

Autonomous Vehicle and Road Markings

Preliminary result of NordFoU project
AVRM

Tine Damkjaer



4 Countries and 3 instituts



EUROPA-PARLAMENTETS OG RÅDETS DIREKTIV
af 23. oktober 2019 om ændring af direktiv 2008/96/EF om vej-
vejinfrastrukturens sikkerhed

- Medlemsstaterne skal opdatere eksisterende procedurer for vejafmærkninger og færdselstavler og sikre, at de opfylder de nye krav til læsbarhed og synlighed for såvel mennesker som køretøjer og nye førerstøttesystemer

Does Road authorities need to change their strategies?

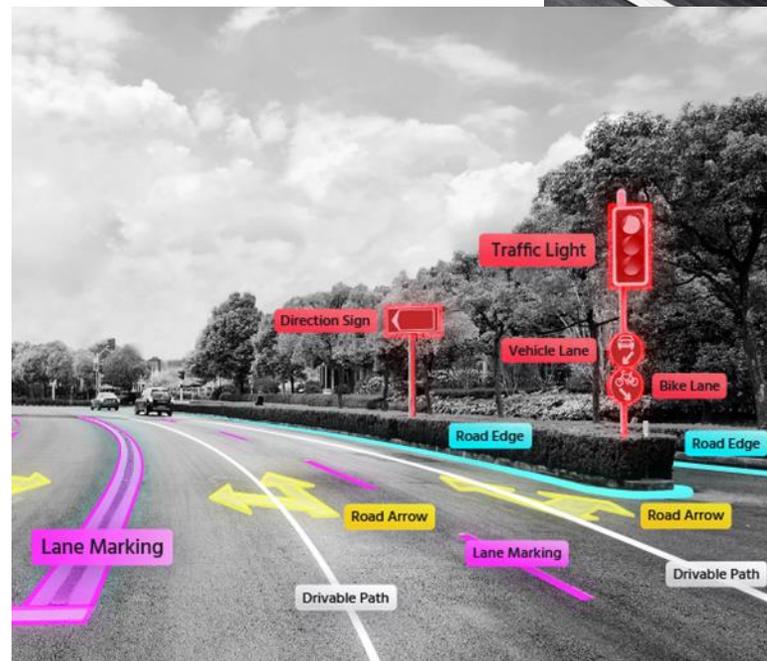
Project AVR

Better understanding of the systems.

- Camera → Software → Steering/control



MobileEye equipment



Aim of AVRМ project

- To get knowledge to determine the lowest level fore detecting and frequency of maintenance efforts necessary for various technologies, including an estimate of costs.

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How does the detecting systems react

Typical Nordic road markings



Nordic road and weather

How does the detecting systems react when snow, darkness, glare ...



Picture: Wallhere

Method

- Mobile measurements

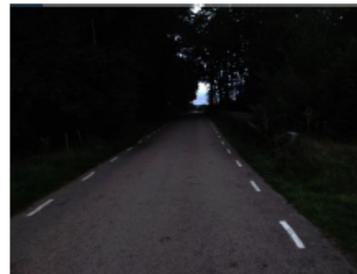
- 30 roads in Skåne
- Ramboll RMT
 - Daytime, dry
- Mobileye 630
 - Daytime, dry + X

- X:

- Daytime, wet
- Daytime, rain
- Night-time, dry
- Night-time, wet
- Night-time, rain

Condition	daylight	night-time
dry	30	4
wet/rain	24	9

- Photos every 10 m



Daylight, dry

LT=0	LT≠0	Comment, possible explanation			
 <p>1.16</p>	 <p>1.05</p>	Shadows may have impact on detection	 <p>0.95</p>	 <p>2.00</p>	Crack in road surface - extra black line may interfere with machine vision
 <p>2.16</p>	 <p>3.65</p>	Very bright road surface, i.e. too low contrast?	 <p>-</p>	 <p>1.90</p>	Edge line missing
 <p>2.75</p>	 <p>2.30</p>	Bus stop with extra longitudinal structures may interfere with machine vision	 <p>1.80</p>	 <p>1.37</p>	Road marking too close to barrier?

Daylight, rain

LT=0	LT≠0	Comment, possible explanation
 <p>0.81</p>	 <p>2.58</p>	Glare due to reflections in road surface
 <p>2.91</p>	 <p>1.74</p>	Road marking too close to barrier?
 <p>1.42</p>	 <p>2.30</p>	Glare due to reflections in road surface

Rektangulært klip

Summary of results

- Mobileye does not detect any road marking (LT=0) due to:
 - Factors unrelated to road markings
 - Shadows
 - Other longitudinal structures
 - Reflections in the road surface
- Road markings should not be detected by the system when they are not present
 - Intersections
 - Roundabouts
 - Junctions Rektangulært klip
 - Missing in curves

Summary of results

- Mobileye does not detect any road marking (LT=0) due to:
 - Factors unrelated to road markings
 - Shadows
 - Other longitudinal structures
 - Reflections in the road surface
 - Factors related to road markings
 - Missing road markings
 - Wear
 - Too low contrast ratio

- Road markings should not be detected by the system when they are not present
 - Intersections
 - Roundabouts
 - Junctions Rektangulært klip
 - Missing in curves

Project status after pilot project

- Original project aim:
 - Acquire knowledge about ADAS detection of road markings, focussing on Nordic roads.
 - To deliver a basis for specifications so that road markings are effectively detectable both by human drivers and ADAS.

