Statens vegvesen

Dagfin Gryteselv, Statens vegvesen, Teknologi Drift og vedlikehold

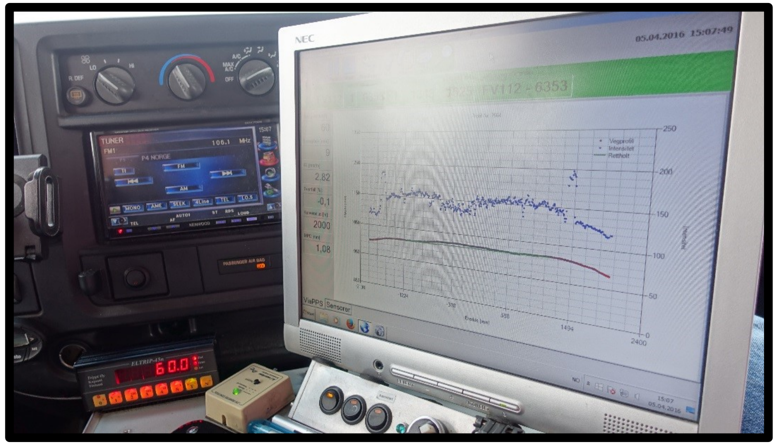
Nye metoder for analyse av tilstandsdata

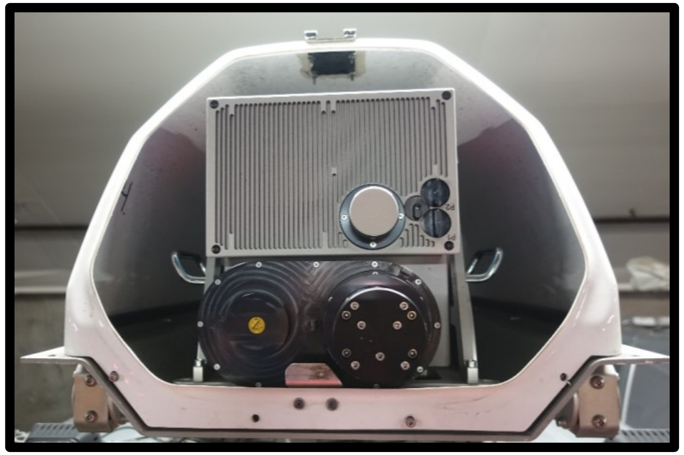
Dekketilstand

Statens vegvesen

Foto: Torleif Haugødegård

Statens vegvesen





Målesystem i Norge:

ViaPPS: SVV 7 stk, FK 8 stk, Field Group

RoAR Friksjon: 5 stk (SVV)

Rosita

Database for dekketilstandsmålinger

Statens vegvesen

Forsiden

Velkommen til Rosita!

Rosita (Road Surface Condition Database) er Statens vegvesens sentrale forvaltningssystem for måledata fra dekketilstandsmålinger (spor/je
riks- og fylkesvegnettet. Systemet overfører nøkkeldata til Nasjonal vegdatabank (NVDB) og kan produsere en rekke statistikkrapporter og a
innlogging.

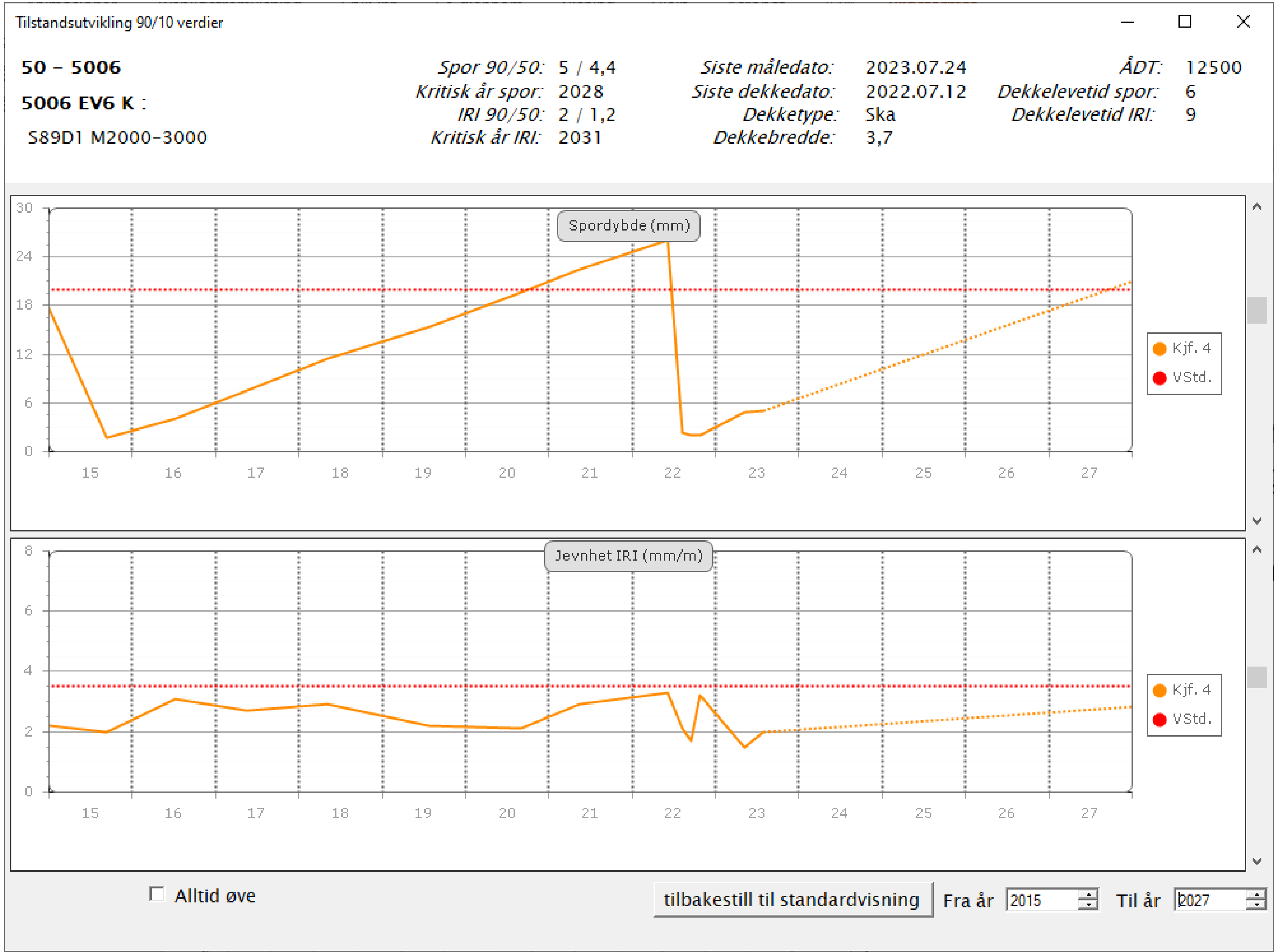
	Spor/jevnhet	
	Hittil i år	Totalt
Antall målestrekninger:	**14 836**	**240 375**
Målt kjørefeltlengde (km):	**81 777**	**1 526 233**
Datamengde (kB):	**2 070 575**	**32 781 098**

2022:	2021:	2020:	2019:	2018:
		Spor/je	Spor/je	Spor/jev
Hittil i år	Hittil i år	Hittil i år	Hittil i år	Hittil i år
15 017	15 636	**15 751**	**15 851**	**17 316**
85 483 km	86 964 km	**90 474**	**100 136**	**104 351**
		2 267 601	**2 259 332**	**2 363 502**

