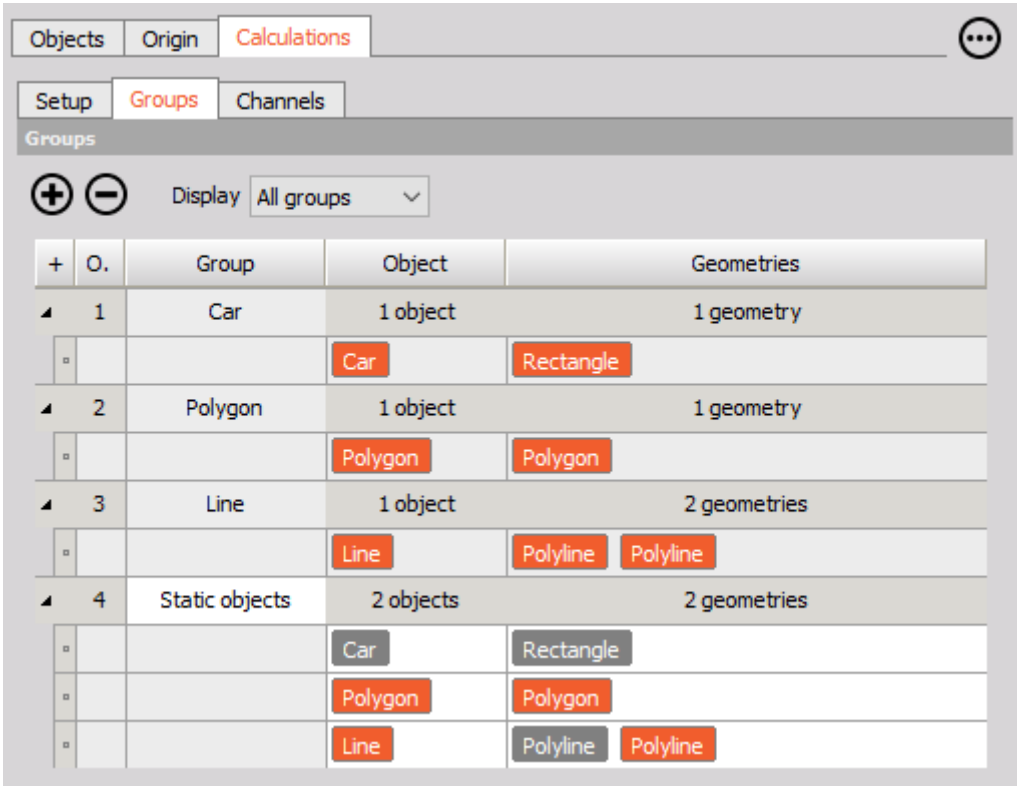
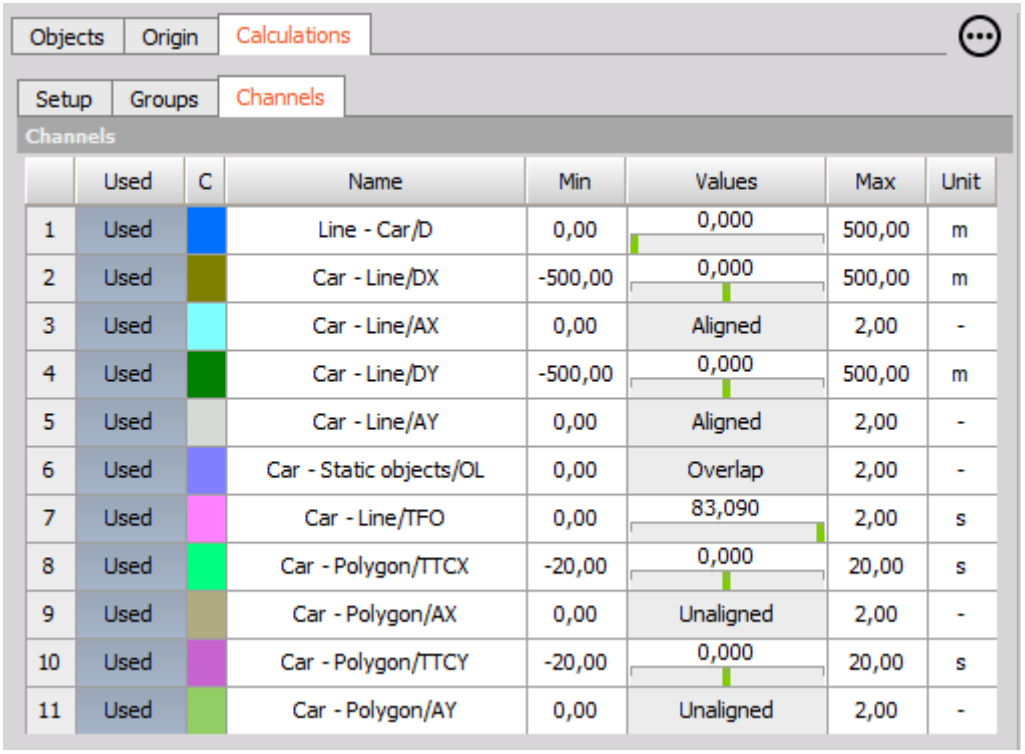