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- Original project aim:
 - Acquire knowledge about ADAS detection of road markings, focussing on Nordic roads.
 - To deliver a basis for specifications so that road markings are effectively detectable both by human drivers and ADAS.
- Probably not possible to find minimum values of performance parameters for machine detectability due to complex relationships.

Aim of the main project

- What is the share of detectability under wet conditions, for different roads and road markings?
- How is ADAS detection in wet conditions at night-time affected by whether the road markings are flat or profiled?

Sites



21, 288 34 Vinslöv till Hässleholm – Google Maps

Edge line: stairs



Edge line: stairs on flat



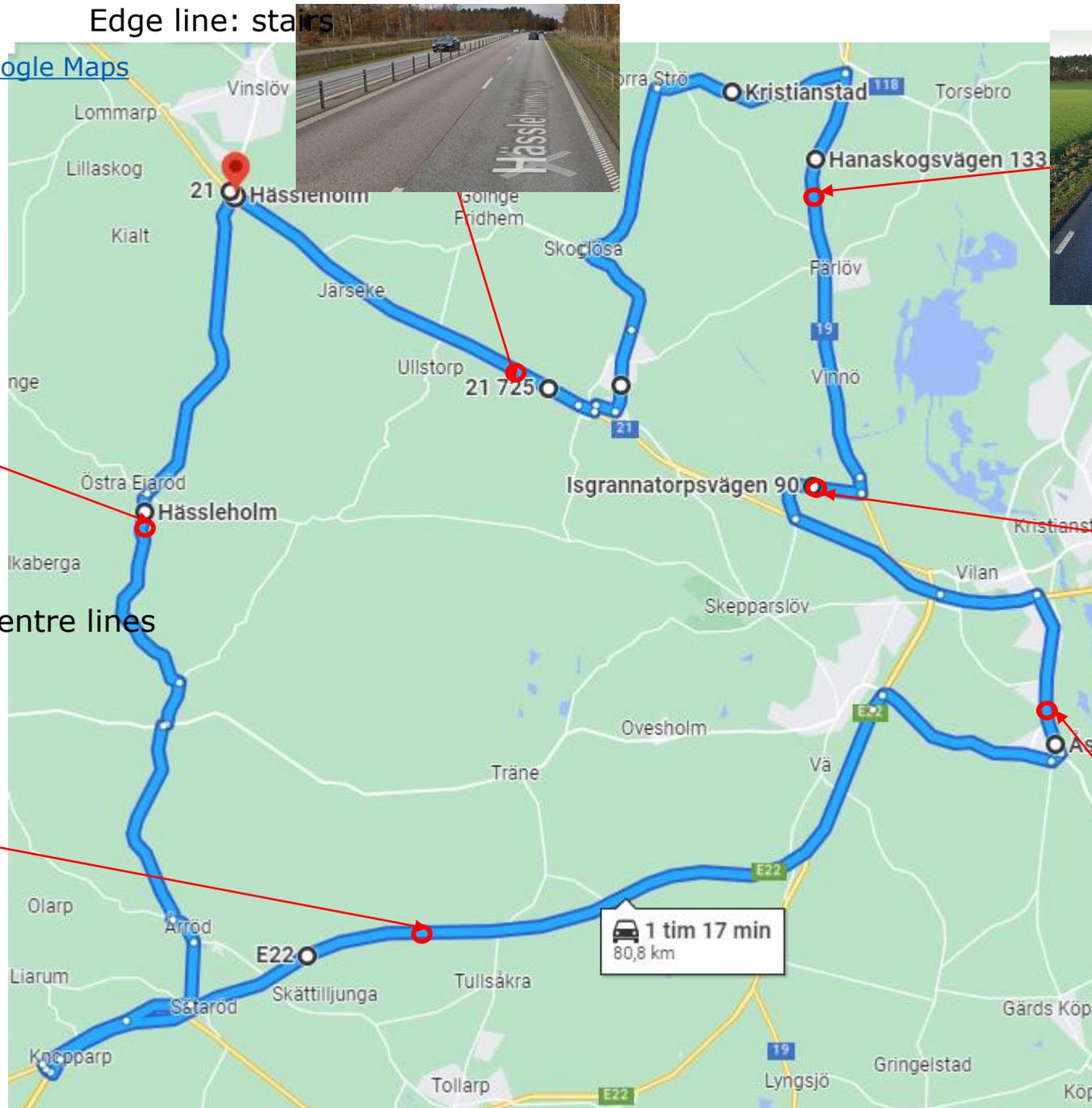
Curvy, narrow road without centre lines



Narrow road without centre lines
Flat, intermittent, 10 cm



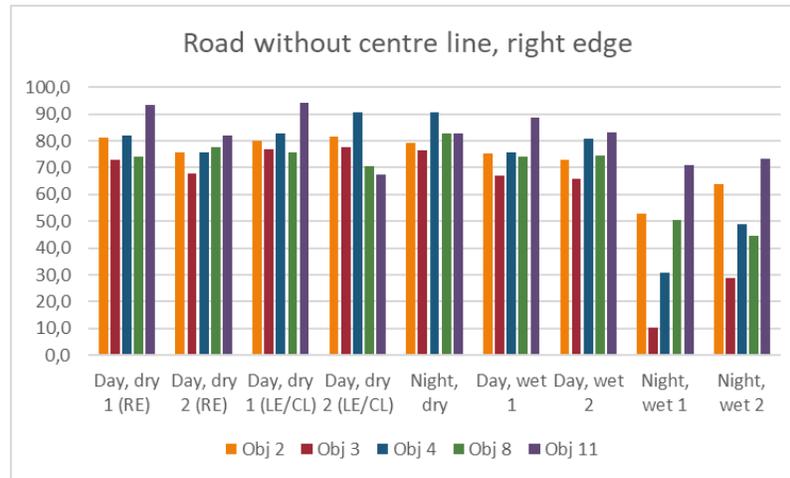
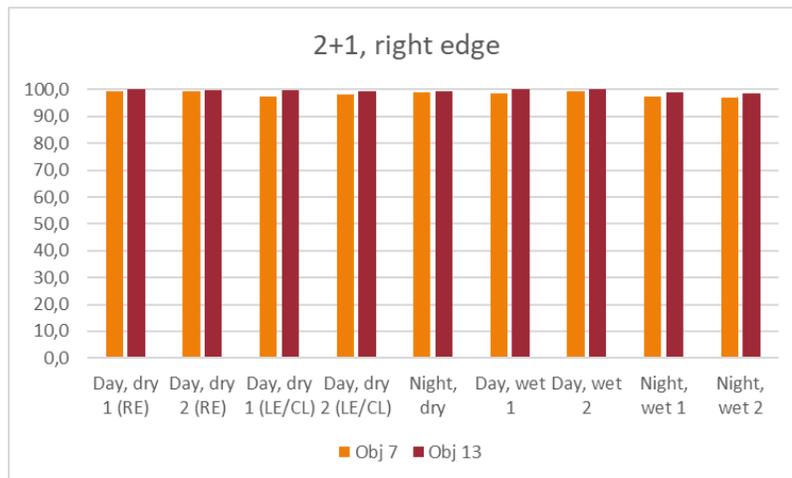
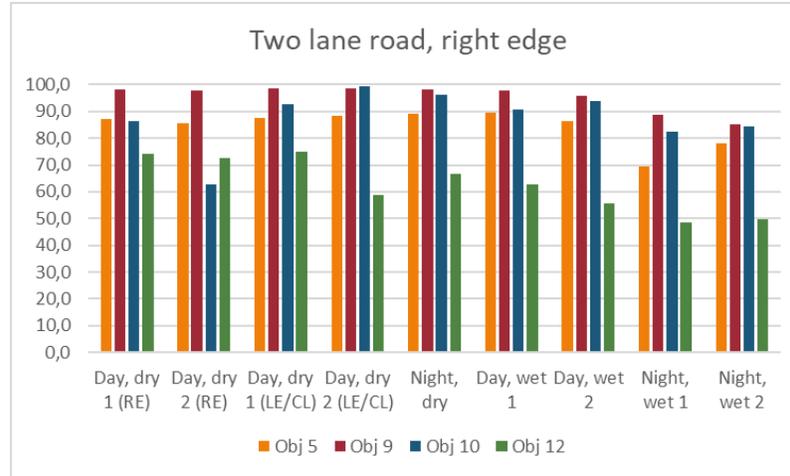
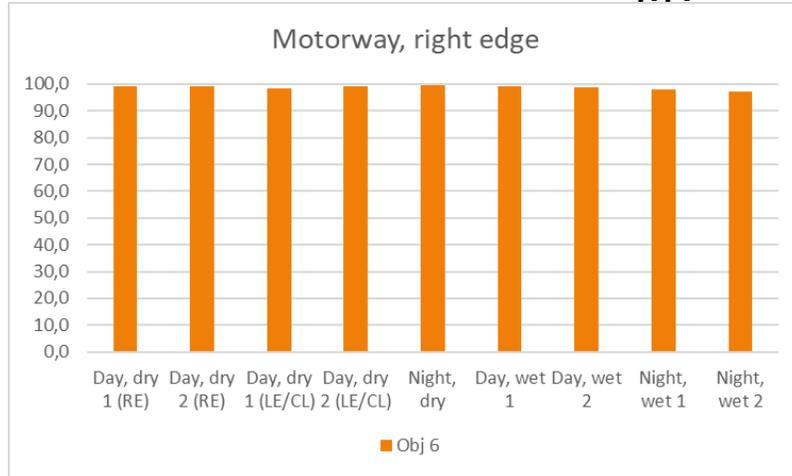
Edge line: stairs



