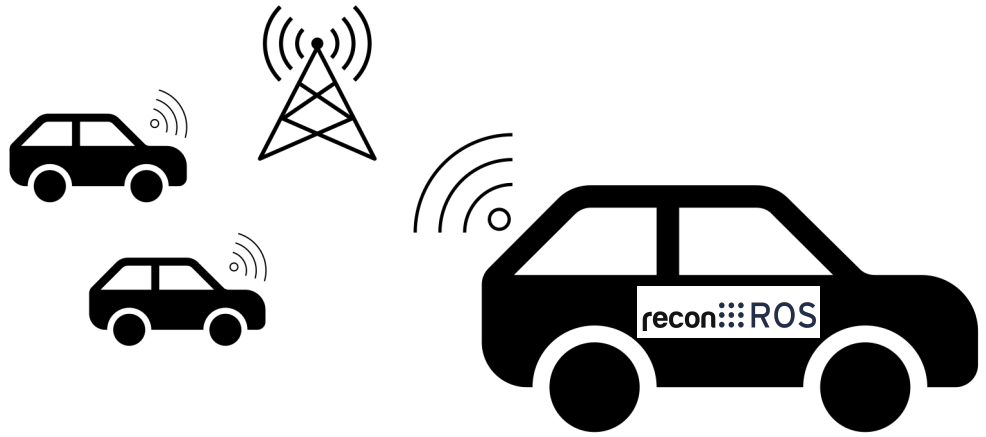


Project Group Presentation

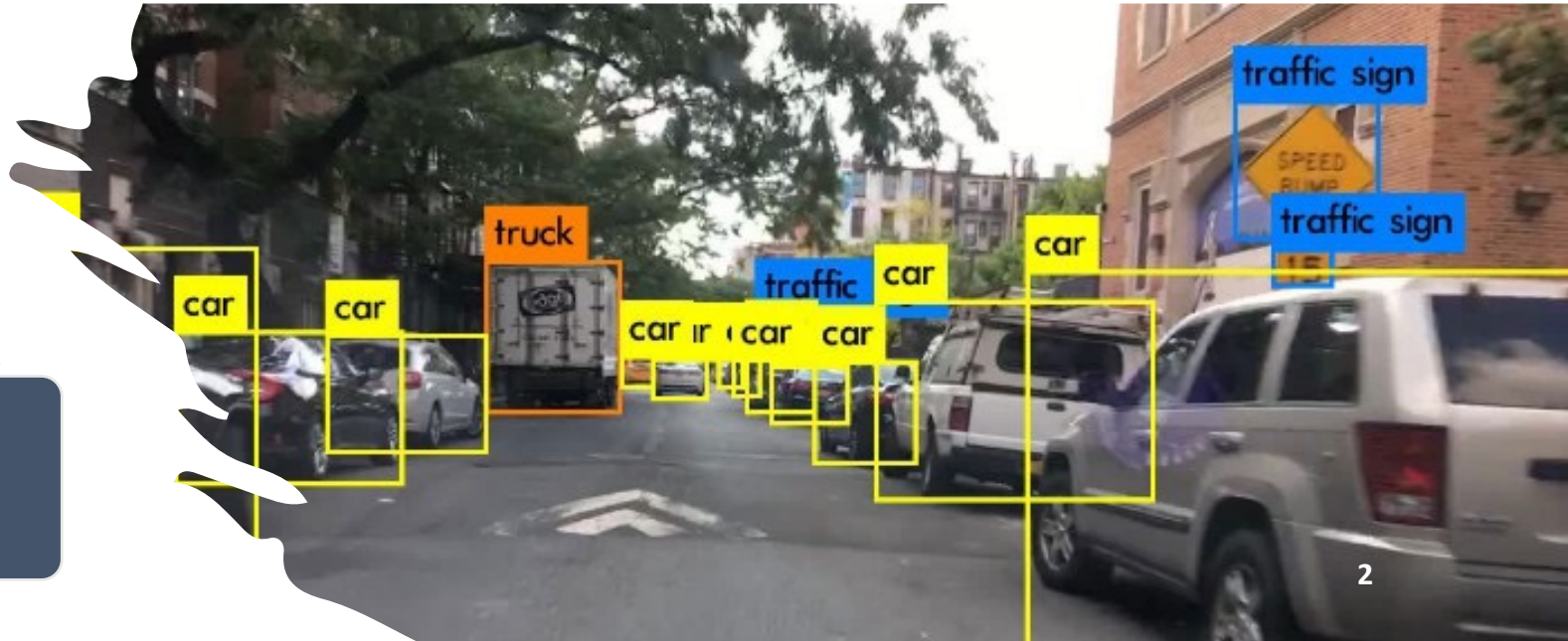
Autonomous Car Swarm with Hardware-accelerated ROS Programming (AutonomROS)