7.3.0

Tilstandsutvikling spor-ujevnhet på tvers / IRI- ujevnhet på langs

Statens vegvesen



Tilstand lengdeprofil

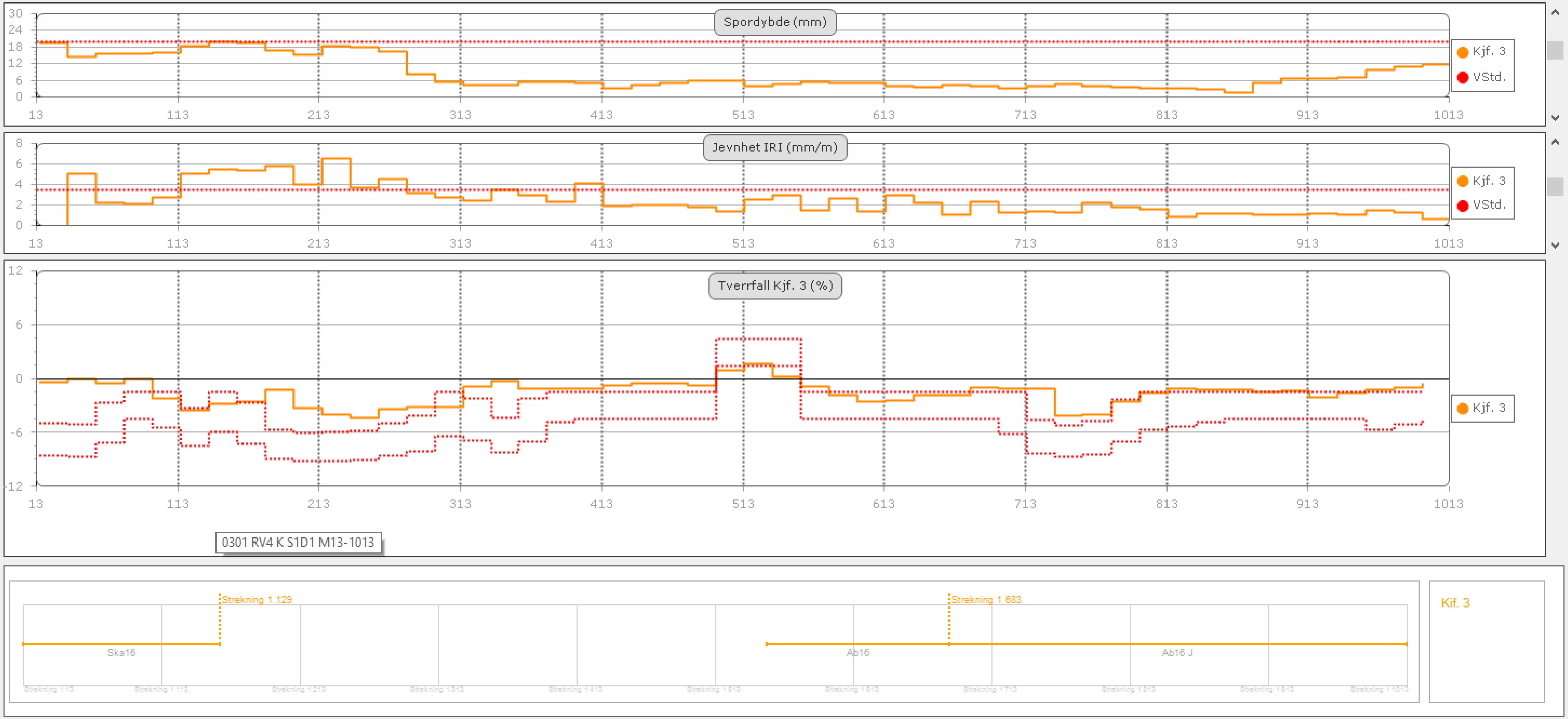
Statens vegvesen

3 – 301

0301 RV4 K : BRU SINSENKRYSSET – BJERKE

S1D1 M13-1013

Spor 90/50:	18,2 / 5,3	*Siste måledato:*	2023.06.11	*ÅDT:*	35000
Kritisk år spor:	2024	*Siste dekkedato:*	2021.05.11	*Dekkelevetid spor:*	3
IRI 90/50:	5,1 / 2,2	*Dekketype:*	Ab	*Dekkelevetid IRI:*	-1
Kritisk år IRI:	2020	*Dekkebredde:*	4,2		