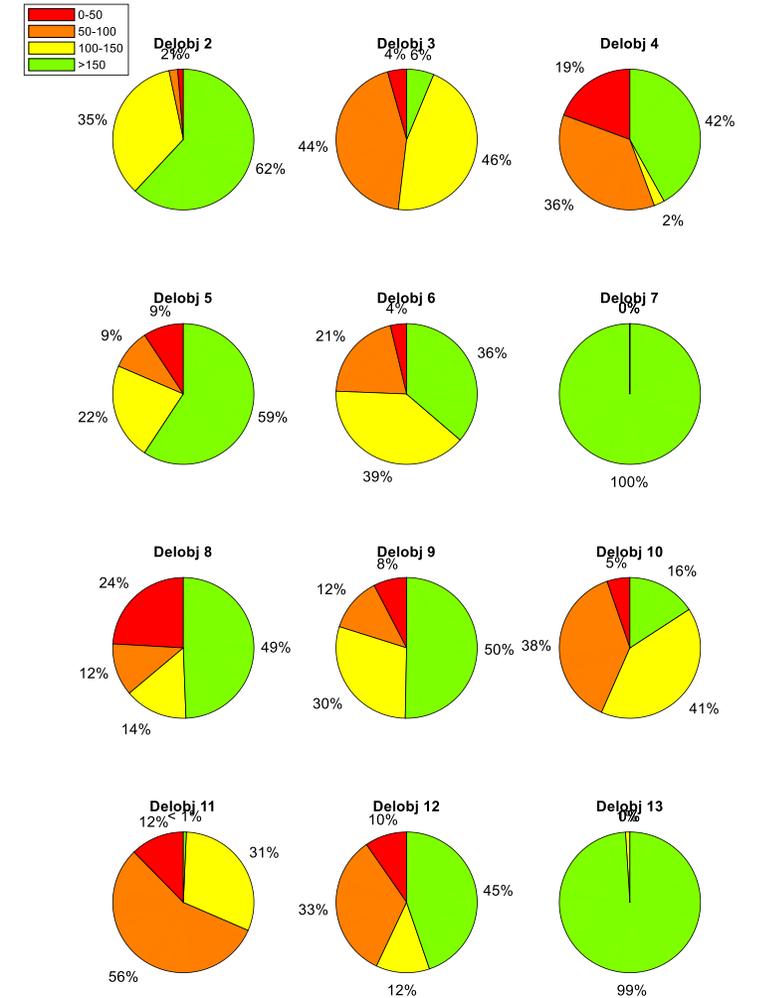
vejdirektoratet
Edge line: Combidrop

Sweden, right line

ADAS detectability, all

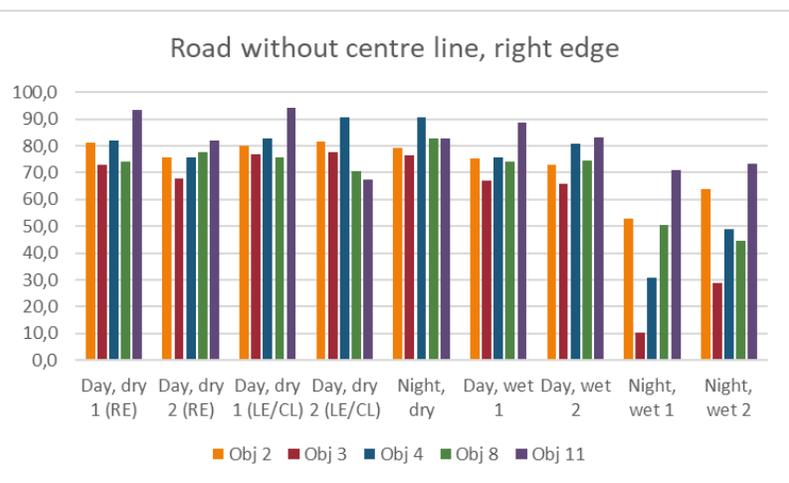
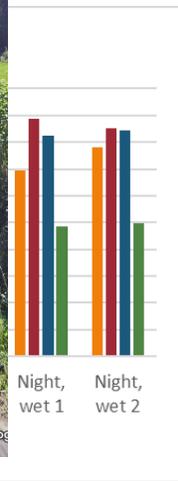
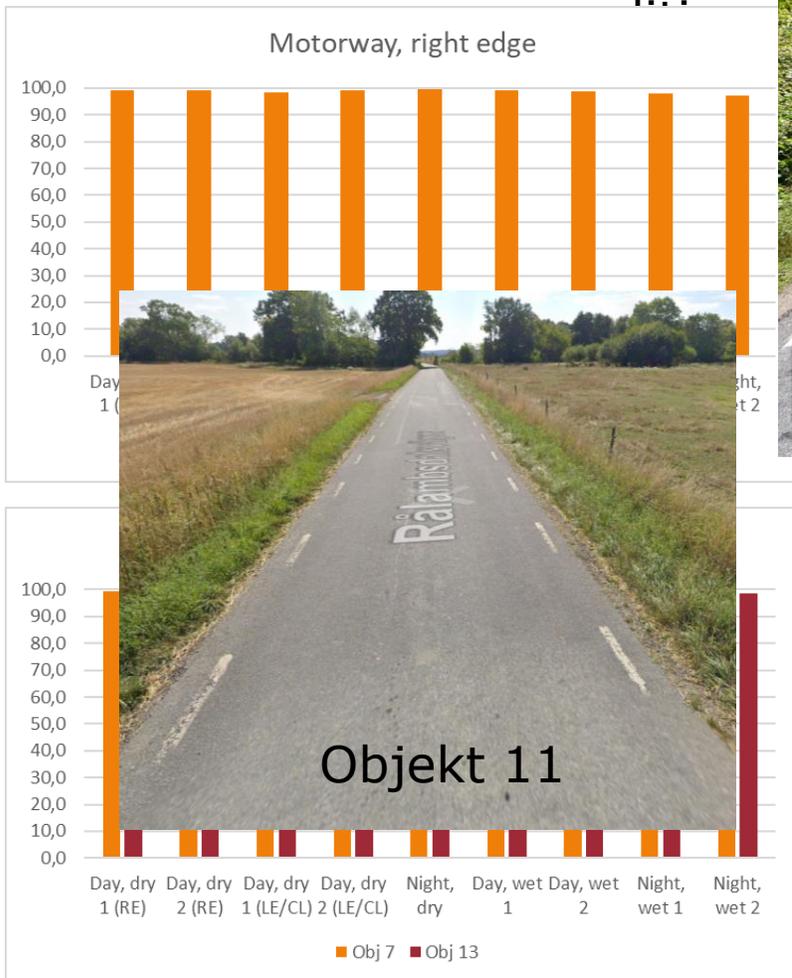