Image 18: Groups tab

Groups are used for the calculations (in calculation when the dropdown menu is shown, you can choose a group). On the top of the tab there are + and - for adding and deleting the groups. In the groups you can choose one or multiple geometries from different or same objects that are used for calculations. This is useful if there is a test for collision to multiple objects. The groups can also be renamed (except the groups that are generated automatically from objects, these Groups also can't be deleted or edited). It has to be noted, that visualization objects are not displayed here since the calculations aren't supported between them.

5.3.3. Channels



	Used	C	Name	Min	Values	Max	Unit
1	Used		Line - Car/D	0,00	0,000	500,00	m
2	Used		Car - Line/DX	-500,00	0,000	500,00	m
3	Used		Car - Line/AX	0,00	Aligned	2,00	-
4	Used		Car - Line/DY	-500,00	0,000	500,00	m
5	Used		Car - Line/AY	0,00	Aligned	2,00	-
6	Used		Car - Static objects/OL	0,00	Overlap	2,00	-
7	Used		Car - Line/TFO	0,00	83,090	2,00	s
8	Used		Car - Polygon/TTCX	-20,00	0,000	20,00	s
9	Used		Car - Polygon/AX	0,00	Unaligned	2,00	-
10	Used		Car - Polygon/TTCY	-20,00	0,000	20,00	s
11	Used		Car - Polygon/AY	0,00	Unaligned	2,00	-

Image 19: Channels tab

The channels tab shows all of the outputs that are calculated from the setup (and also see the preview). Channels can be renamed, the color can be changed, the Min and Max values can be changed and also the units can be edited. The channels that you want to use in the measure screen must be switched to 'Used'.

Default names of the channels are assembled from the names of the groups that are used for the calculation (first is 'From group') and then after the / is:

- D: Absolute distance calculation
- DX/DY: Distance X/Y calculation
- AX/AY: Alignment X/Y calculation
- OL: Overlap calculation
- TFO: Time from overlap calculation
- TTCX/TTCY: Time to collision X/Y calculation

6. Applications

6.1. Pass by noise

Polygon can be used for the calculation of the distance between vehicle and microphones that are on the side of the test track. Static origin is set in the middle of the microphones. Used calculations are Distance Y to know the side distance to microphones and the Distance X to know where the measuring started. The datafile is available here.