☐ Alltid øverst

tilbakestill til standardvisning

Fra meter/til meter 13 1013

<< >>

Vis hele parsellen

Tilstandsdata spor, ujevnhet, tverrfall, tekstur, kurvatur

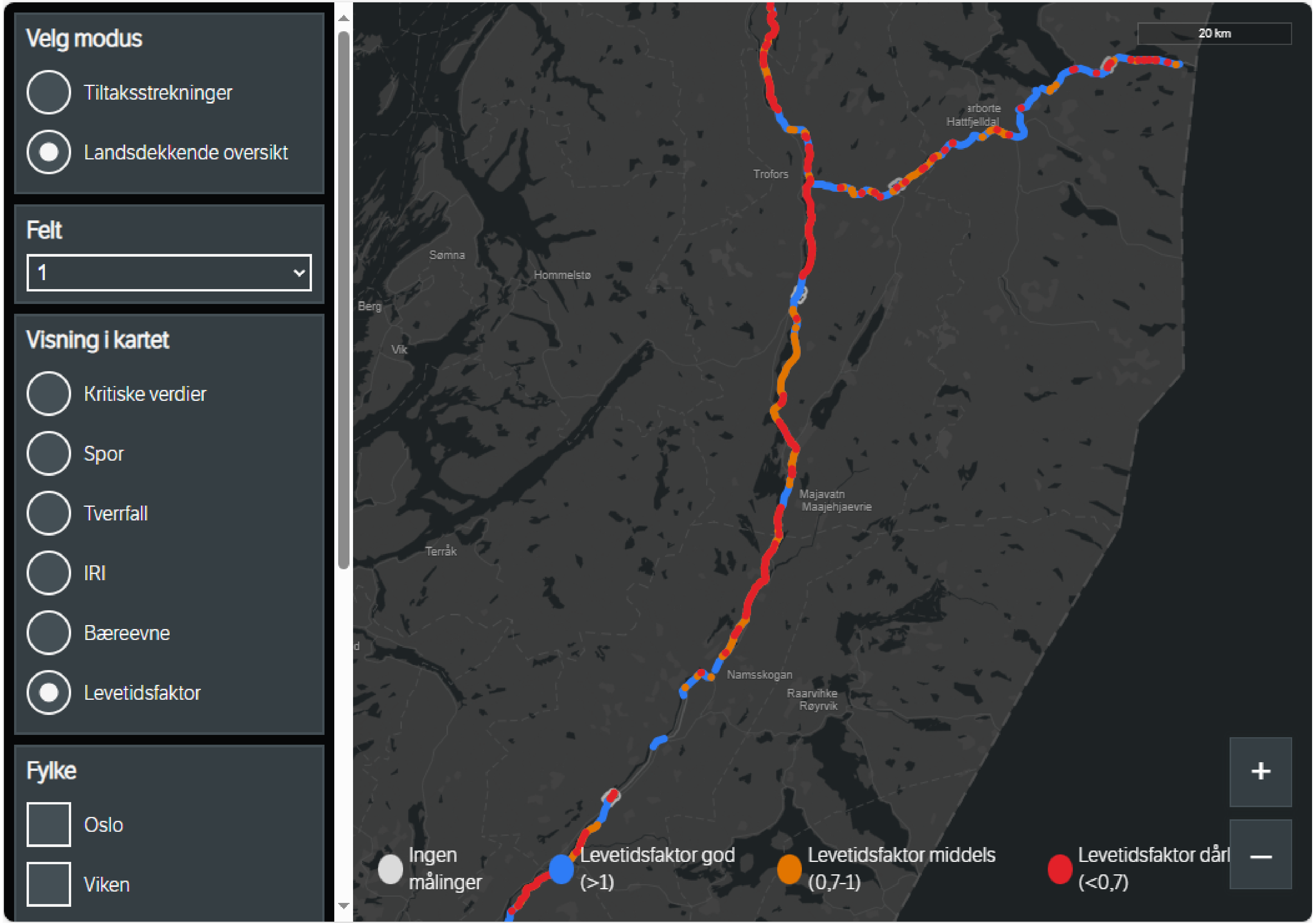
Statens vegvesen

- Data pr kjørefelt med 20m oppløsning (medianverdier) for store deler av vegnettet
- Data fra perioden 2000-2023
- Ligger i Rosita-databesen – > 100 mill. poster
- Ganske utilgjengelig
- Prøver å åpne opp for eksport – faste formater og «csv»-filer

- Grunnlag for ulike analyser – bl.a. beregning/oppdatering av levetidsfaktor for vegdekker

Pilot: Eksempel på bruk av og visning av tilstandsdatadata – ulike parametre

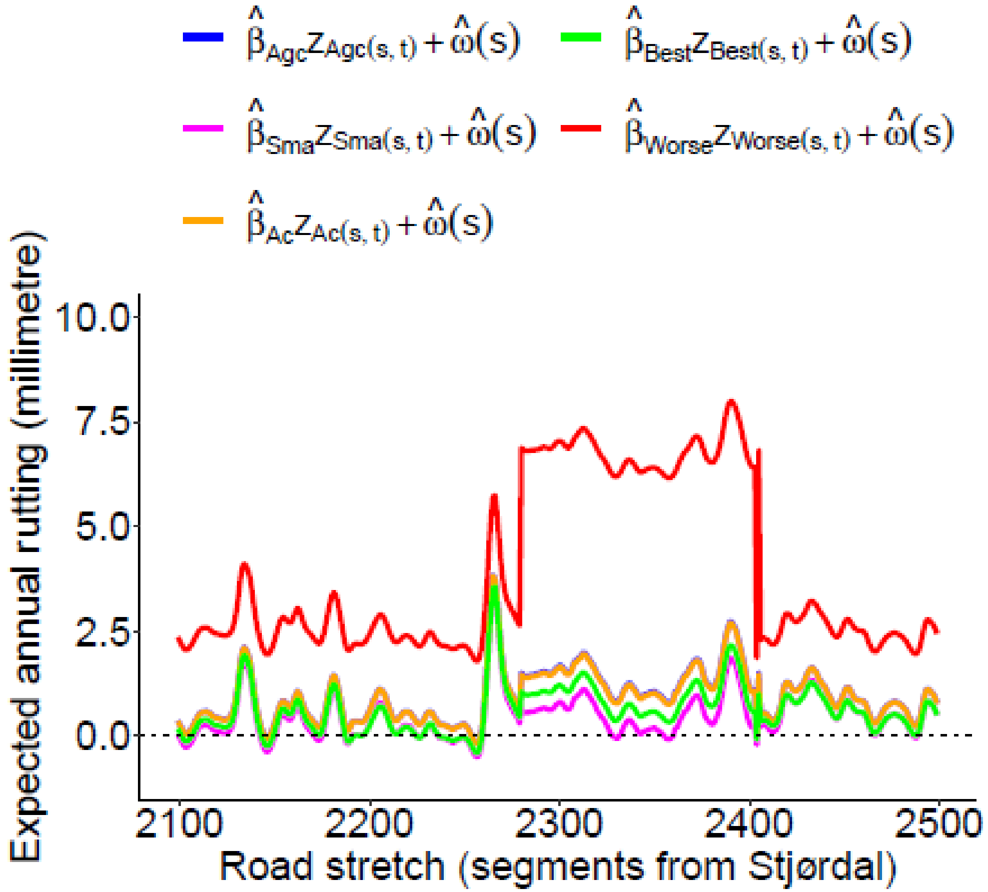
Statens vegvesen



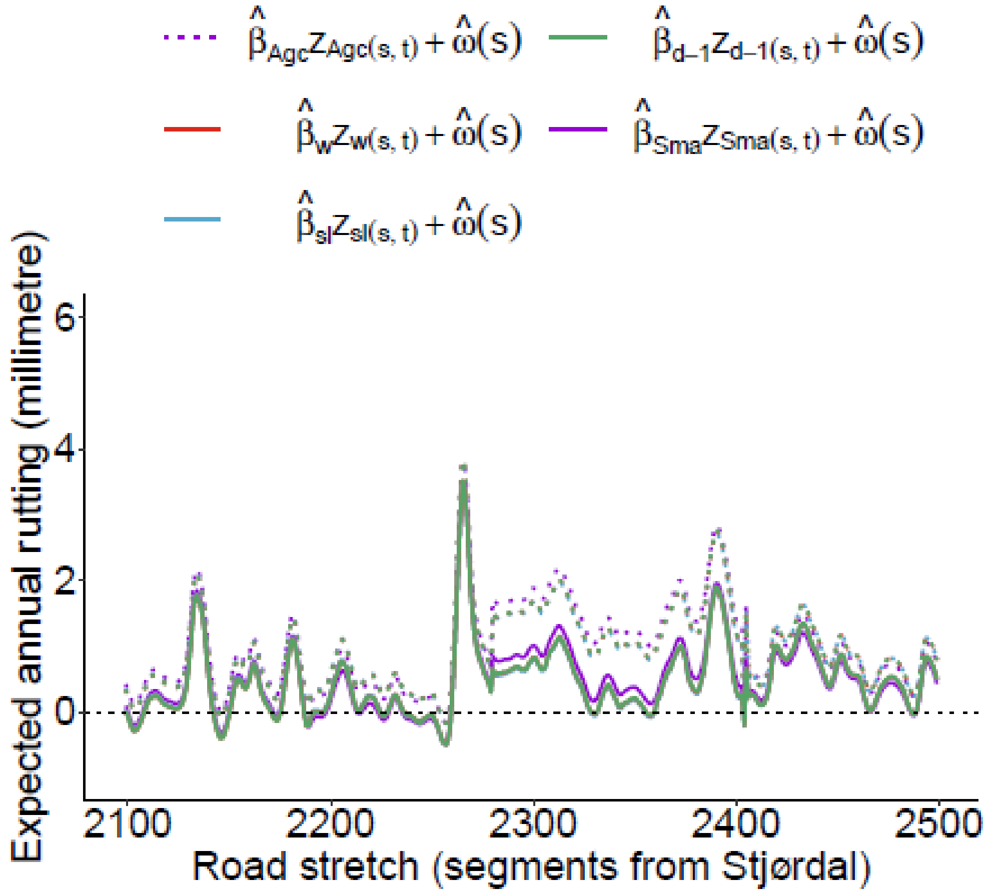
Case: Statistisk analyse av «detaljerte» spordata (20m median) fra 2010-2021