Retroreflexion, dry

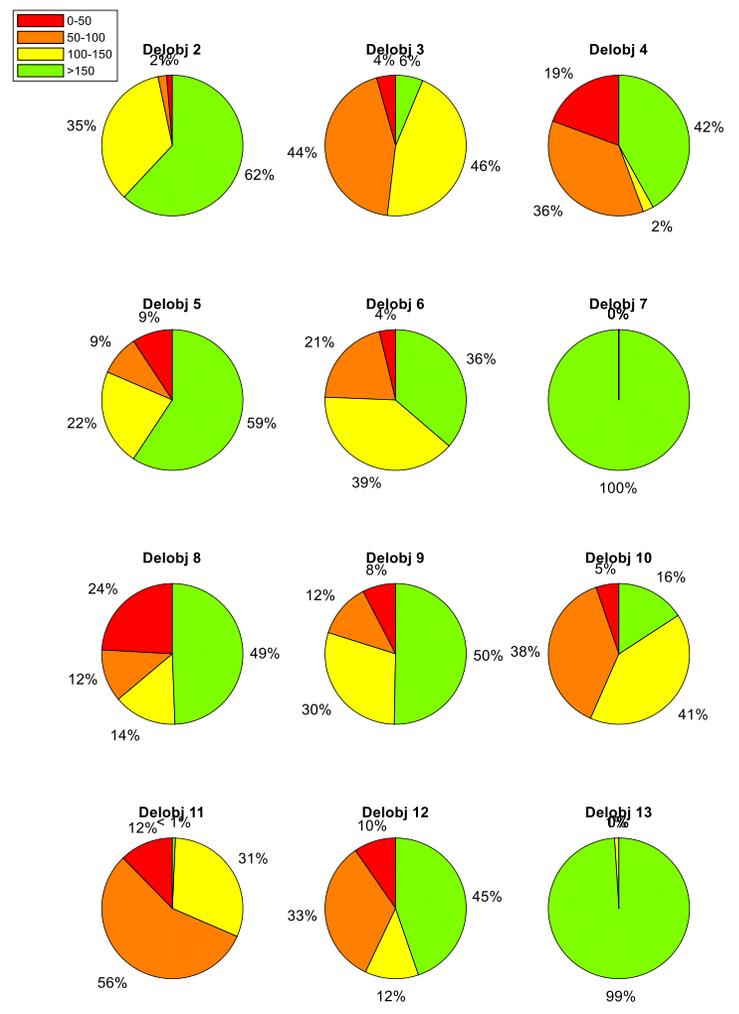


Sweden, right line

ADAS dete



Retroreflexion, dry



[Vevaxelgatan, 212 41 Malmö til Vevaxelgatan, 212 41 Malmö – Google Maps](#)