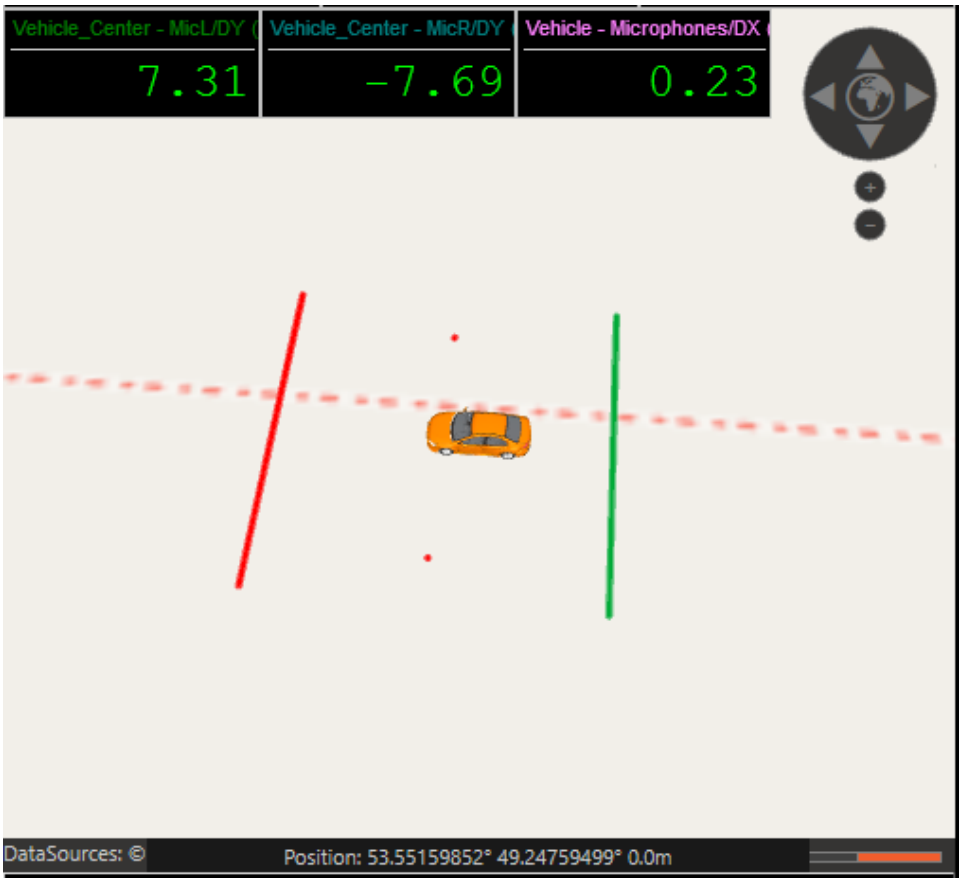


Image 20: Pass by noise

6.2. Brake test

To calculate the braking distance with Polygon, the freeze function can be used. A line moving with the vehicle is used for braking distance calculation. For the freeze input, the velocity channel is selected and is set to negative crossing at 97.1 km/h. This means that the line is traveling with the vehicle until the braking starts. When the braking starts and the velocity drops under the selected velocity, the line freezes and the calculation for the braking distance starts between the line and the vehicle. The datafile is available here.

Image 21: Brake test

6.3. ADAS - Active braking

Here is a datafile available for download, which contains an Active emergency braking test. Two vehicles with dynamic origin are driving one behind another. Dynamic origin is used, because there are no static objects on the test track, but only the distance between both cars is important. The calculations performed here are Time to collision (TTC) in X and the absolute distance between the vehicles. TTC tells the time before a collision happens between vehicles if their speeds would not change and taking into account their paths. The absolute distance is calculated, because the shortest distance between vehicles is our interest.

Image 22: AEB test

6.4. ADAS - Blindspot and collision warning

Here is a datafile available for download, which contains Blindspot and collision warning test. Dynamic origin is used, because there are no static objects on the test track, but only the position of both cars is important. The geometry of the VUT contains one rectangle with Navigational channel assigned and two additional rectangles, with defined offset and size, representing blindspots. Their position is defined with the first rectangle. Target vehicle is only a simple rectangle whose position is defined with another Navigational channel. The calculations done here are Absolute distance between VUT and Target vehicle for collision warning and Overlap calculation between Target vehicle and geometries of the blind spots. In the groups tab, BlindSpot_R and BlindSpot_L groups are defined, to know the side of the Overlap.