Statens vegvesen

Eks: Årlig sporutvikling – Best / Worst scenario (kilde: PostDoc Natoya Jourdan – FoUI SMARTere vedlikehold)



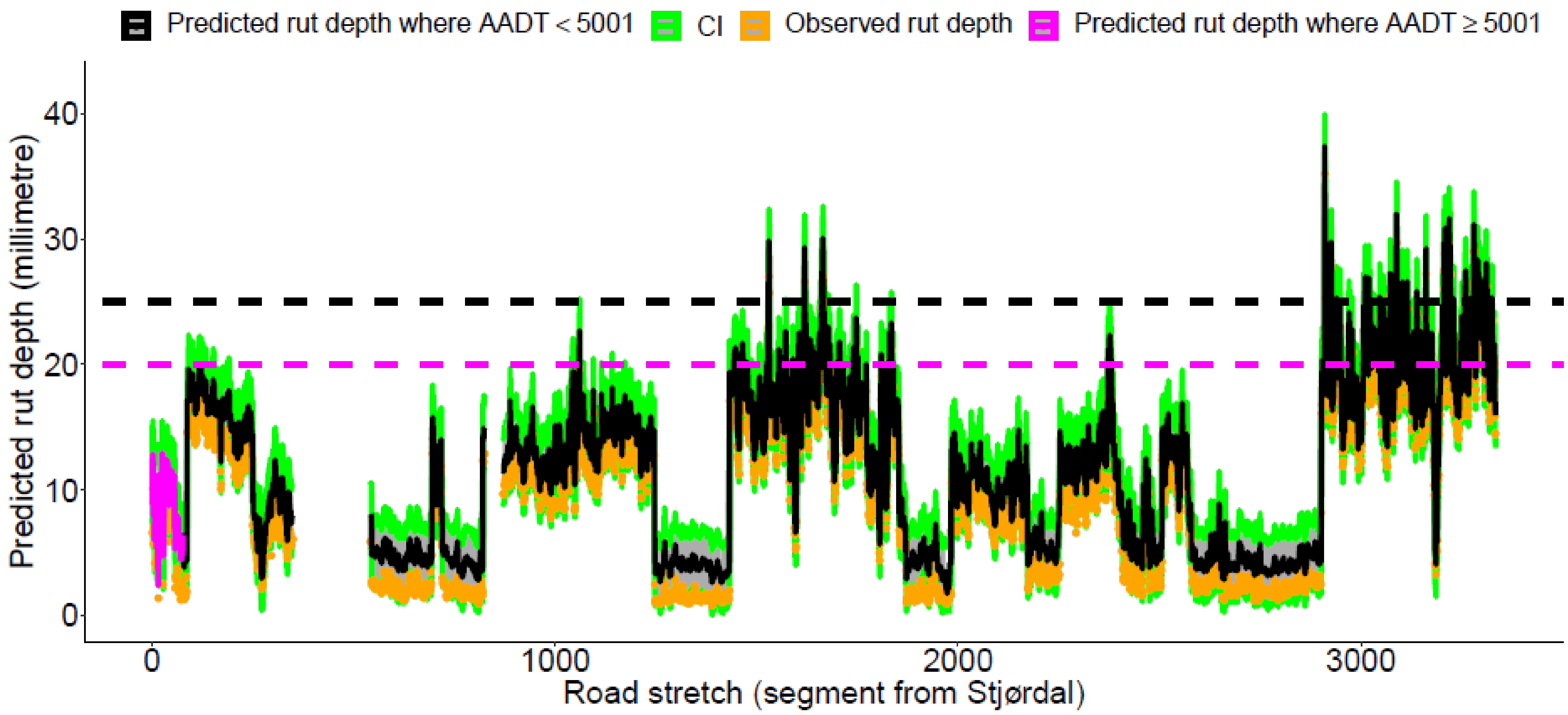
(a) Expected annual rutting for road segments 2100 – 2500 towards Sweden.



(b) Expected annual rutting from adding each fixed covariate sequentially.

Eks: Prognose spor – strekninger/punkt med «unormale» verdier for sporutvikling

Statens vegvesen



(kilde: PostDoc Natoya Jourdan)

Skadekartlegging med bruk av bilder og AI-teknikker

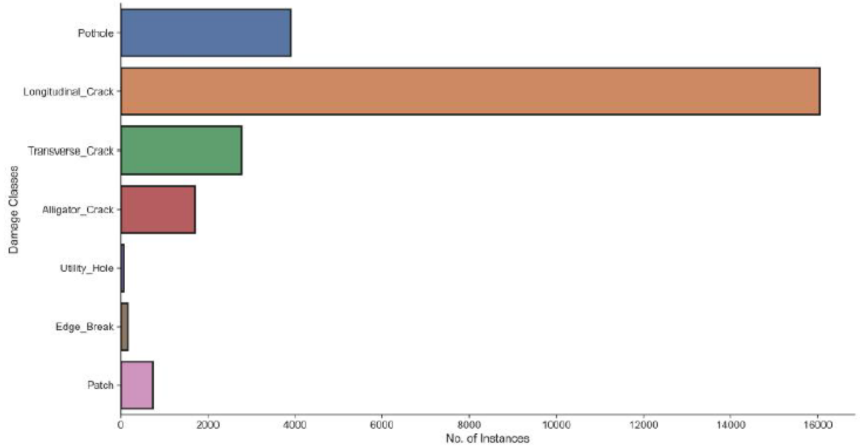
Statens vegvesen

- PostDoc og Phd-kandidater ved NTNU - tilknyttet FoUI-program SMARTere vedlikehold
- Ser på bruk av Vegbilder, men også bruk av rimelige kamera montert på f.eks. busser

Current Work Progress

Data Collection and Annotation

- Images are currently collected by Innlandet Fylkeskommune.
- Norwegian Road Damage Dataset (NRDD)
  - 6258 Images (County Roads)
    - Longitudinal Cracks = 16041
    - Pothole = 3902
    - Transverse Crack = 2765
    - Alligator Crack = 1701
    - Patch = 744
    - Edge Break = 159