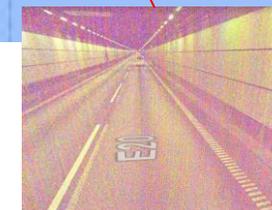
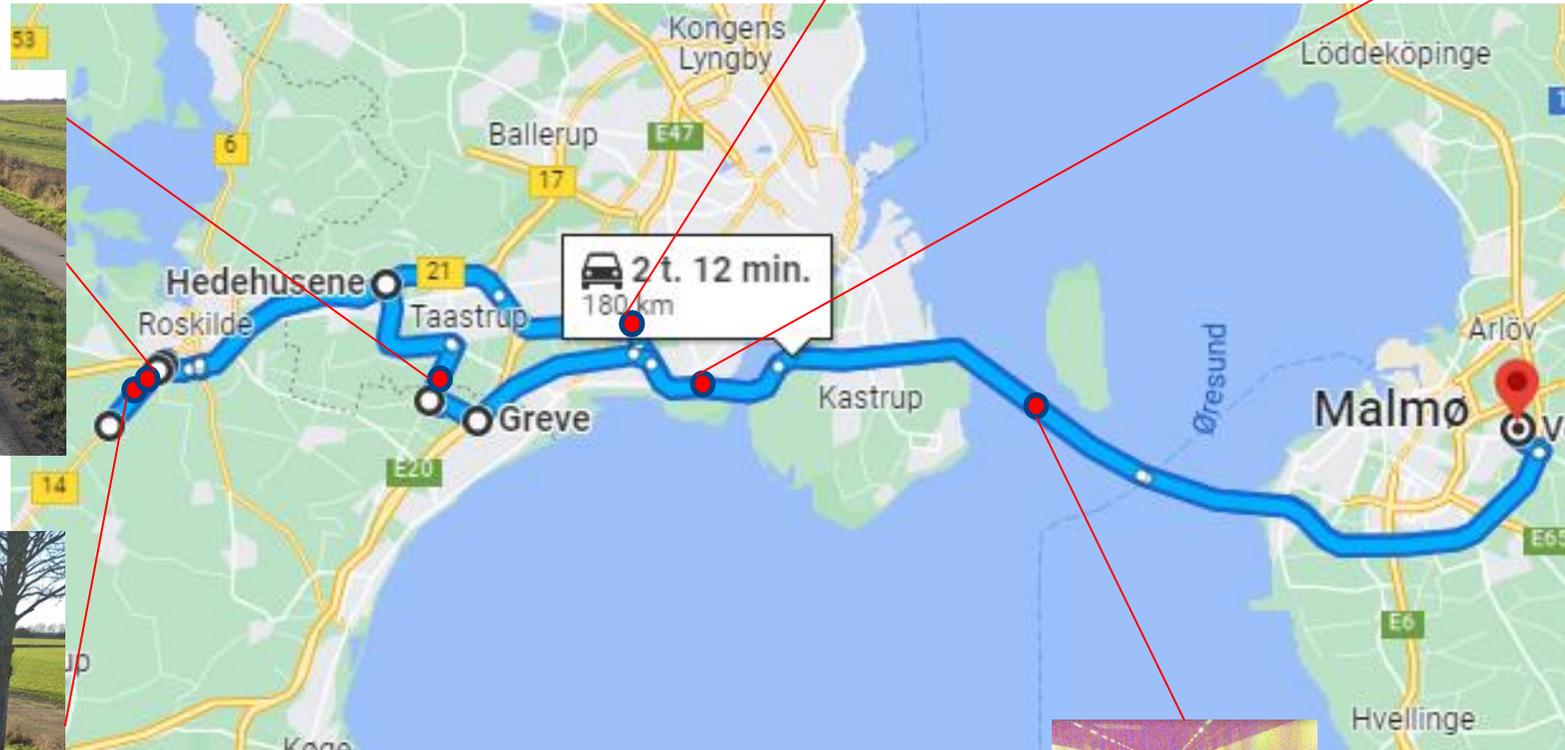
Edge line:
flat, continuous, 10 cm



