Advances in laser and optical technologies for road state detection applications

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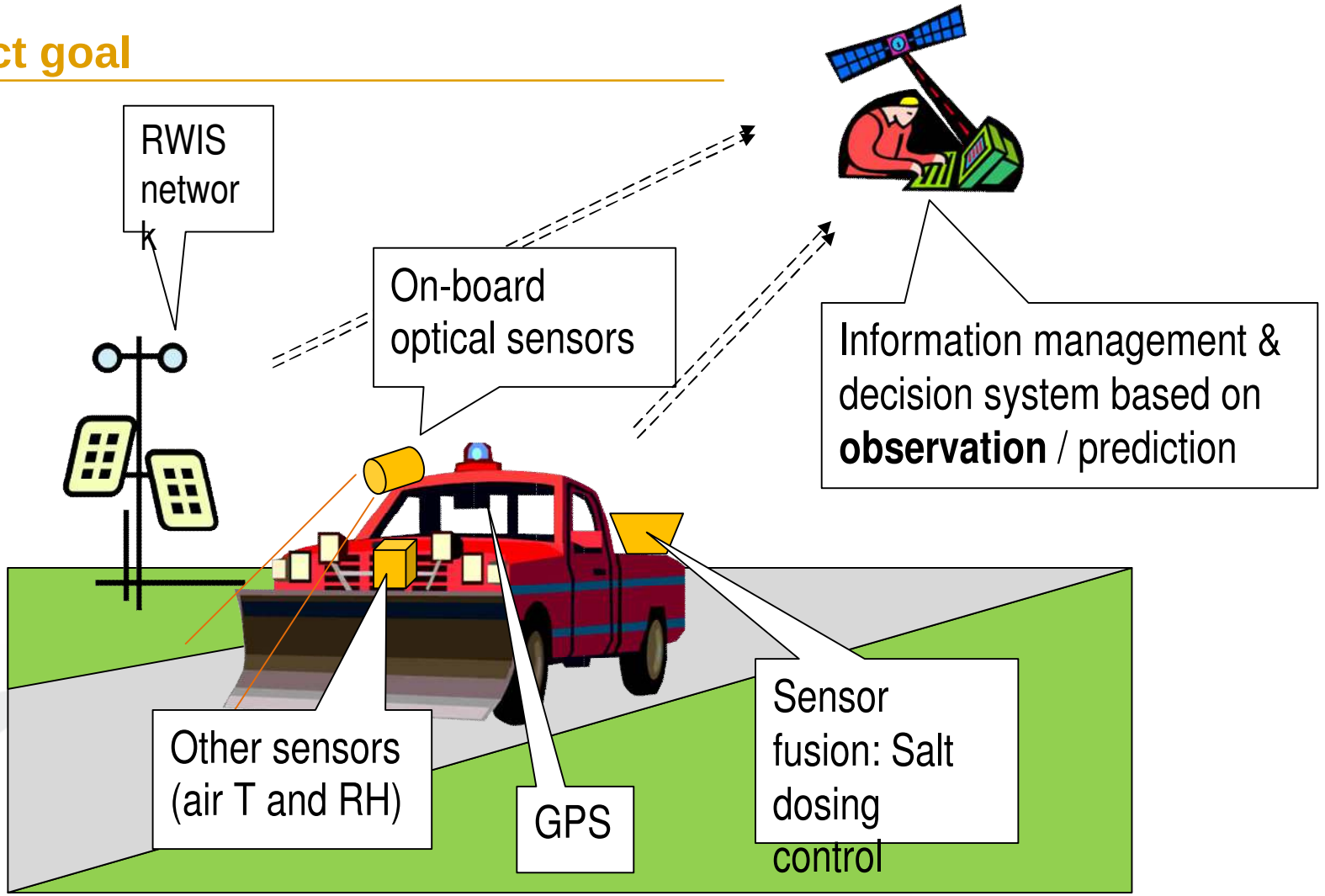
0. Project goal