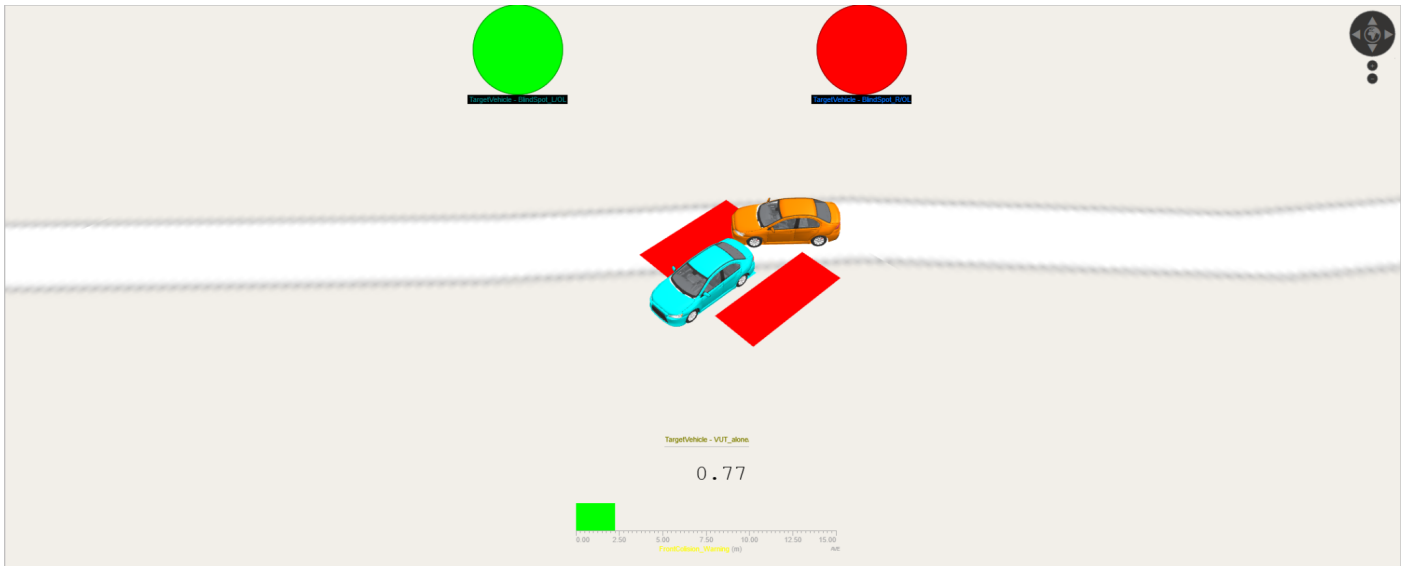


Image 23: Blindspot and collision warning test

7. Warranty information

Notice
The information contained in this document is subject to change without notice.

Note:
Dewesoft d.o.o. shall not be liable for any errors contained in this document. Dewesoft MAKES NO WARRANTIES OF ANY KIND WITH REGARD TO THIS DOCUMENT, WHETHER EXPRESS OR IMPLIED. DEWESOFT SPECIFICALLY DISCLAIMS THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Dewesoft shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory, in connection with the furnishing of this document or the use of the information in this document.

The copy of the specific warranty terms applicable to your Dewesoft product and replacement parts can be obtained from your local sales and service office. To find a local dealer for your country, please visit https://dewesoft.com/support/distributors.

7.1. Calibration

Every instrument needs to be calibrated at regular intervals. The standard norm across nearly every industry is annual calibration. Before your Dewesoft data acquisition system is delivered, it is calibrated. Detailed calibration reports for your Dewesoft system can be requested. We retain them for at least one year, after system delivery.

7.2. Support

Dewesoft has a team of people ready to assist you if you have any questions or any technical difficulties regarding the system. For any support please contact your local distributor first or Dewesoft directly.

Dewesoft d.o.o.
Gabrsko 11a
1420 Trbovlje Slovenia

Europe Tel.: +386 356 25 300
Web: http://www.dewesoft.com
Email: Support@dewesoft.com
The telephone hotline is available Monday to Friday from 07:00 to 16:00 CET (GMT +1:00)

7.3. Service/repair

The team of Dewesoft also performs any kinds of repairs to your system to assure a safe and proper operation in the future. For information regarding service and repairs please contact your local distributor first or Dewesoft directly on https://dewesoft.com/support/rma-service.