Project group
SS 22 + WS 22/23

For CS &CE students

Autonomous Driving Challenges

- Key technology for the mobility of tomorrow, more and more autonomous capabilities
- Perception and decision making requires a huge amount of processing power
- Modern embedded compute platforms are heterogeneous and utilize hardware acceleration
- Integration of hardware accelerators into software architectures and design flows is an open research topic

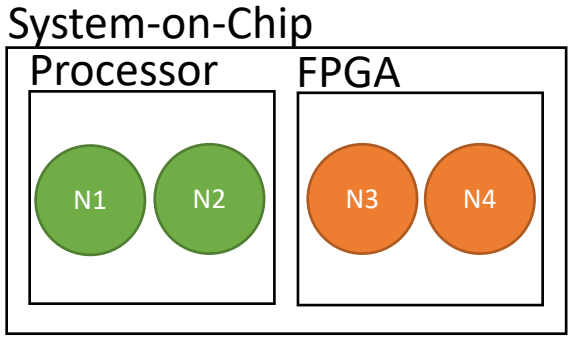


What is ROS?

- ROS is an open-source **robot operating system** supported by a large community
- ROS comprises a set of libraries and tools for programming distributed robotics applications
- Applications are decomposed into nodes, which use message-based communication to interact

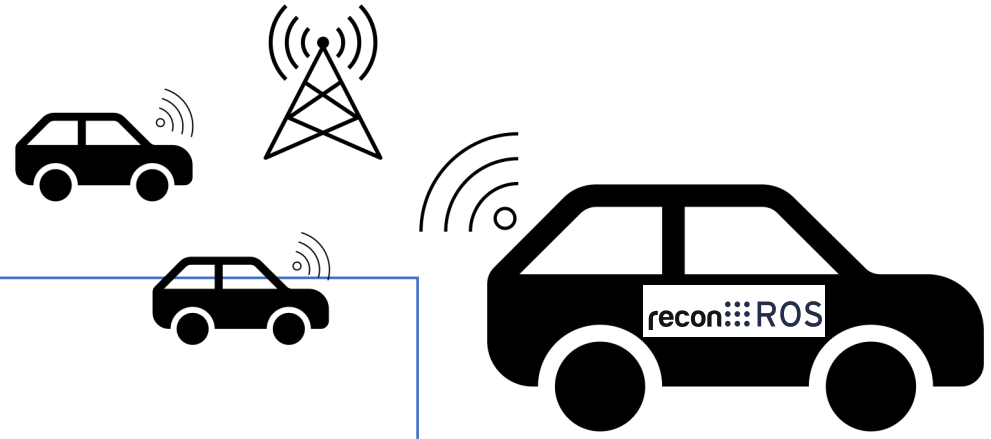
What is ReconROS?

- **ReconROS** builds on ROS 2
- ReconROS allows for using reconfigurable hardware accelerators (FPGA) in robotics applications
- ROS nodes can be either executed in hardware or software



reconROS

Goal of PG AutonomROS



Build a swarm of autonomous model cars

- Model cars should be able to drive without user interaction
- Create and test drive in different environmental areas, e.g., racetrack or model city