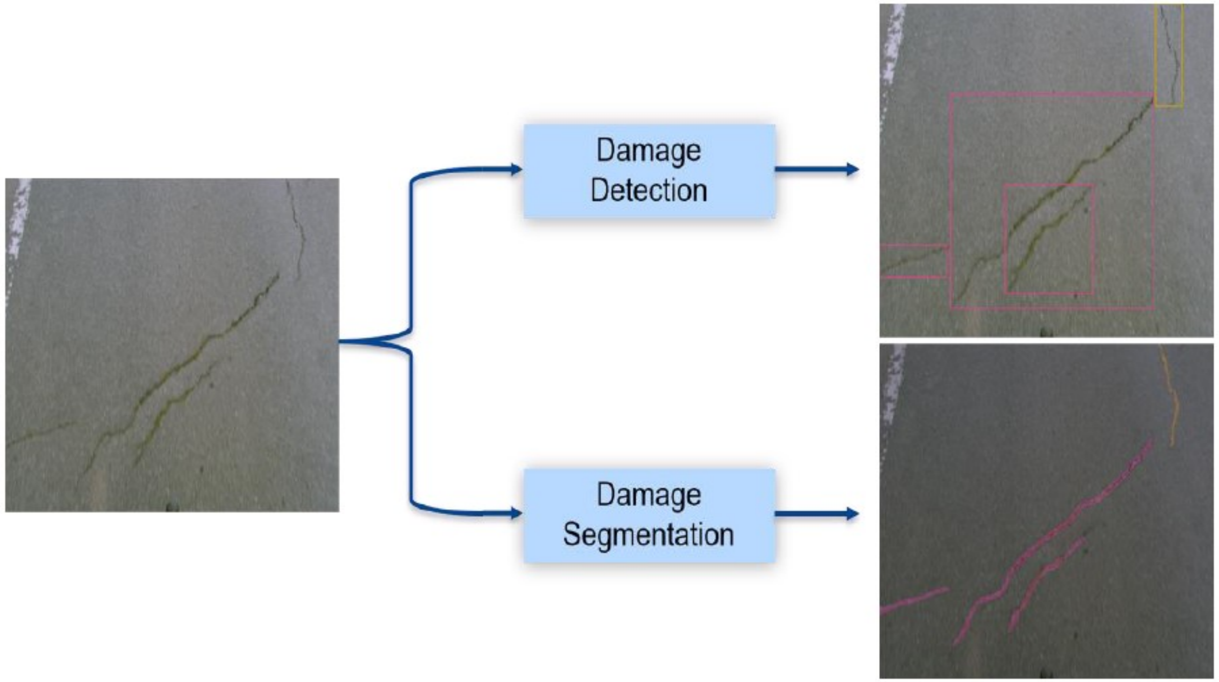
Kilde: Madhavendra Sharma, NTNU

NTNU | Kunnskap for en bedre verden

Dekkeskader – utfordringer med automatisert registrering

Statens vegvesen

Damage Segmentation



❑ Importance of damage segmentation

- Detection bounding boxes consider only the length of the cracks and totally ignore the width.
- A single bounding box may contain more than one damage.
- Produce over/underestimation.
- Segmentation gives a more accurate estimation of the damaged area than the bounding boxes.

Kilde: Muneer Al-Hammadi, NTNU

Dekkeskader – utfordringer med automatisert registrering

Statens vegvesen

Current Status and Future

- Besides the development of segmentation techniques, we need to solve the problem of data scarcity.
- A simple tool is being developed to facilitate the damage annotation at the pixel level.
- It is based on the Segment anything model.
- A tight bounding box should be drawn around the damage to get a good segmentation for the damage.

Kilde: Muneer Al-Hammadi, NTNU

Statens vegvesen

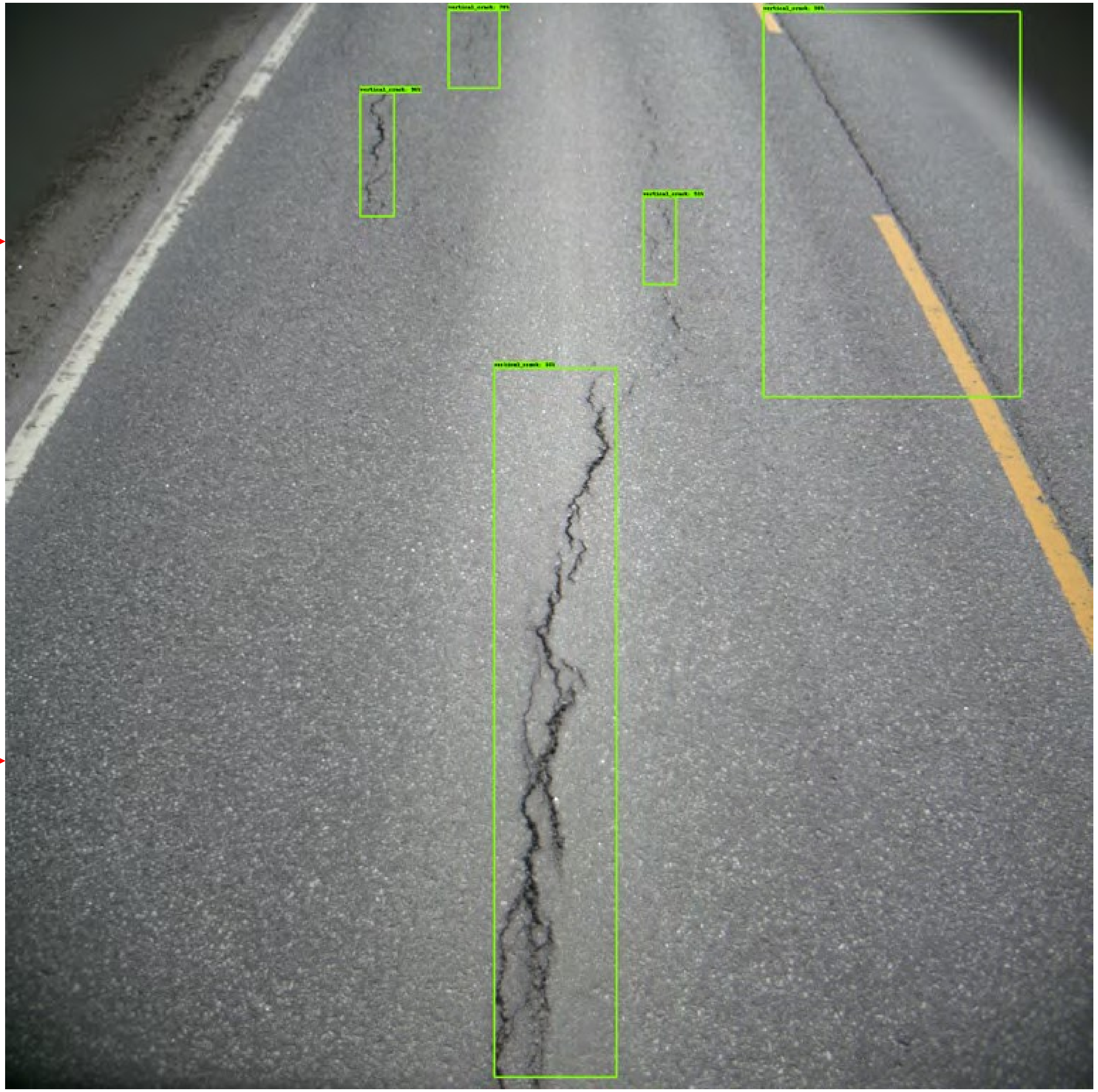
Geo-localization

- **Goal**: To geolocate damages for updating in DT
- Need to geolocate damages to store historical data for predictive maintenance
- Need actual locations of damages to validate our method – not available
- Tested our method on traffic signs

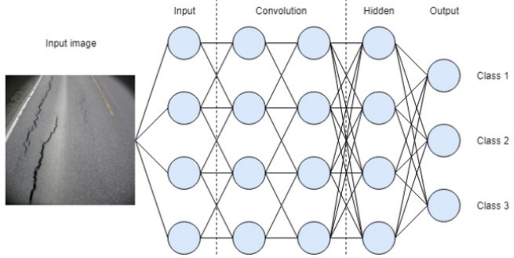
Kilde: Mamoona Birkhez Shami , NTNU

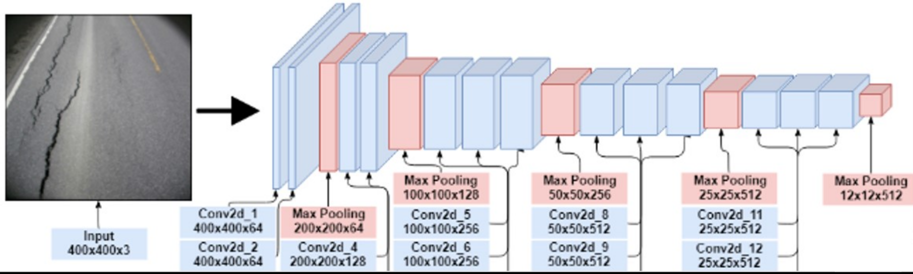
Dekkekamera – Kommer i Vegbilder -Detaljer og kilde for AI-teknikker