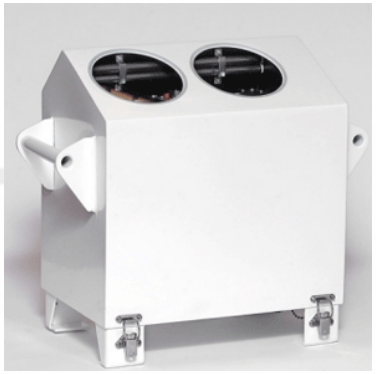
Vehicle-based sensor technologies for winter highway operations

0. CONTENT

1. Introduction: laser and optical technology
2. Optical properties of materials (to detect on road surface)
3. Design of sensor prototypes
4. Preliminary specifications of remote ice sensor
5. Preliminary specifications of remote residual salt sensor
6. Conclusions

1. Laser and optical technology

- Laser (Light Amplification by Stimulated Emission of Radiation): Unique source that produces coherent and monochromatic radiation.
  - Easy to focus/beam shaping (by lenses or other optical devices)
  - Collimated source: communication and metrology applications
- Semiconductor technology (eye safe): optoelectronic engineering

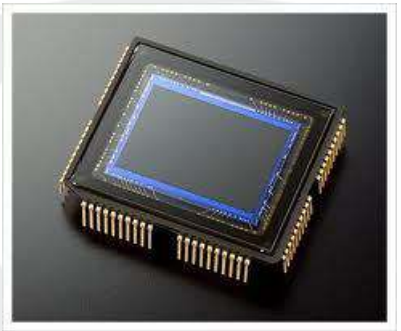


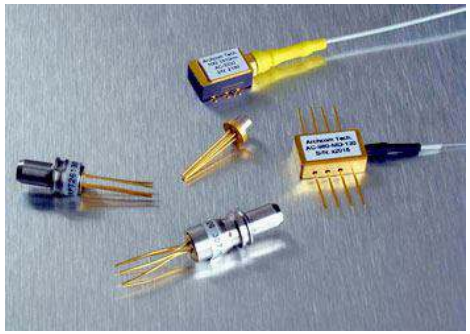
Ceilometer (LIDAR)

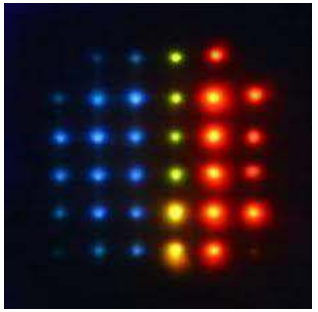
Visibility (LED light scattering)

1. Laser and optical technology

- Optical communications have driven development of optical devices and photonics components in the last 30 years: low cost lasers in the NIR, fiber optic systems, photodetectors, PICs (Photonic Integrated Circuits)…
- Other applications are nowadays promoting advances in lasers and optical technology (biomedical, environmental, manufacturing…): Novel optical sources/detectors in the MIR, tunable sources…
- Take advantage of novel devices and previous expertise for the development of cutting-edge sensor technologies for road applications.