Lane line:
flat vs. longdot

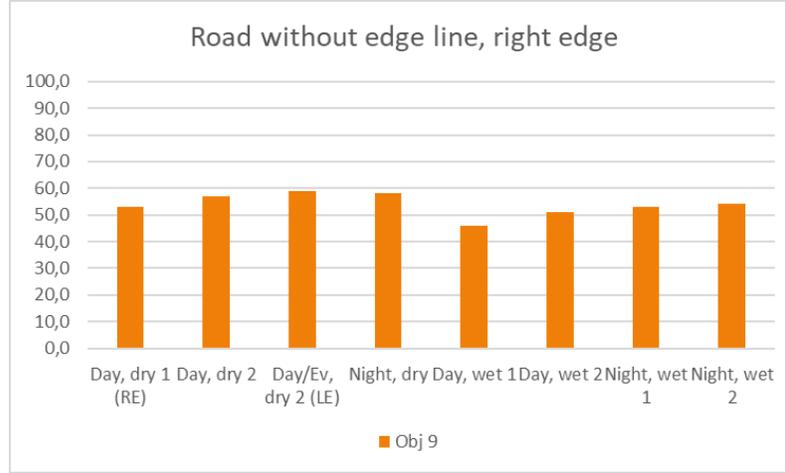
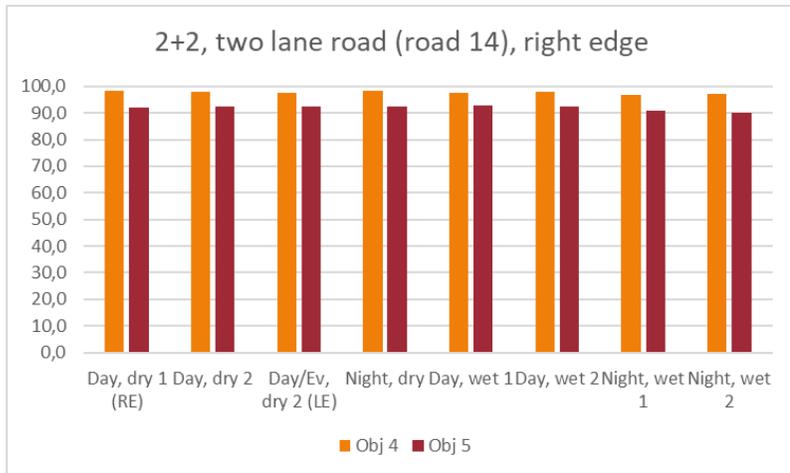
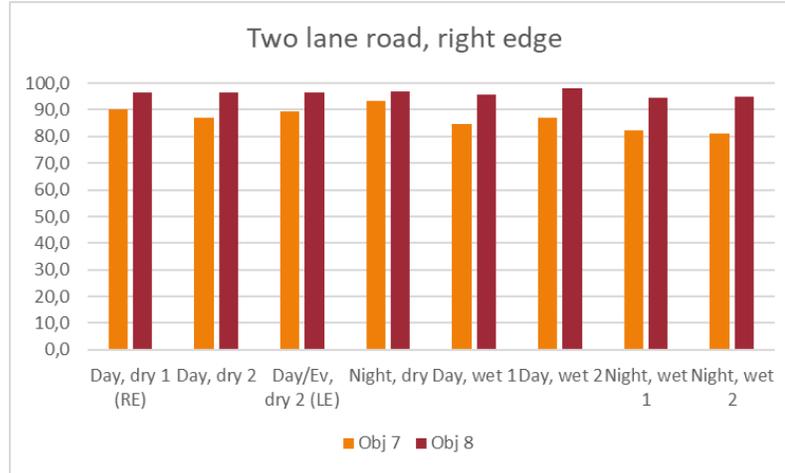
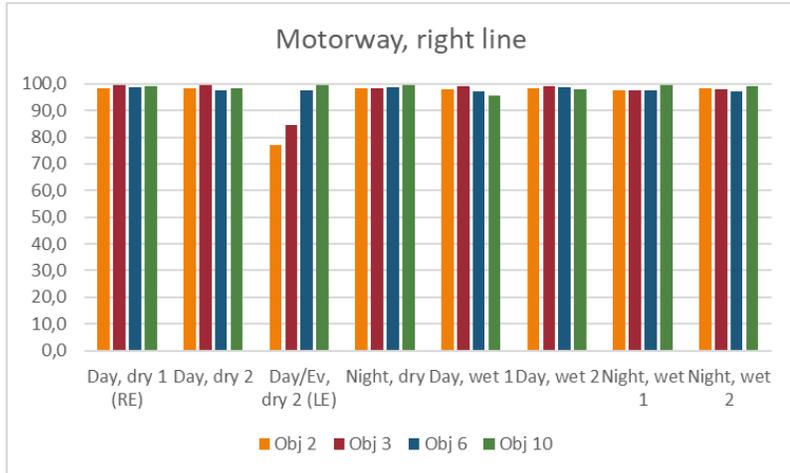


