Pioneering Challenging Rain Conditions for Trustworthy Automated Vehicles

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Digitrans Rain Testing Plant, DI Dr. Christoph Feichtinger

Can we **trust** advanced machines with navigating the most difficult **challenges**, even during a **rainstorm**?

What is Rain?

Weather event

Precipitation

Vapor

Condensing

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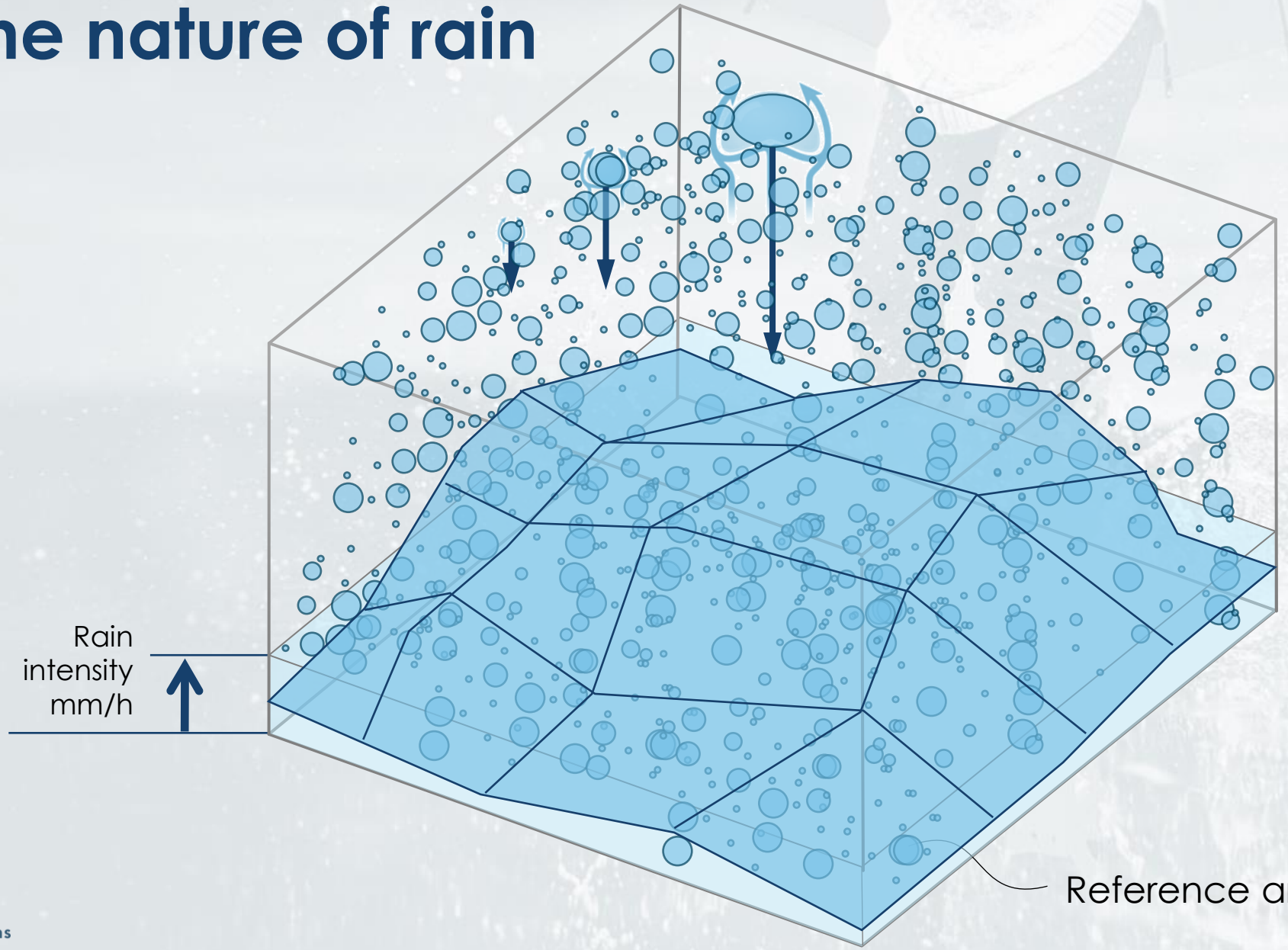
How we know rain?