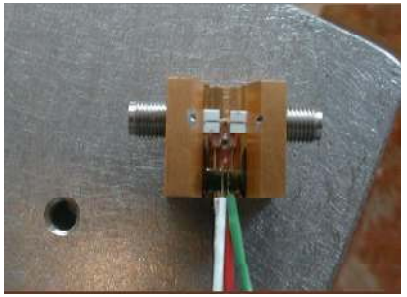


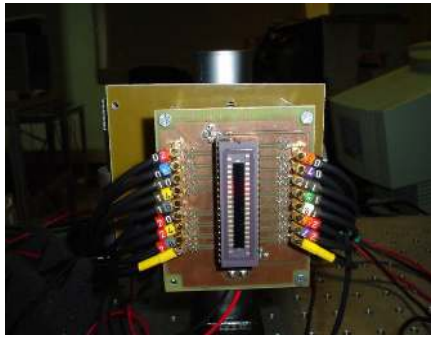


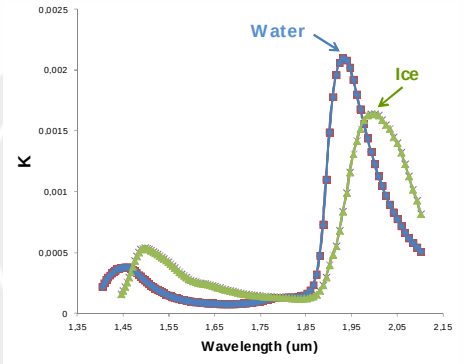


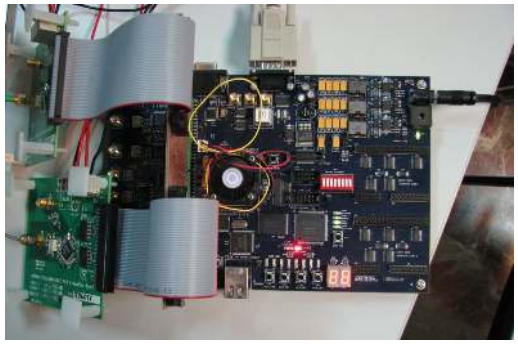
1. Development of laser and optical Sensors: Research & Development capacities within the Group

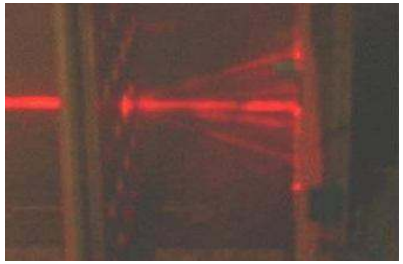
- Design and characterization of lasers and Photonic Integrated Circuits (PICs).
- Development of high sensitivity detection techniques.
- Design of optical systems for beam shaping.
- Deep understanding of sensing fundamentals.
- Embedded system (control and processing).



