SnT
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SnT Automation & Robotics Research Group
- Mobile Robotics Research at SnT -

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uni.lu
UNIVERSITÉ DU LUXEMBOURG

Czech-Luxembourgish Robotics Day, 14. May 2019

Interdisciplinary Centre for Security, Reliability & Trust - SnT

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- **founded in 2009**
- **Figures:**
  - 20 faculty members, >300 researchers & staff
  - 20 Mio € annual budget
  - 100 Mio € third-party funding acquired since start!
- **Objectives:**
  - **Part of Luxembourg's *infrastructure*** (human resources, education/training, research, development, tech transfer) improving competitiveness
  - **Centre of excellence** – internationally leading research and innovations in secure, reliable and trustworthy ICT systems and services
  - Play an instrumental role to **increase R&D investments in Luxembourg** leading to growth and ultimately to highly qualified employments

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SnT strategy

- Impact-oriented research program (long-term / mid-term),
  strategic research areas:
  - Secure and Compliant Data Management
  - FinTech
  - Cybersecurity
  - Space Systems & Resources
  - **Autonomous Vehicles**
  - Internet-of-Things, Industry 4.0

- Target research areas through **long-term strategic partnerships** with national (industrial) partners
- Establish **international collaboration** (academic & industry)
- Recruit **top scientists**
- Offer highly competitive **training** (e.g. PhD candidates with partners)
- Support **Tech Transfer**, entrepreneurship

SnT Automation & Robotics Research Group

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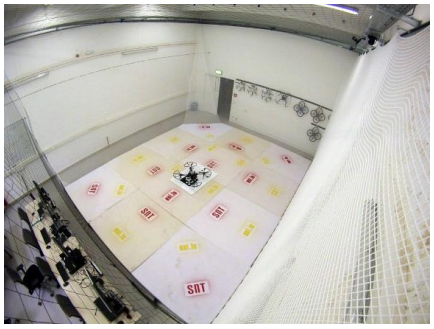
- **Founded in 2012**
- **Main research priorities:**
  - perception & control for autonomous vehicles & robots
  - distributed networked automation and control
- **Team:** ≈ 20 researchers (PostDocs, PhDs), 2 technicians, MSc students
- **Equipment in robotics:**
  - Indoor UAV flight arena with motion capture system
  - partner in Nvidia Joint AI lab
  - partner in 360 Lab / Automated Driving Lab (1 Smart ED, 1 KIA Soul)
  - Space Robotics Lab (in 2019)



Autonomous Vehicles & Robots - Luxembourg perspective

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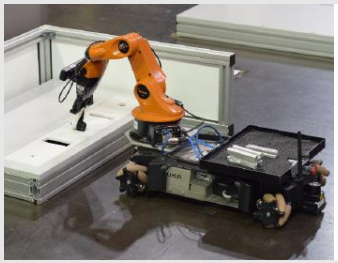


service robots

connected & autonomous driving

unmanned aerial vehicles

space robots

- manufacturing
- logistics
- agriculture
- …

- social robots
- health
- caretaking
- education
- …

- energy-efficient driving
- connected driving
- automated driving
- …

- surveillance
- inspection
- transport
- emergency
- …

- on-orbit servicing
- space exploration
- space resources
- …

THE THIRD INDUSTRIAL REVOLUTION Lëtzebuerg

Smart Cities

Smart Mobility

High Performance Computing (HPC)

Digital Luxembourg

Leading the way towards a smart nation

SPACE RESOURCES.LU

Autonomous Vehicles & Robots – Research Areas

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Research Areas, Methodologies:

Perception & Control:

- Sensor fusion, situation awareness
- Optimization-based control

Autonomie, Intelligence:

- Intelligent control, machine learning
- Distributed, cooperative control

Engineering Design:

- Systems and software engineering
- Simulation for autonomous systems

Autonomous Vehicles & Robots - Applications

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Application Areas and Partners (I):

Unmanned Aerial Vehicles (Drones):
Autonomous operations, flying manipulation, aerial inspection

Partners: Army of Luxembourg, LuxConnect, Cargolux

Service and Social Robotics:

Social robots in public spaces, service robots in Industrie 4.0 and construction industry

Partners: City of Luxembourg, Neobuild

Driver Assistance, Autonomous Driving, e-mobility:

Energy-efficient automated driving for electric & hybrid cars, autonomous driving

Partners: Delphi Automotive, Volvo

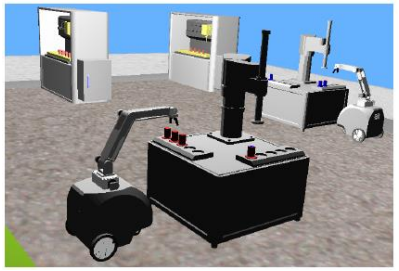
Autonomous Vehicles & Robots - Applications

Application Areas and Partners (II):

Advanced Simulators for Autonomous Systems:

Simulators for autonomous driving, Industrie 4.0, UAVs

Partners: CBN Technologies



Multi-Robot-Systems:

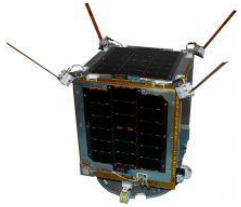
Coordinated control of UAVs, multiple robots in Industrie 4.0

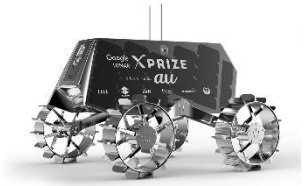
Partners: LuxConnect, CBN Technologies

Space Robotics:

Systems engineering for microsatellites & new space services, space robots for debris removal, space resources / asteroid mining

Partners: LuxSpace, ispace





Selected Areas: Sensor Fusion and Situational Awareness

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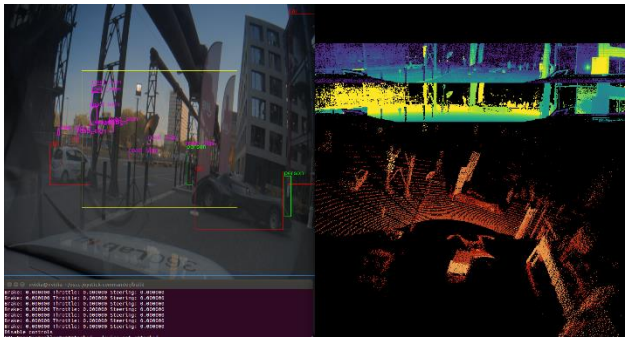
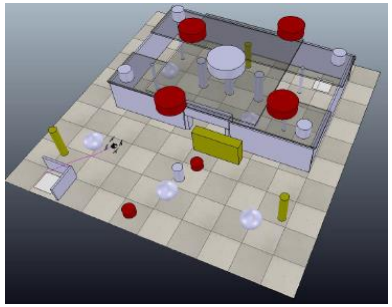
- **Sensor fusion for advanced situation awareness**



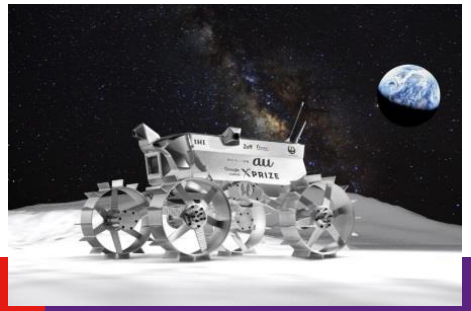
Example: solutions based on vision and LIDAR

- **Semantic representation of complex dynamic environments**



Example: semantic representation for fast UAV path planning

- **Localization and Mapping (SLAM) in extra-terrestrial environments**



Example: SLAM for Moon rover missions, cooperation with ispace Europe.

Selected Areas: Optimization-based Control

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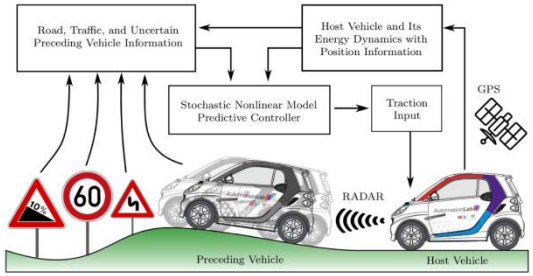
- **Fast stochastic nonlinear model predictive control**



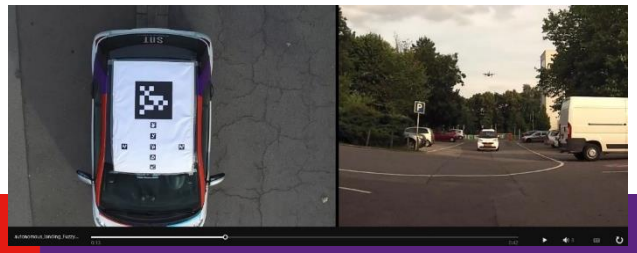
Proposed Semi-autonomous Eco-ADAS

Example: energy efficient driving for electric vehicles

- **Model predictive control for advanced manipulation**

Example: control of Flying manipulation

- **Task-adaptive model predictive control**



Example: autonomous start and landing, obstacle avoidance, ..

Selected Areas: Intelligent Control, Machine Learning

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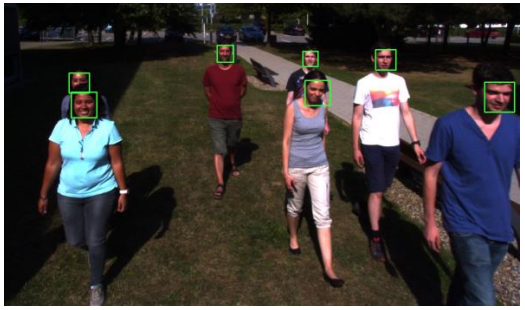
- **Improved visual navigation and localization with deep learning**

Example: UAV localization in aerial inspection

- **Detection & tracking of objects in complex scenarios using ML**



Example: detection & tracking of people and faces with UAVs

- **Learning of Control Behaviours with reinforcement learning**

Example: flight control, flying manipulation