- Rain: Water droplets of 0.5mm or greater.
- Rainfall rates:
  - Light rain: < 2.5 mm/hour
  - Moderate rain: 2.5 – 7.5 mm/hour
  - Heavy rain: > 7.5 mm/hour

The nature of rain



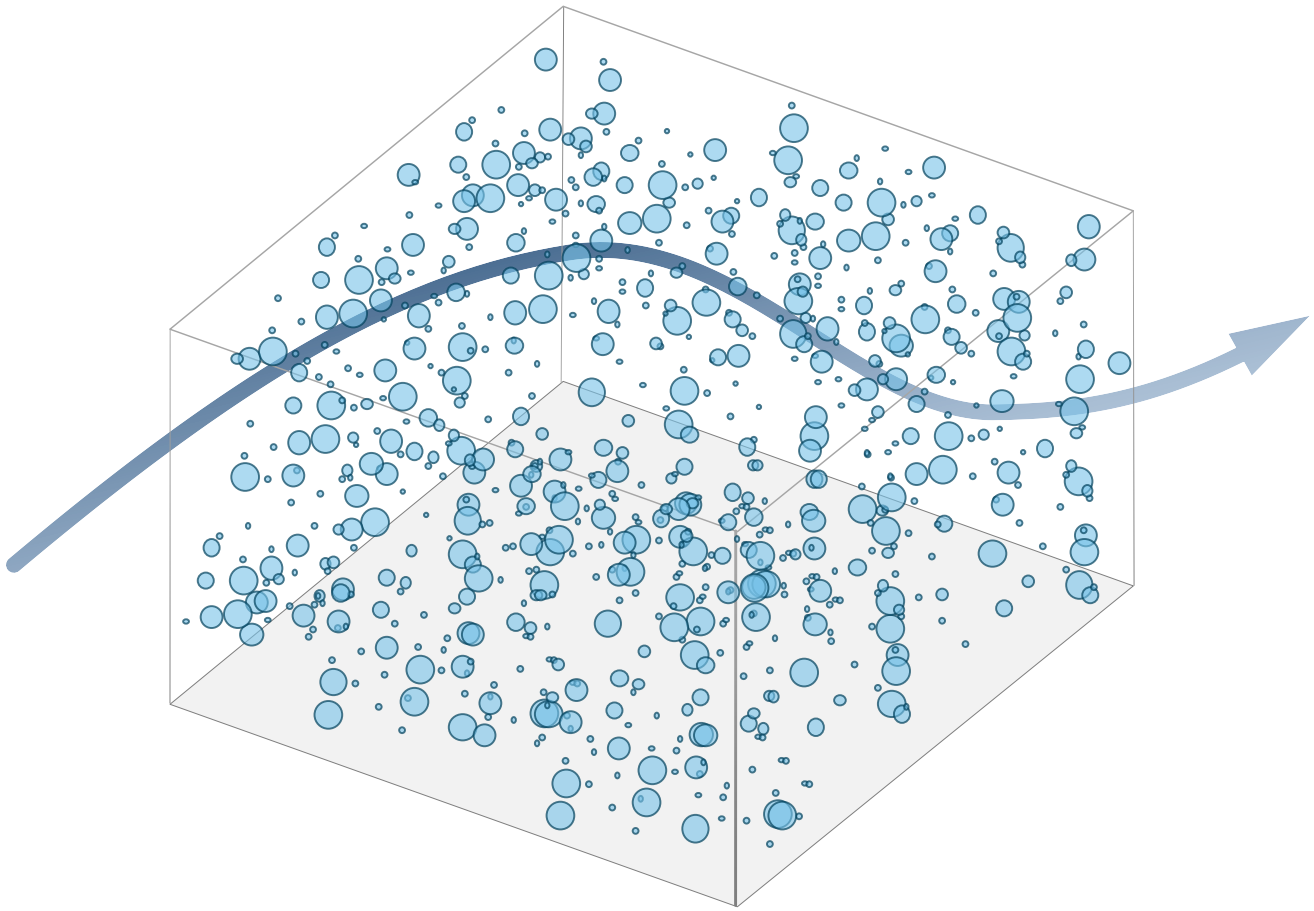
- The droplets in natural rain have different droplet sizes
- Raindrops have a certain velocity
- The rain fills the air volume around us with droplets
- In natural rain we experience somehow homogeinity (except spray and gusts of wind)