Statens vegvesen



- Feedforward ANN
- Deep learning models (RNN & CNN)
- Transfer learning





Tilgjengelige sensortyper for tilstandsregistrering

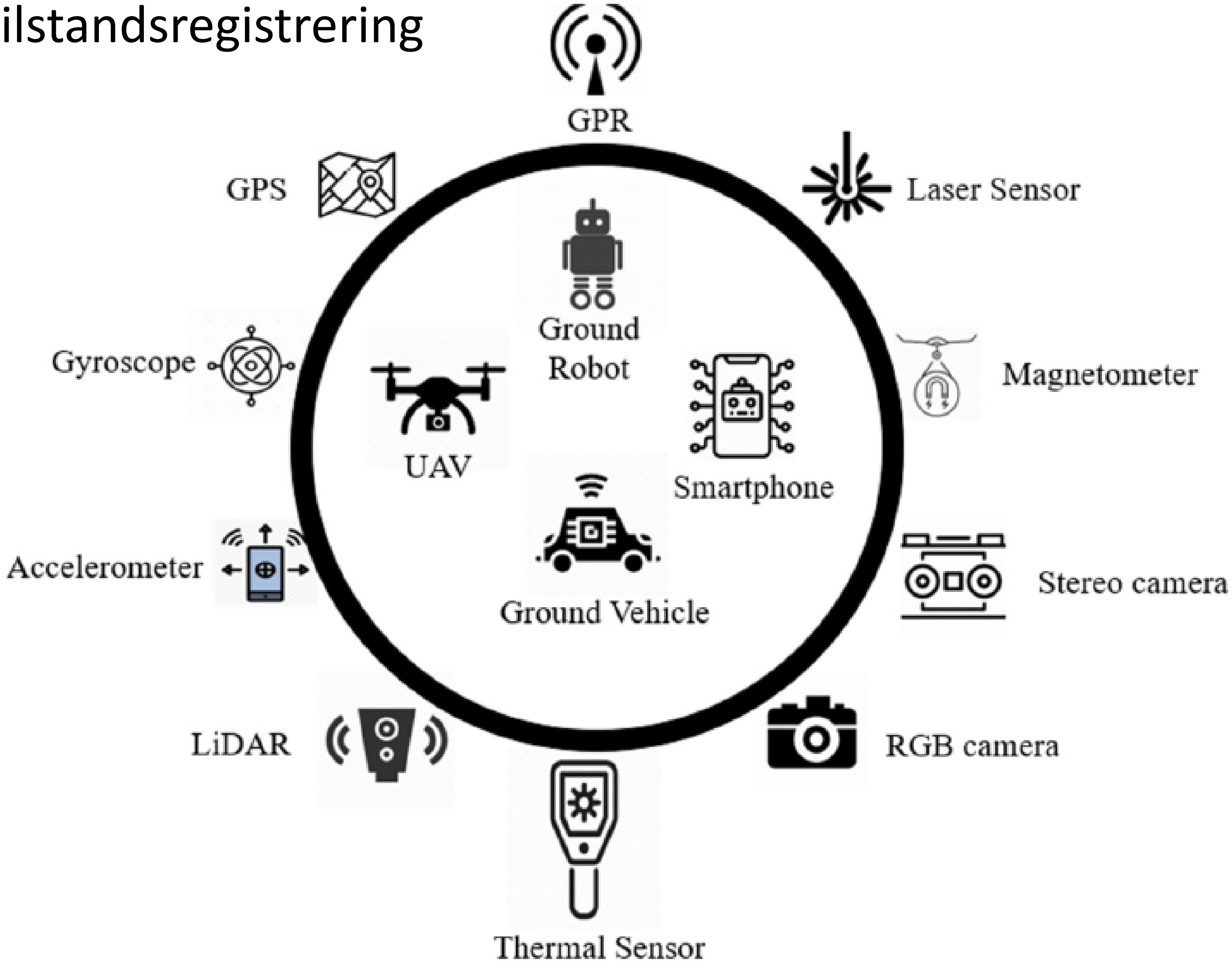


Figure 1. A schematic representation of next-generation sensors and their platforms.

Kilde: Ranyal, Sadhu, Jain (2022): Road Condition Monitoring Using Smaty Sensing and Artificial Intelligence: A Review

Bilen som sensor

Statens vegvesen

- electronic stabilization program (ESP)
- traction control system (TCS)
- anti-lock braking system (ABS)
- active suspension
- lane departure warning systems
- reversing camera
- global positioning system (GPS)
- air temperature.