7.4. Restricted Rights

Use Slovenian law for duplication or disclosure. Dewesoft d.o.o. Gabrsko 11a, 1420 Trbovlje, Slovenia / Europe.

7.5. Printing History

Version 2.0.0, Revision 217 Released 2015 Last changed: 23. July 2018 at 16:54.

7.6. Copyright

7.7. Trademarks

We take pride in our products and we take care that all key products and technologies are registered as trademarks all over the world. The Dewesoft name is a registered trademark. Product families (KRYPTON, SIRIUS, DSI, DS-NET) and technologies (DualCoreADC, SuperCounter, GrandView) are registered trademarks as well. When used as the logo or as part of any graphic material, the registered trademark sign is used as a part of the logo. When used in text representing the company, product or technology name, the ® sign is not used. The Dewesoft triangle logo is a registered trademark but the ® sign is not used in the visual representation of the triangle logo.

8. Safety instructions

Your safety is our primary concern! Please be safe!

8.1. Safety symbols in the manual

Warning

Calls attention to a procedure, practice, or condition that could cause the body injury or death

Caution

Calls attention to a procedure, practice, or condition that could possibly cause damage to equipment or permanent loss of data.

8.2. General Safety Instructions

Warning

The following general safety precautions must be observed during all phases of operation, service, and repair of this product. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the product. Dewesoft d.o.o. assumes no liability for the customer's failure to comply with these requirements.

All accessories shown in this document are available as an option and will not be shipped as standard parts.

8.2.1. Environmental Considerations

Information about the environmental impact of the product.

8.2.2. Product End-of-Life Handling

Observe the following guidelines when recycling a Dewesoft system:

8.2.3. System and Components Recycling

Production of these components required the extraction and use of natural resources. The substances contained in the system could be harmful to your health and to the environment if the system is improperly handled at its end of life! Please recycle this product in an appropriate way to avoid unnecessary pollution of the environment and to keep natural resources.

This symbol indicates that this system complies with the European Union's requirements according to Directive 2002/96/EC on waste electrical and electronic equipment (WEEE). Please find further information about recycling on the Dewesoft web site www.dewesoft.com

Restriction of Hazardous Substances
This product has been classified as Monitoring and Control equipment and is outside the scope of the 2002/95/EC RoHS Directive. However, we take care of our environment and the product is lead-free.

8.2.4. General safety and hazard warnings for all Dewesoft systems

Safety of the operator and the unit depend on following these rules.

- Use this system under the terms of the specifications only to avoid any possible danger.
- Read your manual before operating the system.
- Observe local laws when using the instrument.
- DO NOT touch internal wiring!
- DO NOT use higher supply voltage than specified!
- Use only original plugs and cables for harnessing.
- You may not connect higher voltages than rated to any connectors.
- The power cable and connector serve as Power-Breaker. The cable must not exceed 3 meters, the disconnect function must be possible without tools.
- Maintenance must be executed by qualified staff only.
- During the use of the system, it might be possible to access other parts of a more comprehensive system. Please read and follow the safety instructions provided in the manuals of all other components regarding warning and security advice for using the system.
- With this product, only use the power cable delivered or defined for the host country.
- DO NOT connect or disconnect sensors, probes or test leads, as these parts are connected to a voltage supply unit.
- Ground the equipment: For Safety Class 1 equipment (equipment having a protective earth terminal), a non-interruptible safety earth ground must be provided from the mains power source to the product input wiring terminals.
- Please note the characteristics and indicators on the system to avoid fire or electric shocks. Before connecting the system, please read the corresponding specifications in the product manual carefully.