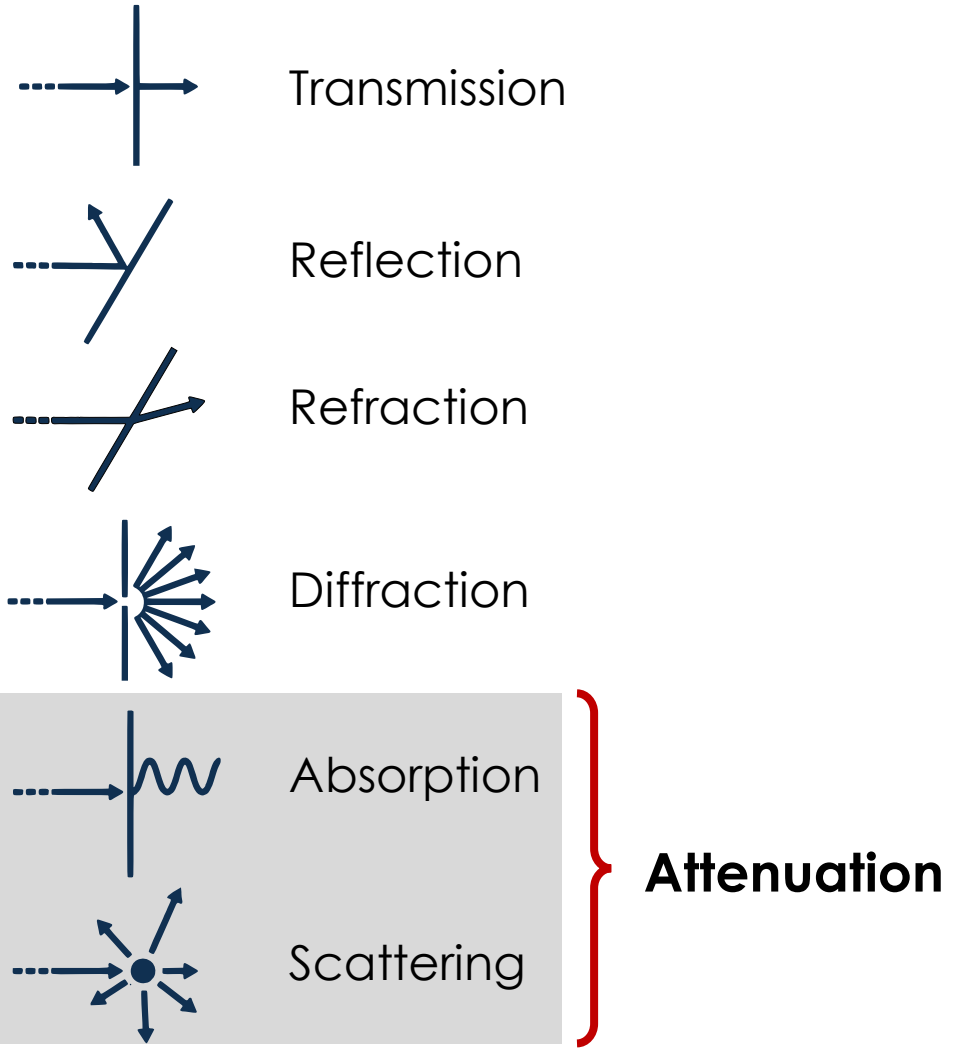
What‘s the issue with rain?

- Rain presents a formidable obstacle for human and machine **vision** due to the complexities of light interaction with raindrops.
- Vision, as experienced by humans and many animals, is primarily based on the detection and interpretation of **electromagnetic waves**, specifically in the range of wavelengths we refer to as "visible light."