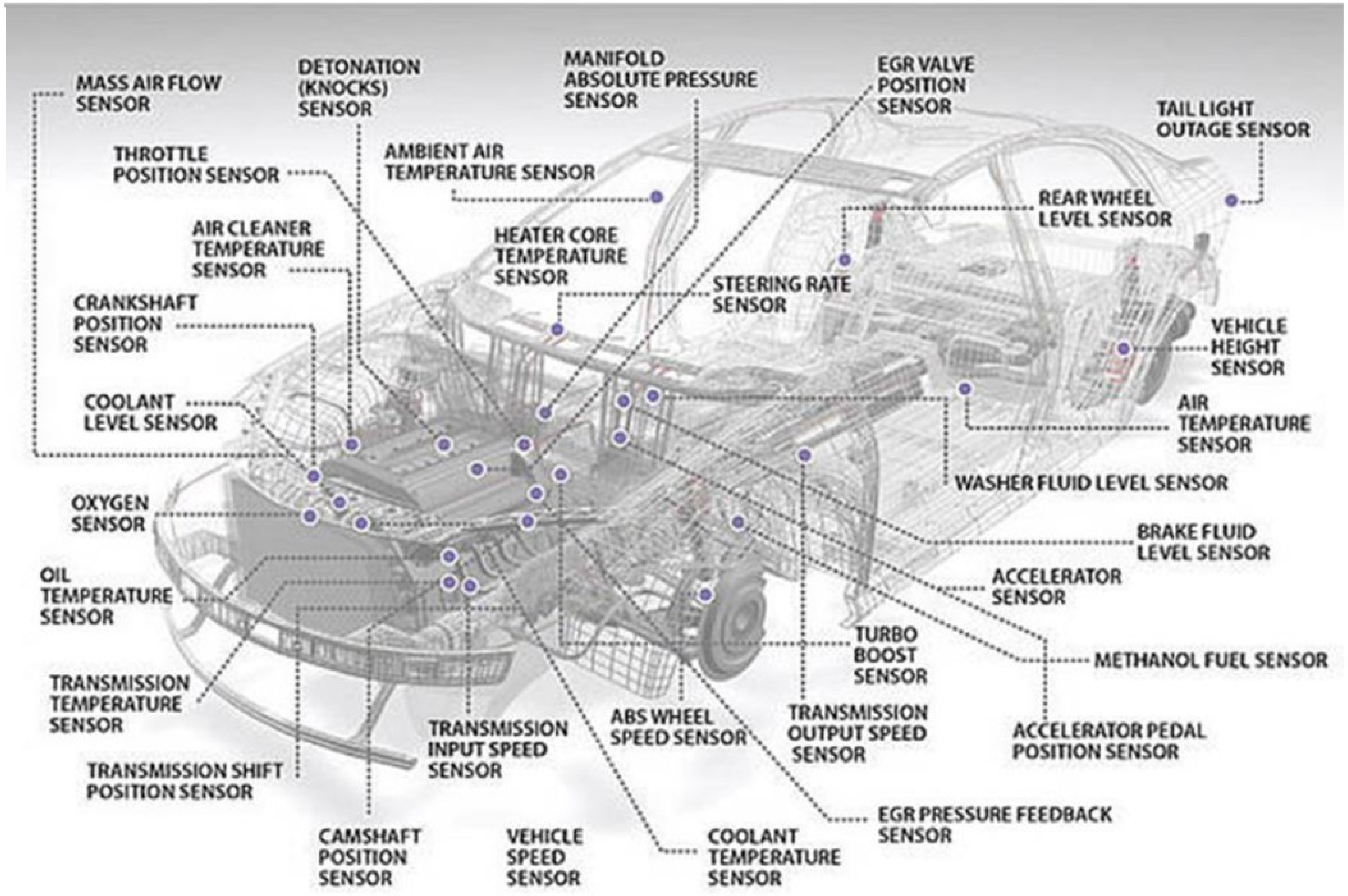
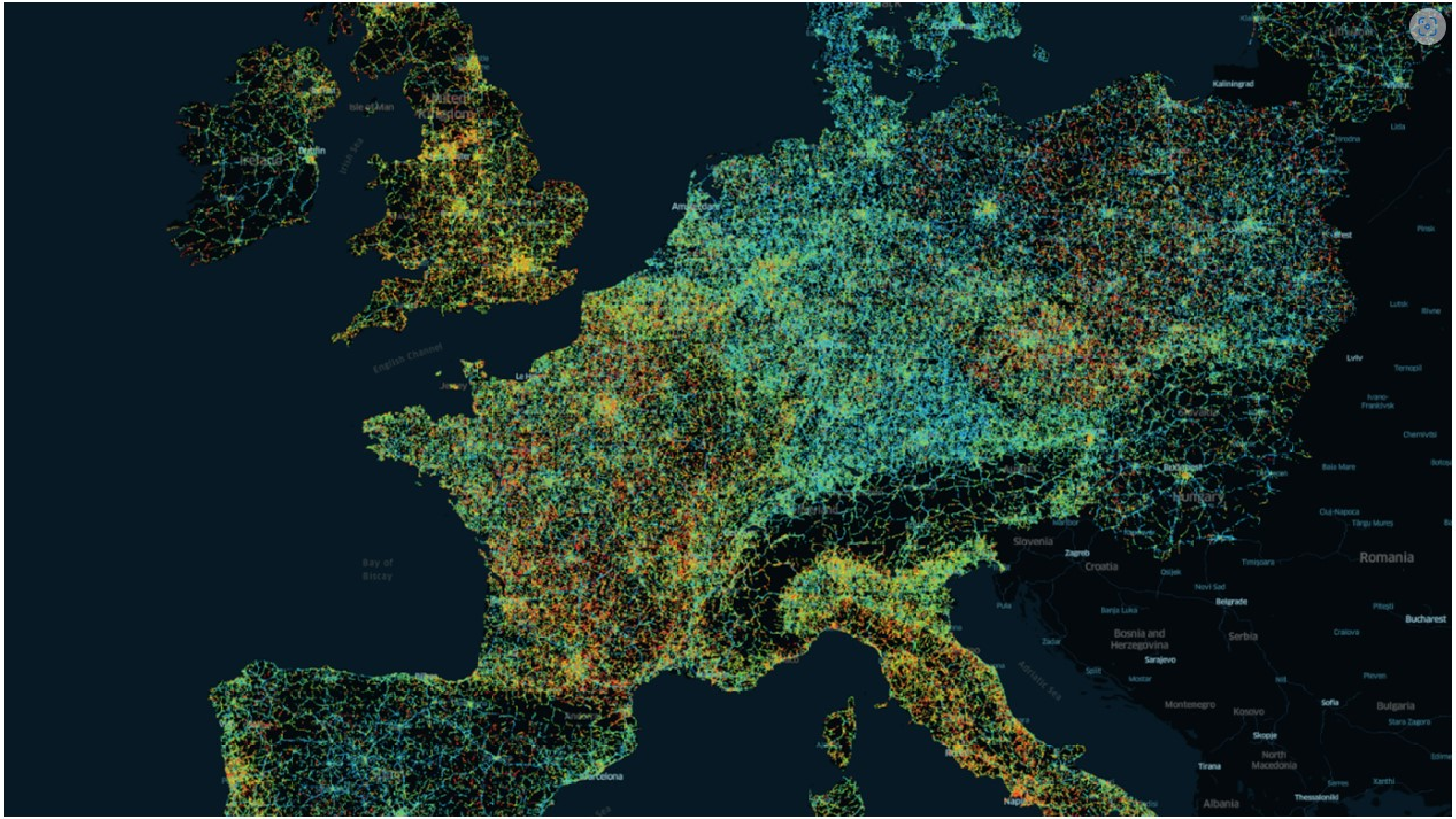


Figure 2.1-3: The CAN bus network [source: can.cia.org]

Kilde: [PIARC-rapport: Use of Big Data for Road Cndiion Montoring, 2023]

Bilen som sensor

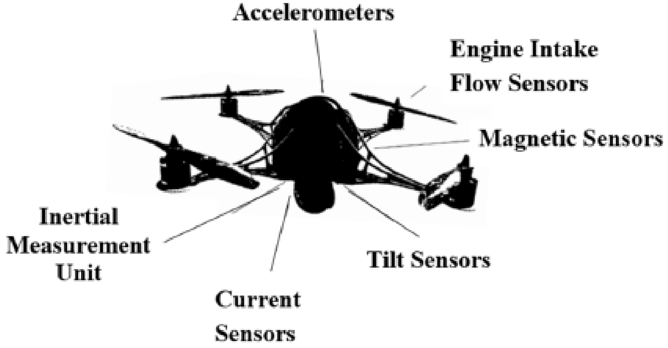
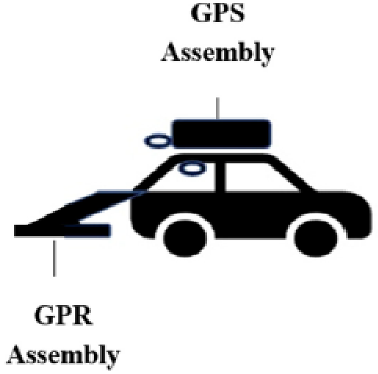
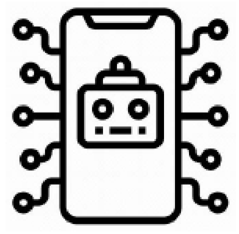
Statens vegvesen



Optimized maintenance management through continuous monitoring of road conditions with live vehicle data

Statens vegvesen

Table 3. List of sensor platforms available for data acquisition.

Sensor Platform	Advantages	Limitations
Unmanned Aerial Vehicle 	Large FOV. High Resolution. In-depth, detailed data. Ease of deployment and accessibility in hazardous areas. Flexibility for quick inspections.	Payload and memory restrictions. Legislative restrictions.
Ground Vehicle 	Long span availability. Array of sensors. High-resolution imagery. Highly dense and occluded terrain.	Small FOV.Less cost-effective. High dependency on manpower.
Smartphone 	Lightweight technology. Economically viable.	Low-resolution imagery. Limited by RGB data.