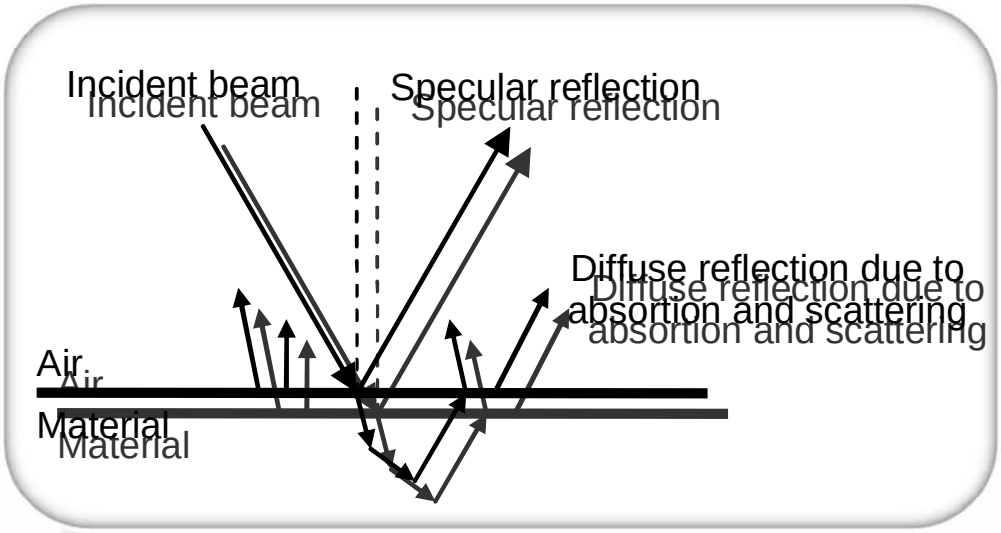


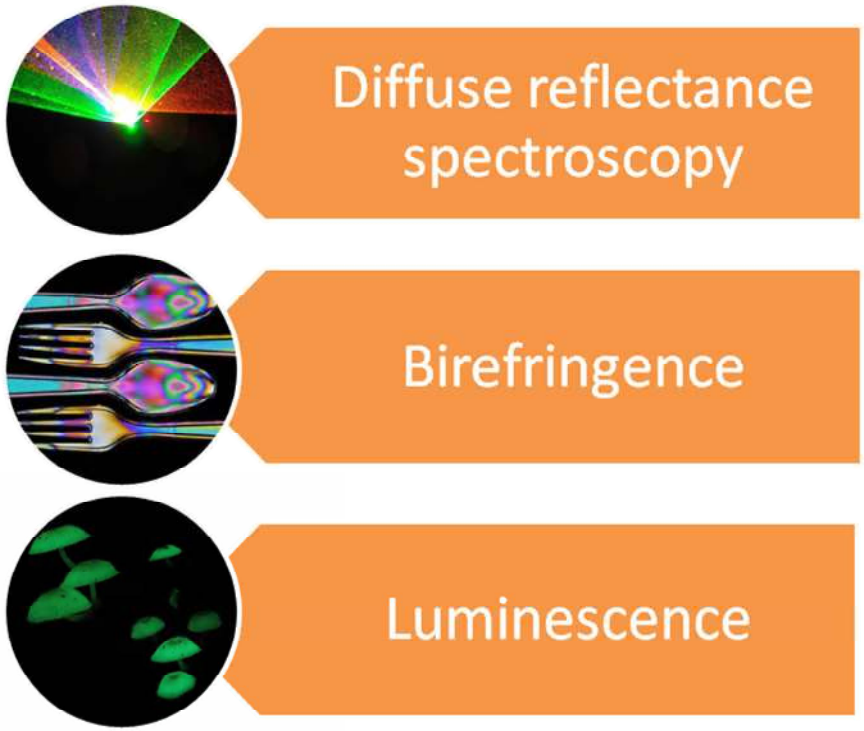




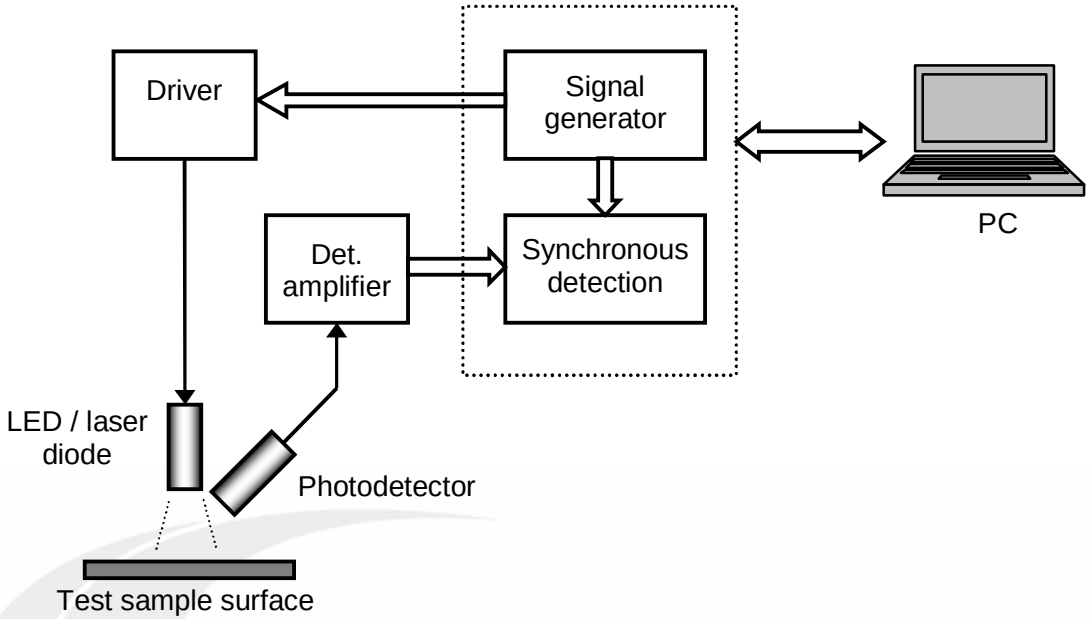


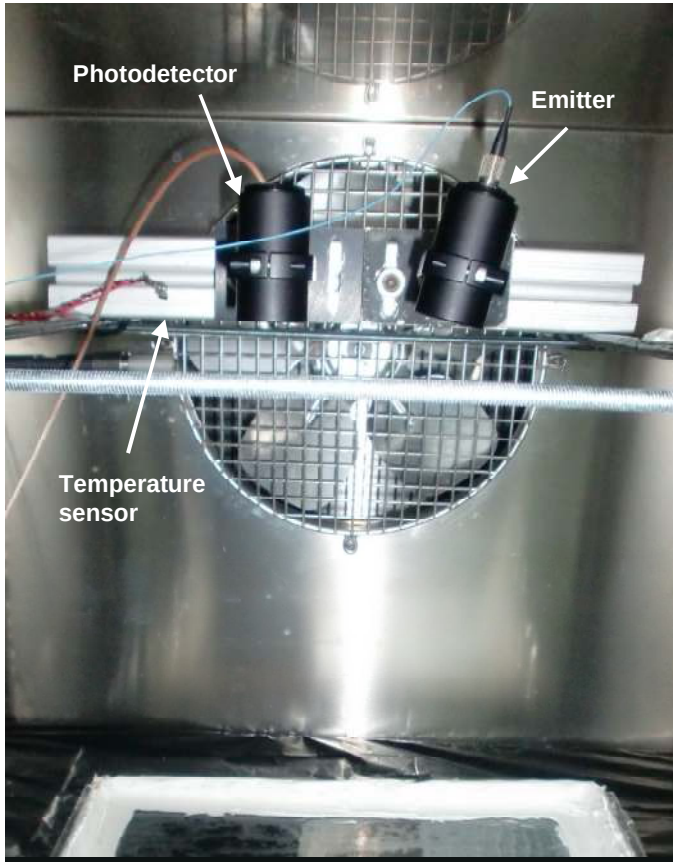
2. Optical properties of materials



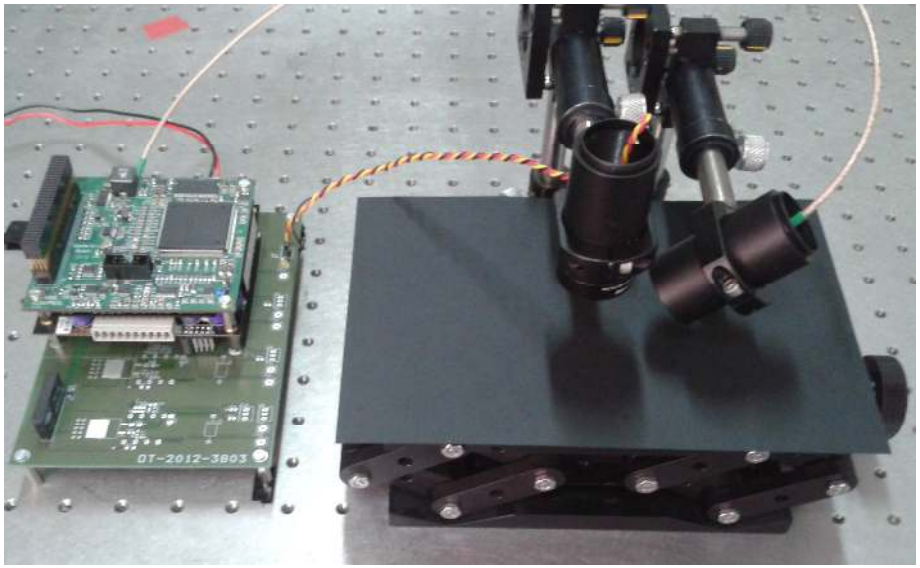


3.1 Basic optical scheme for road state sensors





3.2 Sensor prototypes

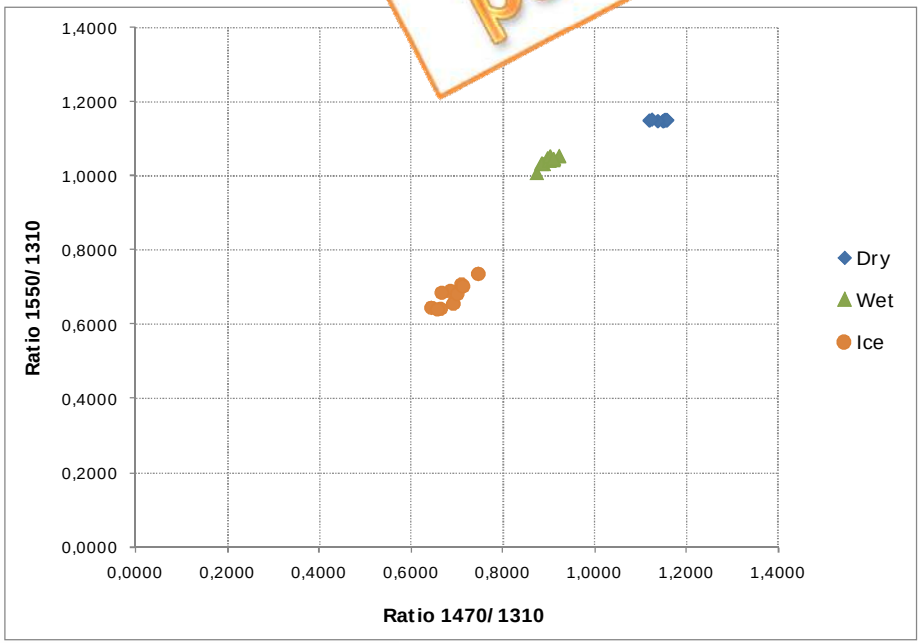


4. Preliminary specifications of remote ice sensor

- Near Infrared diffuse reflectance spectroscopy operating principle