When a wave travels through a medium, its intensity diminishes with distance.

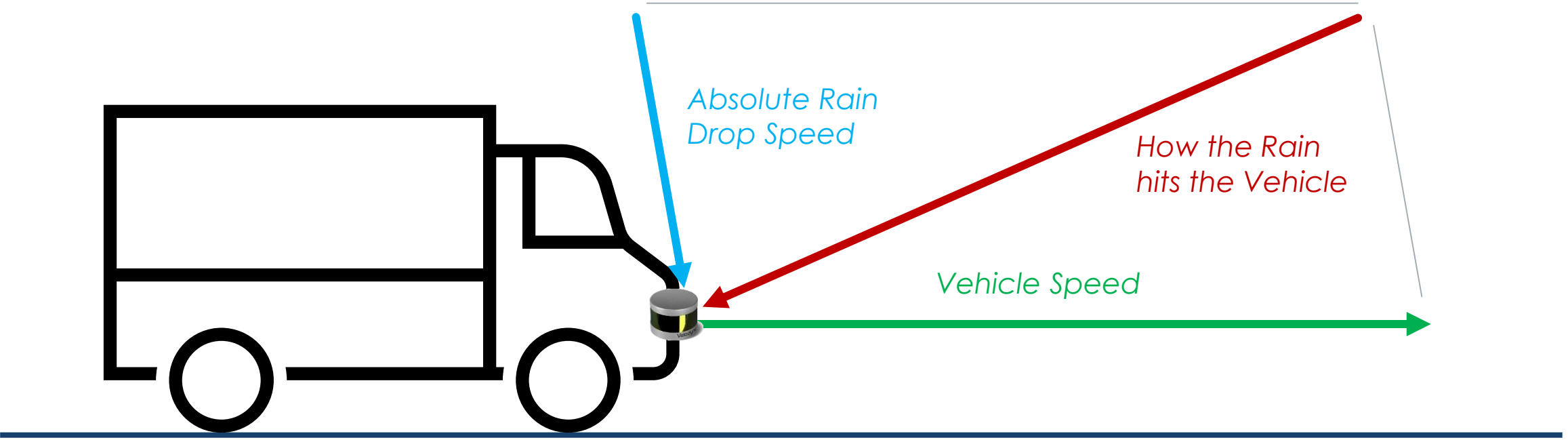
Key mechanisms of electromagnetic waves





Why rain testing with moving vehicles?