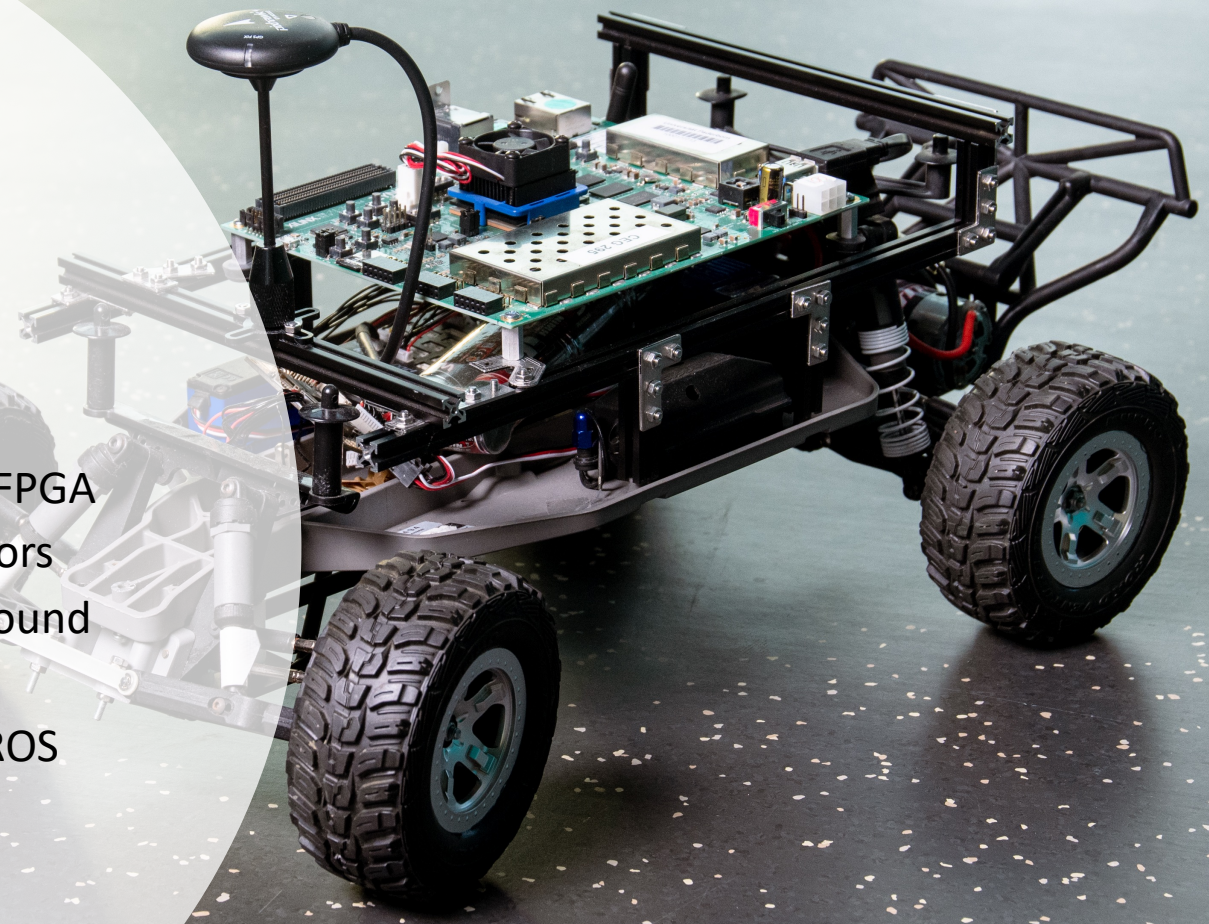
Implementation on an embedded compute platform

- Use modern platform FPGA comprising multi-core CPUs, reconfigurable logic, and peripherals
- Develop advanced hardware/software co-designs for autonomous driving functions

Address research questions

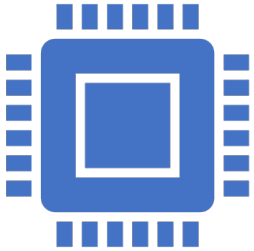
- How to best use ReconROS for distributed robotics systems?
- How to best deploy, debug, and evaluate such systems?

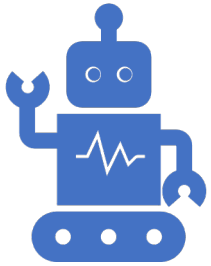
Starting Point: Existing Model Car

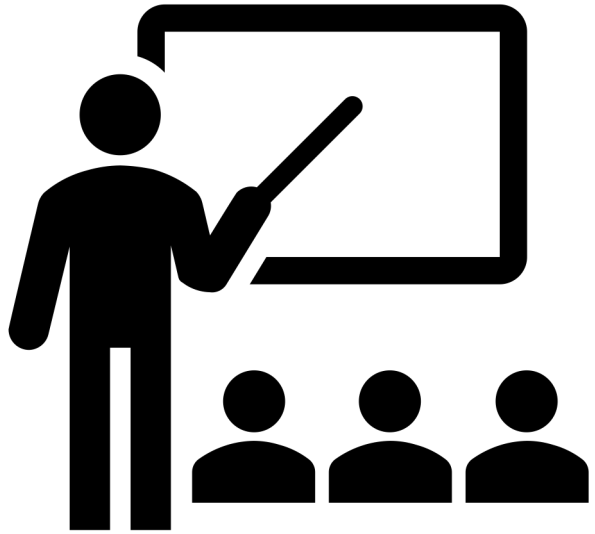


- Hardware with state-of-the-art platform FPGA
  - Perception via cameras / other sensors
  - Communication with other cars / ground station
- Software / FPGA design based on ReconROS
  - Ubuntu Linux operating system
  - ROS 2 applications in C/C++

Pre-requirements / Learning







What should you bring with you?

Interest in embedded system design using C/C++ (software and/or hardware)

Interest in robotics

Basic experience with programming embedded processors and/or FPGAs is a plus

How can you benefit from participation?

Learn about state-of-the-art algorithms for autonomous driving

Build up skills to design robotics applications with the robot operating system (ROS 2)

Gain practical experience in embedded system design (software and hardware)

Contact & Further Information

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Considered tools / further reading

ROS

https://www.ros.org/

ReconROS

https://ieeexplore.ieee.org/abstract/document/9415549

Autoware.auto

https://www.autoware.org/

TUM Roborace Project

https://github.com/TUMFTM/mod_vehicle_dynamics_control