Edge line:
flat vs. longflex

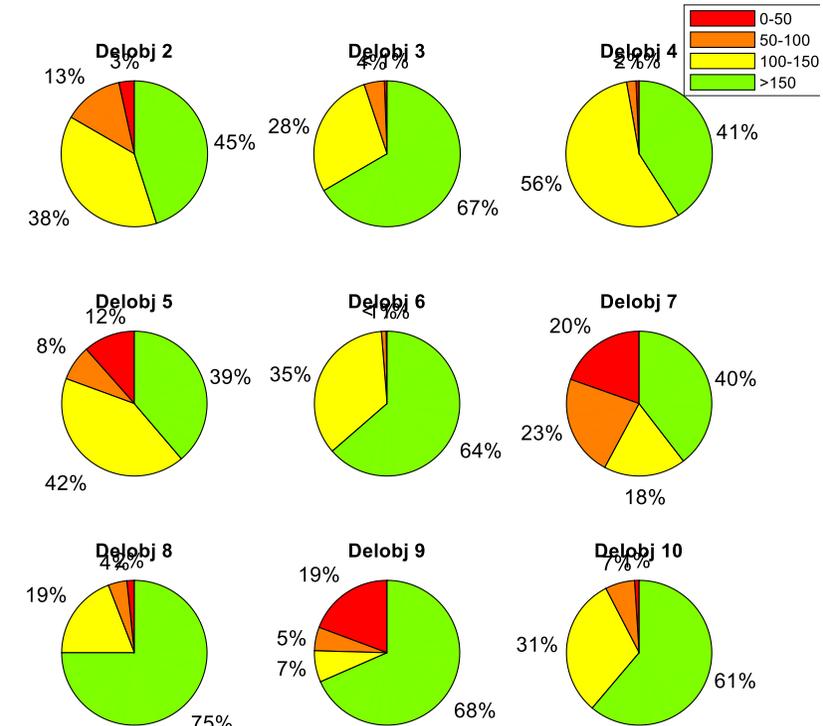


Tunnel conditions for ADAS

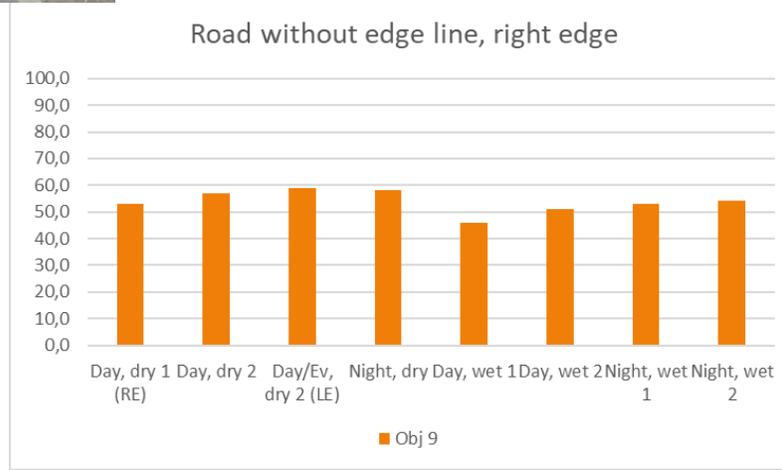
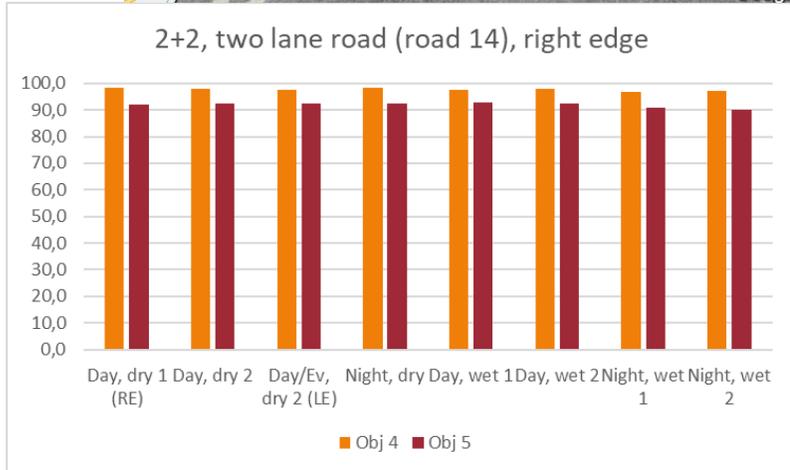
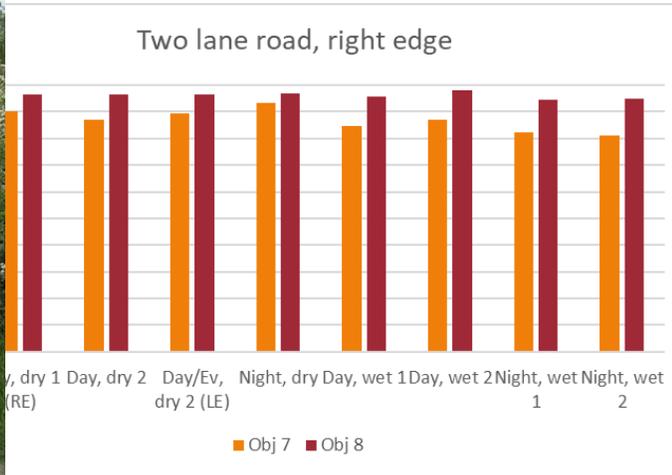
Denmark, right line



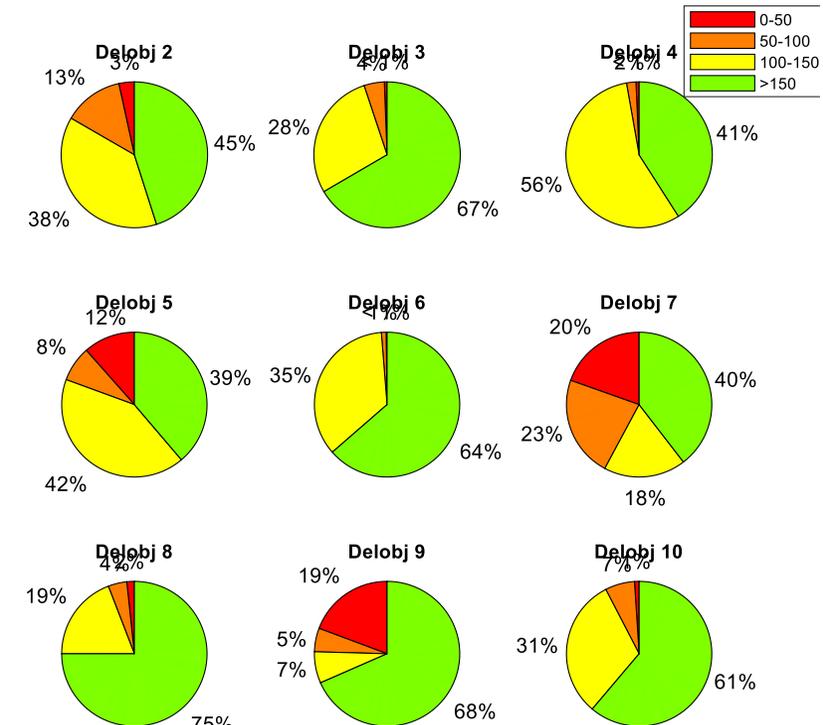
Retroreflexion, dry



Denmark, right line



Retroreflexion, dry



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