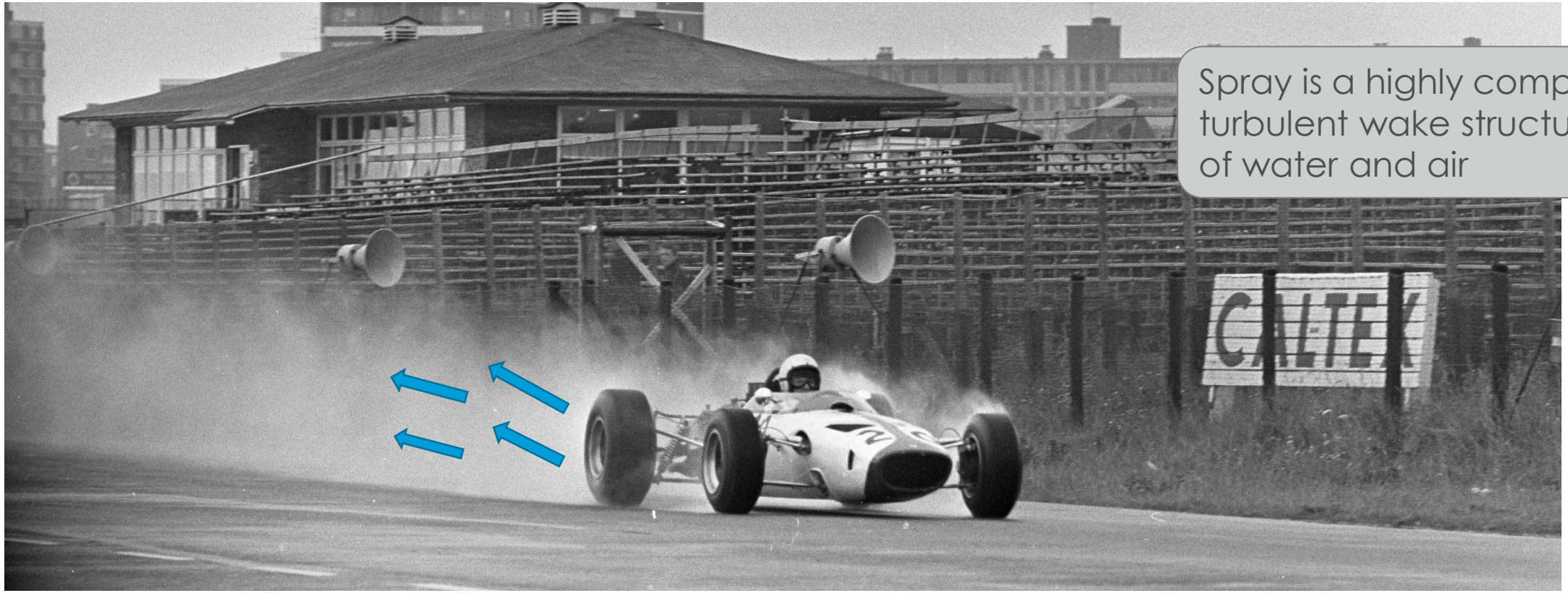
Vehicle movement + rain



Rain
ABSOLUTE

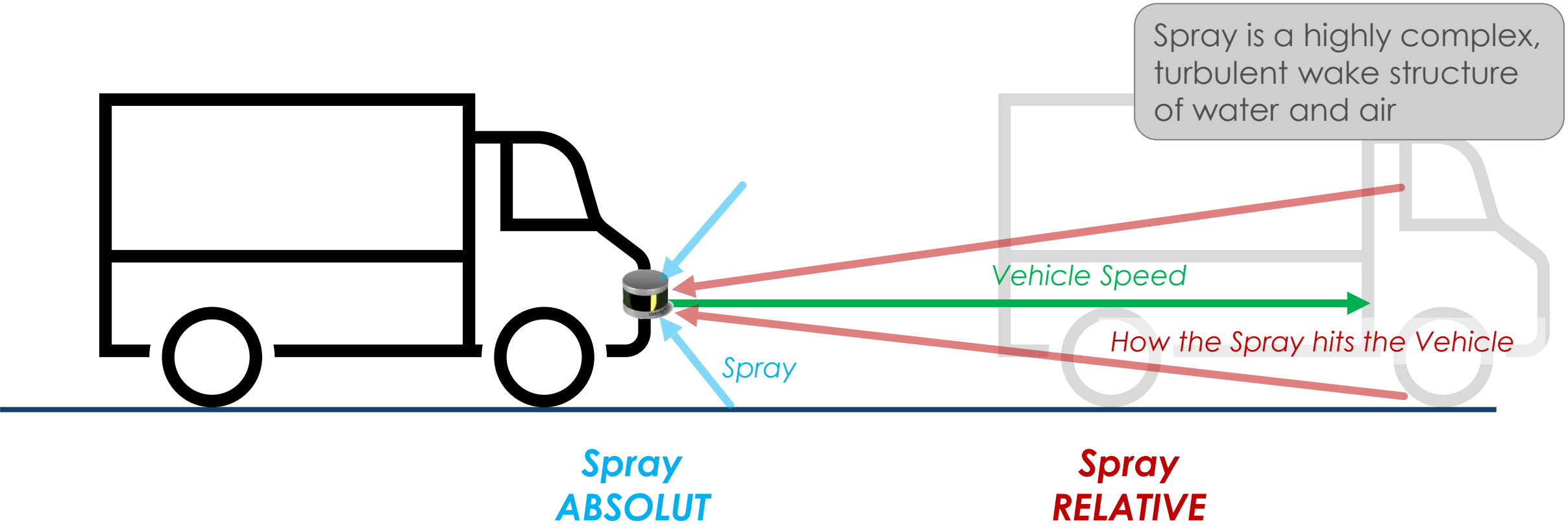
Rain
RELATIVE

Rain spray



Spray is a highly complex, turbulent wake structure of water and air

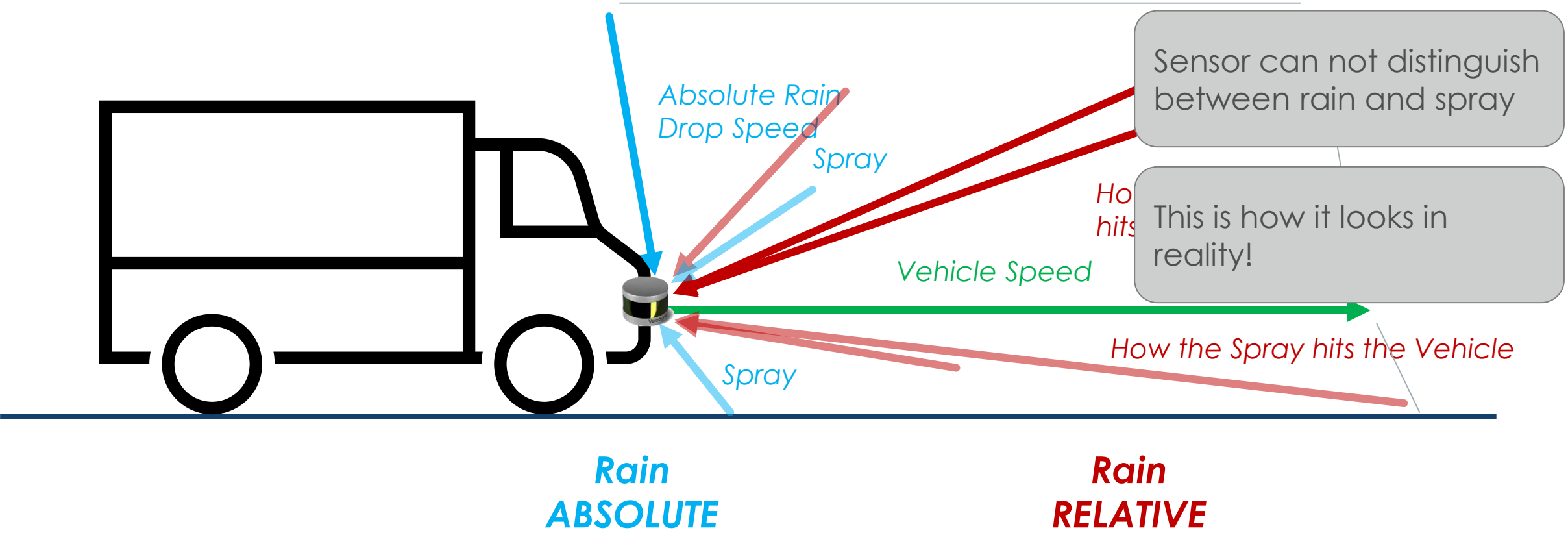
Vehicle movement + spray



Spray ABSOLUT

Spray RELATIVE

Vehicle movement + rain + spray (SUPERIMPOSED)



Find answers through rain – testing

- **Accuracy**: Measure the precision of automotive sensors' data collection under rainy conditions, ensuring minimal discrepancy from baseline performance.
- **Response Time**: Evaluate the speed at which sensors detect and transmit information during rain events, maintaining real-time responsiveness for critical driving situations.
- **Reliability**: Assess the consistency of sensor functionality throughout prolonged rain exposure, guaranteeing dependable operation in varying weather scenarios.
- **False Positive/Negative Rate**: Quantify instances where sensors incorrectly identify or miss rain-related stimuli, refining algorithms to minimize both types of errors.
- **Environmental Resilience**: Gauge the sensors' ability to withstand rain-induced wear and tear, preserving their efficiency and extending their operational lifespan.

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