- The inputs must not, unless otherwise noted (CATx identification), be connected to the main circuit of category II, III and IV.
- The power cord separates the system from the power supply. Do not block the power cord, since it has to be accessible for the users.
- DO NOT use the system if equipment covers or shields are removed.
- If you assume the system is damaged, get it examined by authorized personnel only.
- Adverse environmental conditions are Moisture or high humidity Dust, flammable gases, fumes or dissolver Thunderstorm or thunderstorm conditions (except assembly PNA) Electrostatic fields, etc.
- The measurement category can be adjusted depending on module configuration.
- Any other use than described above may damage your system and is attended with dangers like short-circuiting, fire or electric shocks.
- The whole system must not be changed, rebuilt or opened.
- DO NOT operate damaged equipment: Whenever it is possible that the safety protection features built into this product have been impaired, either through physical damage, excessive moisture, or any other reason, REMOVE POWER and do not use the product until the safe operation can be verified by service-trained personnel. If necessary, return the product to Dewesoft sales and service office for service and repair to ensure that safety features are maintained.
- If you assume a more riskless use is not provided anymore, the system has to be rendered inoperative and should be protected against inadvertent operation. It is assumed that a more riskless operation is not possible anymore if the system is damaged obviously or causes strange noises. The system does not work anymore. The system has been exposed to long storage in adverse environments. The system has been exposed to heavy shipment strain.
- Warranty void if damages caused by disregarding this manual. For consequential damages, NO liability will be assumed!
- Warranty void if damage to property or persons caused by improper use or disregarding the safety instructions.
- Unauthorized changing or rebuilding the system is prohibited due to safety and permission reasons (CE).
- Be careful with voltages >25 VAC or >35 VDC! These voltages are already high enough in order to get a perilous electric shock by touching the wiring.
- The product heats during operation. Make sure there is adequate ventilation. Ventilation slots must not be covered!
- Only fuses of the specified type and nominal current may be used. The use of patched fuses is prohibited.
- Prevent using metal bare wires! Risk of short circuit and fire hazard!
- DO NOT use the system before, during or shortly after a thunderstorm (risk of lightning and high energy over-voltage). An advanced range of application under certain conditions is allowed with therefore designed products only. For details please refer to the specifications.
- Make sure that your hands, shoes, clothes, the floor, the system or measuring leads, integrated circuits and so on, are dry.
- DO NOT use the system in rooms with flammable gases, fumes or dust or in adverse environmental conditions.
- Avoid operation in the immediate vicinity of high magnetic or electromagnetic fields, transmitting antennas or high-frequency generators, for exact values please refer to enclosed specifications.
- Use measurement leads or measurement accessories aligned with the specification of the system only. Fire hazard in case of overload!

- Lithium ion batteries are classified as not hazardous when used according to the recommendations of the manufacturer described in Battery Safety Data Sheet, which is available for download from this link.
- Do not switch on the system after transporting it from a cold into a warm room and vice versa. The thereby created condensation may damage your system. Acclimatise the system unpowered to room temperature.
- Do not disassemble the system! There is a high risk of getting a perilous electric shock. Capacitors still might be charged, even if the system has been removed from the power supply.
- The electrical installations and equipment in industrial facilities must be observed by the security regulations and insurance institutions.
- The use of the measuring system in schools and other training facilities must be observed by skilled personnel.
- The measuring systems are not designed for use in humans and animals.
- Please contact a professional if you have doubts about the method of operation, safety or the connection of the system.
- Please be careful with the product. Shocks, hits and dropping it from already- lower level may damage your system.
- Please also consider the detailed technical reference manual as well as the security advice of the connected systems.
- This product has left the factory in safety-related flawlessness and in proper condition. In order to maintain this condition and guarantee safety use, the user has to consider the security advice and warnings in this manual.

EN 61326-3-1:2008
IEC 61326-1 applies to this part of IEC 61326 but is limited to systems and equipment for industrial applications intended to perform safety functions as defined in IEC 61508 with SIL 1-3.

The electromagnetic environments encompassed by this product family standard are industrial, both indoor and outdoor, as described for industrial locations in IEC 61000-6-2 or defined in 3.7 of IEC 61326-1.

Equipment and systems intended for use in other electromagnetic environments, for example, in the process industry or in environments with potentially explosive atmospheres, are excluded from the scope of this product family standard, IEC 61326-3-1.

Devices and systems according to IEC 61508 or IEC 61511 which are considered as “operationally well-tried”, are excluded from the scope of IEC 61326-3-1.

Fire-alarm and safety-alarm systems, intended for the protection of buildings, are excluded from the scope of IEC 61326-3-1.

8.3. Documentation version history

Version	Date	Notes
V23-2	03.20.2023	First initial version