



Assess and develop your products under degraded weather conditions

Cutting-edge fields (road, rail, aeronautics, maritime, construction or military) develop solutions whose operation can be impaired by weather-related hazards. Ensuring the security and performance of the products deployed is a major challenge.

From diagnosis to research and innovation work, Cerema supports you in evaluating and developing your products under degraded weather conditions (fog and rain).



YOU ARE

- ▶ **An industrial** car manufacturer, signalling equipment or sensor manufacturer
- ▶ **An SME or a startup** developing technical solutions deployed to an outdoor environment
- ▶ **An academic research laboratory** specialising in optics, photonics, artificial vision, human vision or psychology

YOUR NEEDS



- > Do you want to assess the performance of your product under degraded weather conditions?
- > Do you want to reinforce the robustness of your product under fog and rain conditions?
- > Are you looking for a partner for a research and innovation project?

OUR STRENGTHS

- ▶ Provision of a unique tool for reproducing extreme fog and rain in a spacious enclosure
- ▶ Repeatable weather conditions representative of natural conditions
- ▶ Mobilisation of the Intelligent Transport Systems research team, with 30 years of experience and involved in multiple national and international projects (H2020, ANR, etc.)
- ▶ Independence, confidentiality and neutrality related to our status as a public institution

SOLUTIONS OFFERED

BY THE PAVIN EXTREME WEATHER FACILITY

The facility takes the form of a **50 m long** covered track, specifically fitted out and instrumented with different equipment: rain and fog generator, **advanced weather sensors**, reference vision sensors.

The test tunnel can be set up in **day or night conditions**. Lighting is fully controllable, with both natural light and LEDs. Each roller shutter and luminaire can be adjusted independently to offer a wide range of scenarios.

TUNNEL DIMENSIONS

Length	50 m
Width	7 m
Effective height	5,4 m



POSSIBLE STUDY TYPES

- Validation of sensors and products to be deployed outdoors
- Performance measurement of driver assistance systems / ADAS (e.g. pedestrian and obstacle detectors)
- Performance measurement of innovative signalling and lighting systems
- Study of the driver's perception under conditions of reduced visibility
- Development of new imaging technologies adapted to fog and rain conditions (e.g.: infra-red, laser, radar)
- Comparison between artificial and human vision systems
- Design of algorithms for analysis and processing of images and 3D scatter plots



REPRODUCIBLE WEATHER CONDITIONS

- ▶ **Dense to light fog by dissipation (not stabilised)**, meteorological visibility from 10 m to 1,000 m
- ▶ **Dense fog in stabilised stages**, meteorological visibility from 10 m to 80 m
- ▶ **2 types of fog particle size**, radiation (0.8 microns) and advection (0.8 to 8 microns)
- ▶ **Heavy rain in stabilised stages**, rain intensity from 20 mm/h (duration of up to 100 minutes) to 180 mm/h (duration of up to 9 minutes).

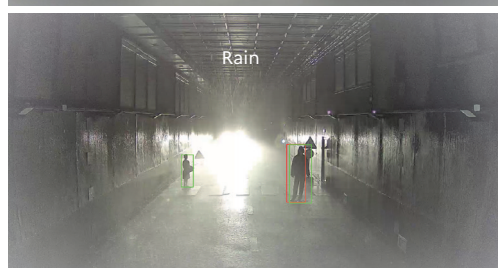
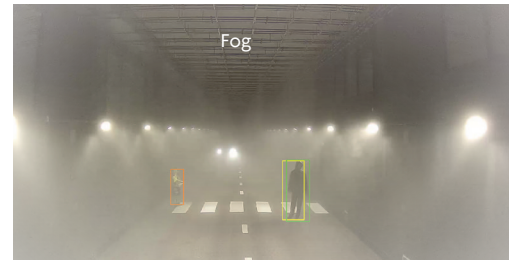
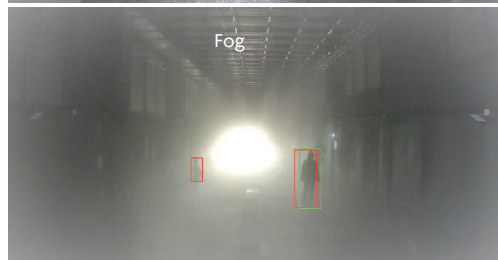
MEASURING EQUIPMENT	MEASURED PHYSICAL QUANTITIES AND MEASUREMENT RANGES
Transmissiometers	Meteorological visibility from 5 to 1,000 m
Optical particle size analyser	Particle size from 0.4 to 40 microns
Spectro-pluviometer	Rain intensity from 0.001 to 1,200 mm/h, size and speed of drops
Bucket rain gauges	Rainfall rate
Photocolorimeter video	Luminance from 0.003 to 50,000 cd/m ²
Spectroradiometer	Range 350 nm to 2,500 nm
Cameras	Visible domains, SWIR and LWIR
Targets	Baseline targets R = 5%, 50% and 90%. Realistic targets (vehicles, pedestrians, road equipment). Thermal targets and black body

Fog and rain generated by water injection at various pressures

CLEAR DAY

COMPLETE NIGHT

LIT NIGHT



OUR TAILOR-MADE ANSWERS

Carry out a series of tests with the PAVIN Extreme weather facility

- > Development of the diagnosis: qualification of the need and state of the art
- > Support for the construction and validation of the test protocol
- > Testing with provision of equipment
- > Consolidation, validation and processing of meteorological data

Have your product evaluated and developed by the research team

- > Feasibility study: qualification of the need, constitution of the state of the art, preliminary calculations
- > Development of a simulation tool intended to test various scenarios
- > Drafting of the test protocol according to an iterative process
- > Testing to qualify the product (with the PAVIN Extreme weather facility)
- > Data processing and analysis (meteorological and product)
- > Preparation of the report: analysis of measurements, recommendations, avenues for future development

Innovate together in the context of national or European projects

- > Project set-up in partnership
- > Testing with provision of equipment
- > Development of test facilities on the platform to address new conditions
- > Research and simulations (example themes: radiative transfer, artificial intelligence, etc.)
- > Promotion of the project and its results: scientific publications, organisation of events

THEY TRUSTED US

The PAVIN Extreme weather facility has regional and national recognition

- Identification within the I-SITE CAP 20-25 project of the University of Clermont-Auvergne
- Component of the IMobS3 Laboratory of Excellence
- Projects labelled by the CIMES, CARA, Indura and NextMove competitiveness clusters
- Reference for the qualification of sensors within the NFI Autonomous Vehicles plan
- Support from the Auvergne-Rhône-Alpes Region and the Ministry of Ecological Transition



The Horizon Europe project Robust Automated Driving in Extreme Weather (ROADVIEW), carried out with private (such as Ford) and academic partners, has served to develop robust and cost-efficient in-vehicle perception and decision-making systems for connected and automated vehicles with enhanced performance under harsh weather conditions and different traffic scenarios.

Like Lhoist, entrust your R&D service to an establishment certified by the Carnot Institute. The institute supported the international group Lhoist by quantifying the optical reflectance of a milk of lime in order to assess the impact of this material on reducing road surface temperatures for urban overheating issues.

CONTACT US

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At the cutting edge of research, Cerema has been awarded the Carnot Institute label since February 2020, with the Clim'adapt project. The Carnot Clim'adapt institute helps businesses and local authorities to make their transition to a low-resource, low-carbon economy that respects the environment. Through bilateral contract research services, Cerema provides these economic stakeholders with the scientific excellence of its researchers and experts, in the establishment's six fields of activity.

www.cerema.fr/fr/innovation-recherche/institut-carnot-clim-adapt

