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# Dealing with Environment Change in All-weather Perception for Autonomous Driving

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# Our mission is to enable autonomous driving everywhere

People, businesses and society should have the benefits of autonomous driving everywhere and everytime. We make that happen. Our unique software will take autonomous vehicles to places where others can't operate.

**sensible**<sup>4</sup>

Key customers



**TOYOTA**

**NOKIA**

**Panasonic**

**MUJI**  
無印良品



# All-weather Perception

The environment is always changing

## Changes happen both suddenly and over a long time

- Weather around the vehicle: rain, slush, snow, fog
- Accumulation of ice and snow over the winter
- Seasonal changes in trees and other roadside plants
- Roadwork and new buildings

## Perception systems need to adapt to these challenges

- Measurement noise due to particles in the air
- Maps of the environment lose precision over time



# Robust Object Detection

Always aware of the surroundings

## Smart filtering

- Remove noise from the sensor signals
- Focus detection on where it matters
- Efficient high-speed filtering methods

## Safe Object Detection

- Identify persistent parts of an object
- Robust to noise in the sensor signal
- Robust to partial occlusion of the object
- Low-latency updates



# Robust Localization

Never losing our way

## Probabilistic mapping

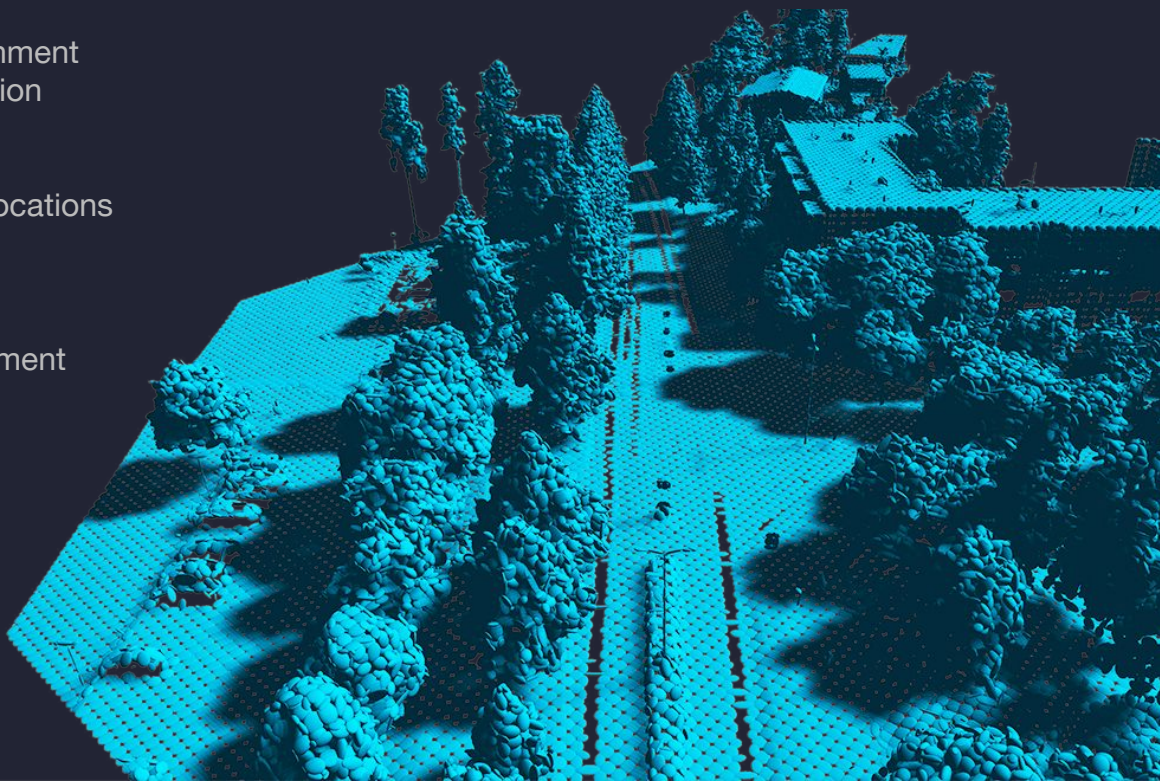
- High-definition 3D maps of the environment
- Enables efficient probabilistic localization

## Robust Localization

- Probability distribution over possible locations
- Efficient high-frequency updates

## Benefits

- Tolerates large changes in the environment
- Tolerates high measurement noise



# Research Collaboration

Defining the methods of the future



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## Robust automated driving in extreme weather conditions

- Visibility estimation
- Friction estimation
- Safe control
- Safe navigation



## Robust perception and decision making for autonomous driving

- Scene analysis
- Robust perception
- Robust localization
- Robust motion planning



## Robust & automated mapping and localization methods

- Autonomous mapping
- HD maps
- Map updating
- Map quality assessment

We are always open for new collaboration!

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[www.sensible4.fi](http://www.sensible4.fi)