Kilde: Ranyal, Sadhu, Jain (2022): Road Condition Monitoring Using Smaty Sensing and Artificial Intelligence: A Review

Statens vegvesen

Table 2. A comparative evaluation of the smart sensors used in RCM.

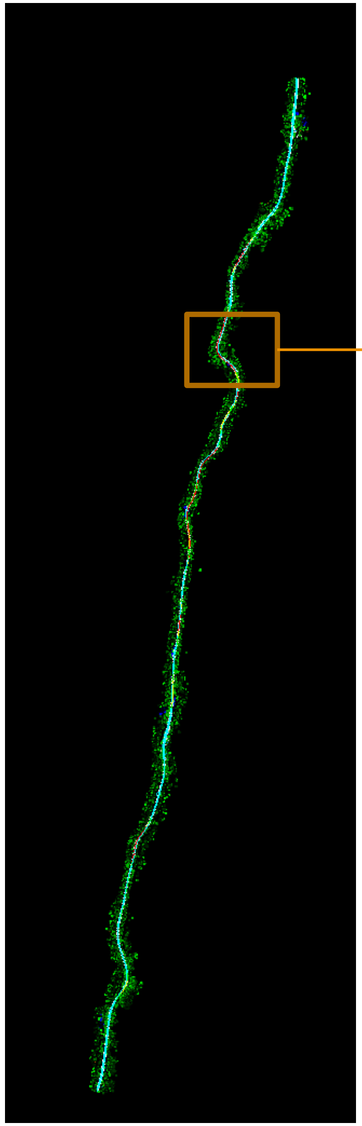
Key Variables	Camera	Laser	GPR	Thermal	Vibration
Technology	2D imaging	3D construction of image using reflection	Radio waves to explore underground surface; creates 3D image of sub-surface	Based on the change in temperature of surrounding objects using infrared waves	Accelerometers, gyroscope, and GPS readings
Processing	Complex image-processing algorithms	Collection of 3D point cloud	Collection of depth images and simulation data required	Collection of heat variation of surface	Readings are directly used
Real-Time Application	Processor dependent	Yes	Yes	Yes	Cannot be used in real-time detection
Sensing Time	While approaching distress	While approaching distress	While approaching distress	While approaching distress	Only after experiencing distress
Characterization of Distress	Based on shape and size	Based on 3D image	Based on 3D image	Based on heat maps	Detection only along wheel path as 1D parameters
Light Sensitivity	Sensitive to illuminance levels, light source position	Not sensitive to light effect	Not sensitive to light effect	Not sensitive to light effect, but surface temperatures	None
Accuracy	Algorithm dependent	High	High	High	Highly susceptible to errors
Resolution	Varying low to high	High-resolution images	Depends on frequency	Needs improvement	-
Processing Time	Data collection and analysis is fast; response time is processor dependent	Data collection is fast and can be collected at speeds as high as 100 km/h	Delayed due to large data processing; however, data collection is automated	Data collection and analysis is fast	Poor as data processing is required
Cost	Economical	High	Highly expensive	Very expensive	Low
Data Type	2D, 3D	3D	3D	2D, 3D	1D

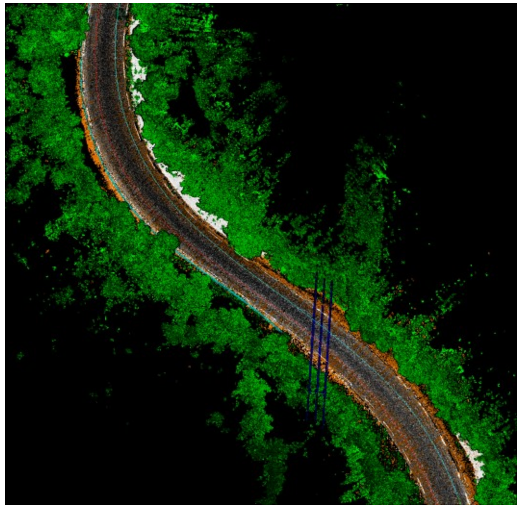
Kilde: Ranyal, Sadhu, Jain (2022): Road Condition Monitoring Using Smaty Sensing and Artificial Intelligence: A Review

Bruk av punktsky fra målebiler

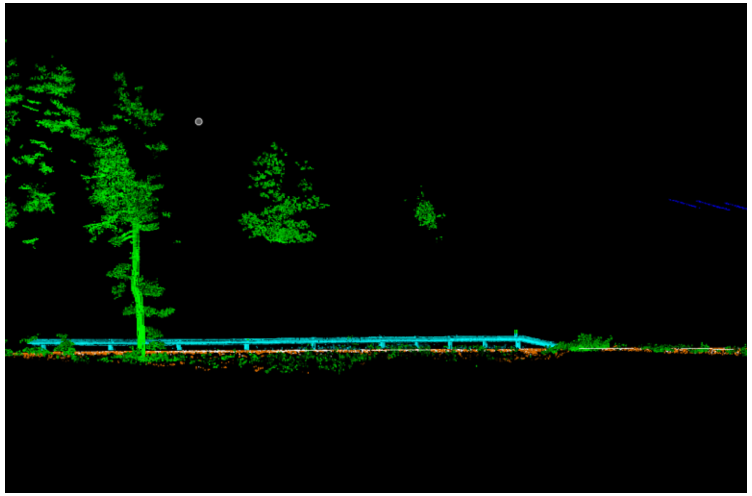
Statens vegvesen

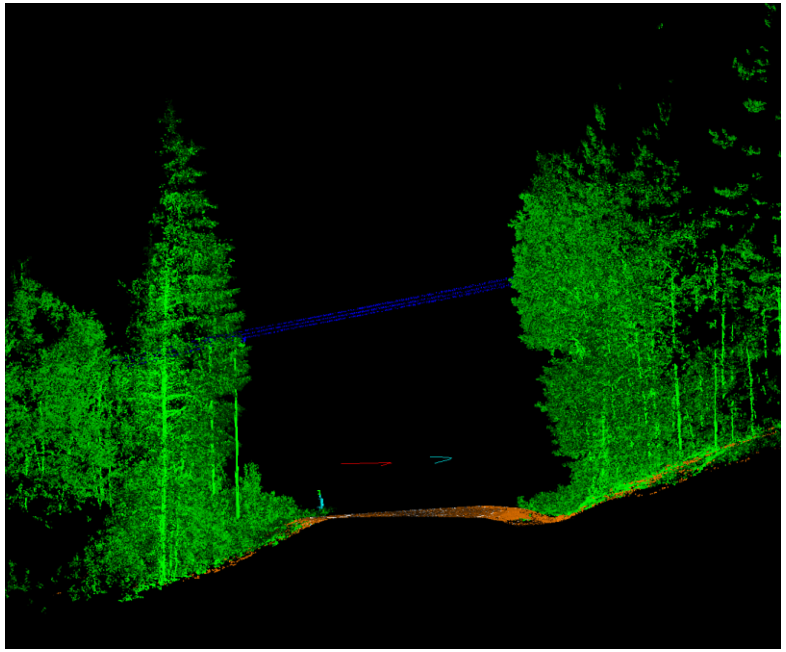
Rv 41 – S5D1 – 0 m – 3392 m





- To gjennomkjøringer justert sammen
- Vegoppmerking i XML fil
- Klassifisering av punktsky:
  - Rekkverk
  - Vegetasjon
  - Høyspent ledninger
  - Fjellskjæringer
  - Biler
  - Huser
  - Bro
  - Hard bakke





PIARC-rapport fra 2023

- Use of Big Data for Road Condition Monitoring

  Briefing Note