



GREENWOOD RMV (Road Marking Vehicles)

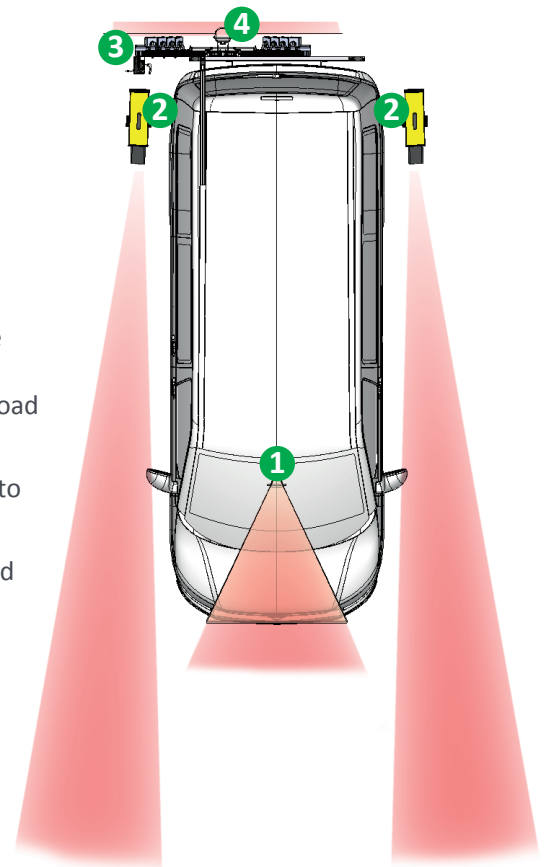
ADVANCED MEASUREMENTS OF ROAD LANE MARKING

Greenwood Engineering's Road Marking Vehicle (RMV) is an advanced integrated vehicle for measurements of road lane marking parameters. It fulfills all requirements according to TDOK 2013:0461 from the Swedish Transport Administration. Several of our customers has been approved by The Swedish National Road and Transport Research Institute (VTI), in the yearly certification test for mobile measurements on road markings by using RMV.

The Road Marking Vehicle integrates Delta's LTL-M sensor for mobile retro-reflection measurements with Greenwood's own developed systems for laser surface measurements, high quality Surface Imaging System (SIS), front looking Right of Way imaging, all started from one single software application. Accompanying the RMV is a software stack of post processing applications which utilize intelligent Computer Vision algorithms to automatically extract coverage, length, width and more, from the SIS images. Further, linear regression models can be included in data exports to, e.g. deliver, wet retro-reflection, friction, daylight brightness (Qd) and more.

The Road Marking Vehicle consists of:

- 1 Right of Way (ROW) Camera** – Takes pictures in front of the vehicle for every 1 to 100 meters of driven distance during a measurement.
- 2 Delta LTL-M** – Measures:
 - RI – Retroreflection for dry roads. The unit for this measure is $\frac{mcd}{m^2 lx}$ where mcd is milli candela and lx is lux.
 - DC – Daylight Contrast is the contrast between the road marking and the surrounding asphalt.
 - No. of RoadStuds. – small objects with very high reflectivity is seen as road studs in the LTL-M data stream.
- 3 Texture Laser** – Records a high-resolution texture profile which is used to calculate the standard Mean Profile Depth (MPD) parameter.
- 4 Surface Imaging System (SIS)** – takes high resolution images of the road markings as they pass by underneath the camera. From these images a number of parameters are later calculated:
 - Geometry: Width and Length of each road marking object.
 - Coverage, the road marking area of an object divided by the intended dimensions of the road
 - Reflectivity



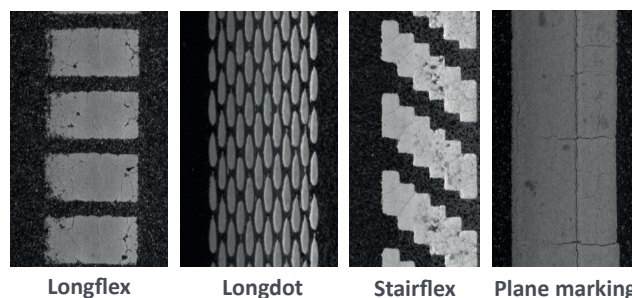
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Surface Imaging Systems (SIS)

Greenwood Engineering's SIS system has been tested on a large number of different marking types in Scandinavian countries. New countries can be added simply by listing the standard marking widths used in each country.

Examples of different markings recorded with SIS:

- Longflex
- Longdot
- Stairflex
- Plane marking



Software for Road Marking Vehicle

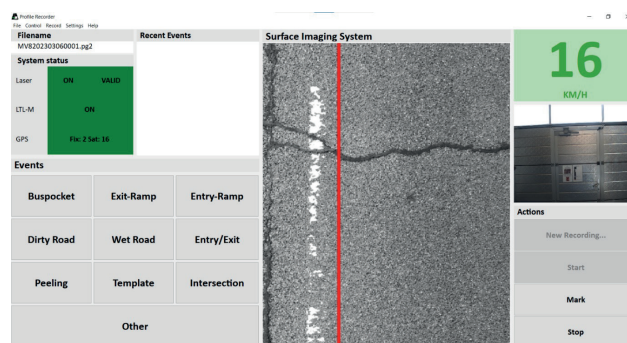
RMV are delivered with a complete software suite for controlling and conducting measurements (Profile Recorder) and for calculating and reporting results (GreenRoad).

Profile Recorder provides a convenient dashboard where the operator can:

- Stop/Start measurements (controlling all sensors and systems)
- Log events
- Follow live guidance for SIS- and other systems

GreenRoad provides a simple graphical user interface where the operator can easily generate reports with calculations of:

- Chainage, Events and Laser measurement (mm)
- MPD, according to ISO 13473-1:2019
- RI left/left center/right center/right and RI-wet
- Qd, Coverage, Width, Reflectivity and Daylight Contrast
- GNSS Information (Global Navigation Satellite System), latitude/longitude/height/time/DOP/#satellites



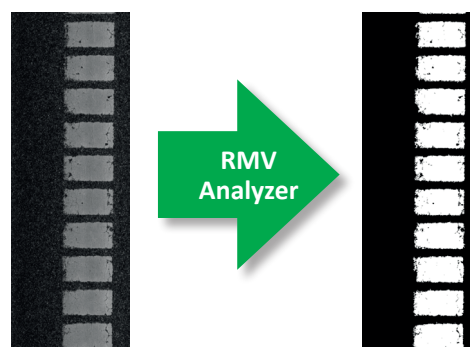
Single Dashboard to control and monitor measurement

Intelligent Computer Vision Analysis

Greenwood's intelligent Computer Vision software converts the marking images recorded by SIS, to binary masks for calculations of different properties. These properties are width, length, coverage, reflectivity and the number of elements the marking consist of. Further, the driving precision is also calculated which measures in percent how much the laser was on track of the markings during a measurement.

Calculations:

- Width
- Length
- Coverage
- Reflectivity
- Number of components
- Driving precision



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