- Semiconductor laser technology (eye safe)

patented

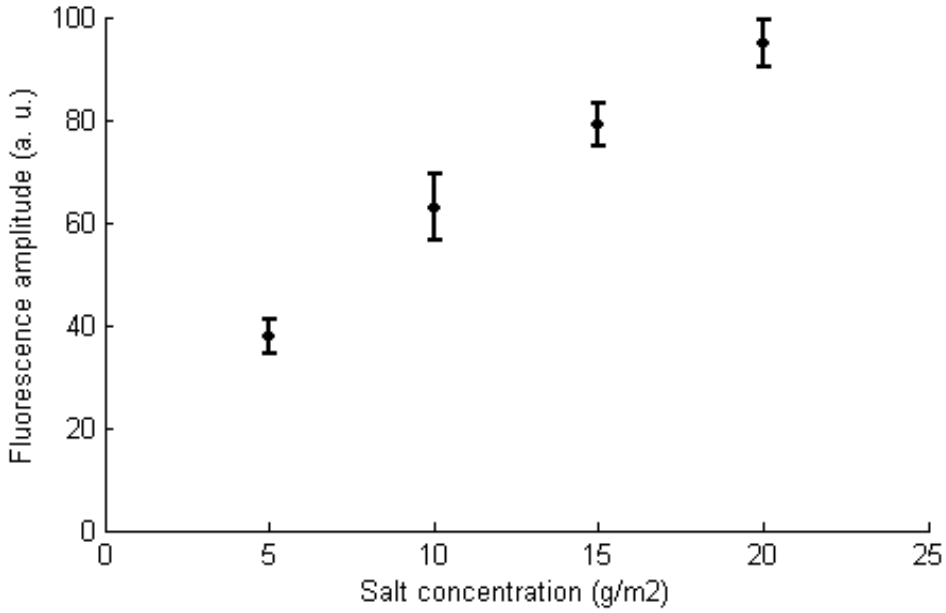
- Road Classification:
  ice, snow, wet, damp, and dry
- Easy integration with existing telematic or data logging systems (including SEVAC protocol)
- Fixed and mobile versions
  (up to 80 Km/h)



4. Preliminary specifications of remote residual salt sensor

- Operating principle based on luminescence properties of salt and road salt additives
- LED technology (eye safe)

- Measure residual salt on dry pavement
- 10% uncertainly (including dependence with temperature) for a full scale value of 20 g/m2
- Compact design for on-board installation: salt dosing control



5. Conclusions

- Cutting-edge vehicle-based technologies can make maintaining winter roadways more efficient, safer and less costly.
- Laser and optical technologies provide cost effective solution for remote mobile sensors.

See you tomorrow at poster session D

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