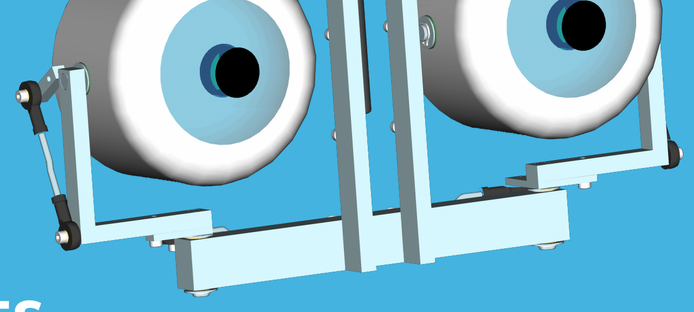
ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

AUTONOMOUS SYSTEMS LAB



Autonomous Driving in Dynamic Environments

Motivation

- Every year millions of people get injured or killed in road accidents
- About 80% of those accidents are happening because of human mistakes, inattention and that like
- Advanced Driver Assistant Systems can help to prevent those accidents by reasoning on the actual traffic situation
- Autonomous Driving in given traffic scenarios can improve efficiency and safety in every day traffic

Objectives

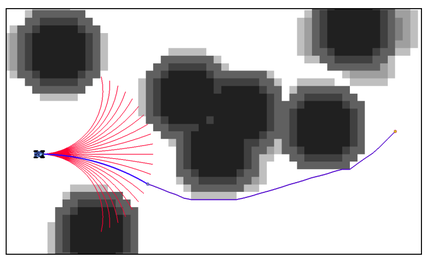
- Set up of a vehicle platform capable of navigating in static environments
- Setting up an enhanced vehicle platform able to navigate in highly dynamic environments
- Combine research interests in localization, mapping and planning in integrated research platforms

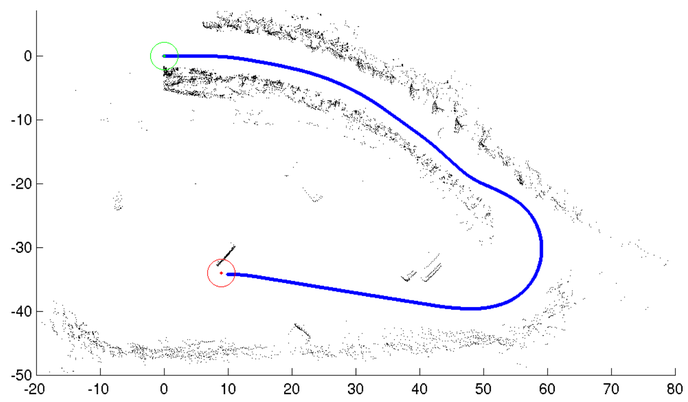
Approach

- Set up of a drive-by-wire demonstrator vehicle
  - Gas-by-wire based on electronic gas pedal
  - Steer-by-wire based on Electronic Power Steering
  - Brake-by-wire using additional actuator
- Using advanced localization techniques based on
  - Differential GPS
  - Inertia Measurement Unit
  - Compass
  - Optical gyroscope
  - Car odometry
- Modeling the environment using laser scanners
- Apply a navigation function to plan a collision free path
- Control the vehicle to execute the commands

The SmarTer setup for all terrain navigation obtains a 3D model of the environment

Navigation in static environments

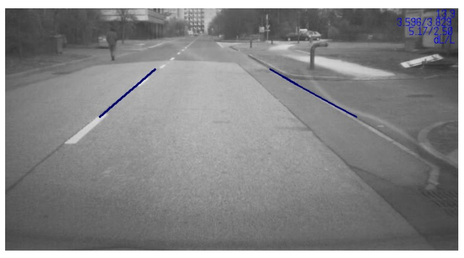


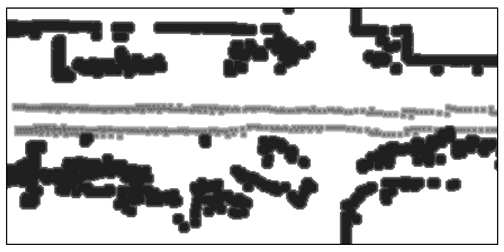


- The environment is mapped using a laser scanner looking straight to the front of the vehicle
- Obstacle information are combined in a map
- Field D* path planning is performed on the map
- A local planning function selects the next action based in the global plan and local traversability information

Road structures

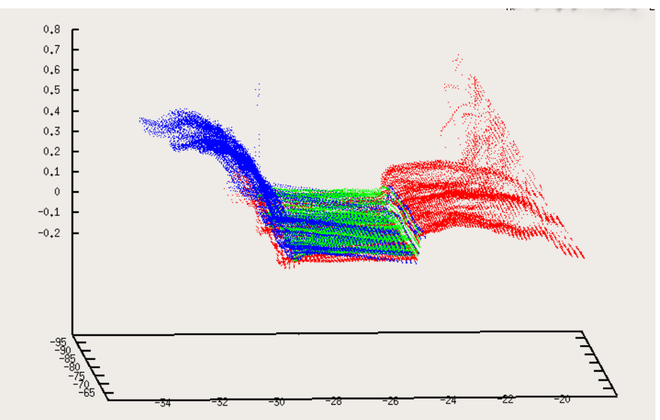
- Usually cars travel on roads that give a certain structure to the environment
- Road Shapes can be detected using computer vision techniques
- The road can be incorporated into the traversability map the vehicle is planning it's motion on
- The pictures show the integration of a lane detection module developed by Mario Bellino at EPFL in the context of the SPARC project





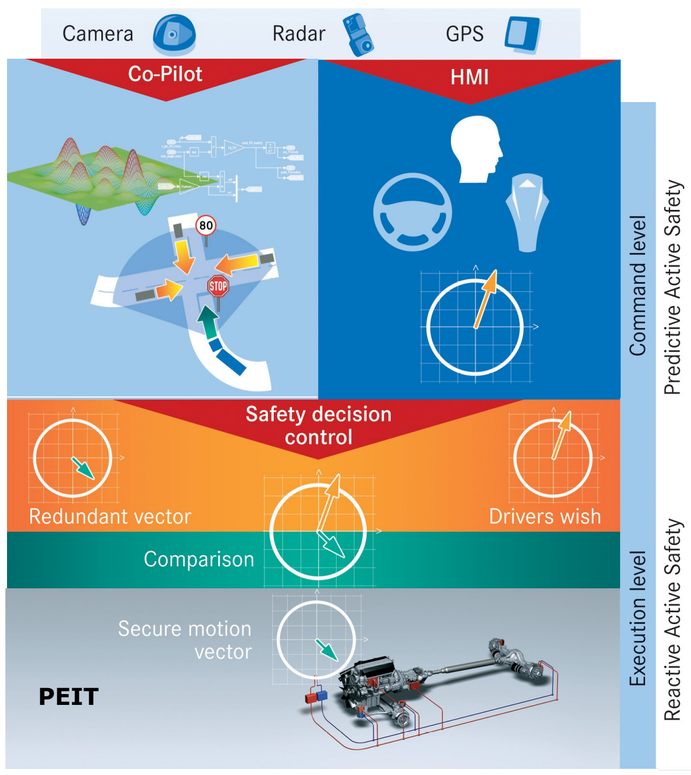
Off-road Navigation

- For autonomous navigation outside of roads and other paved areas, beside obstacles navigation functions have to take into account the roughness of the terrain and include this roughness into the traversability map



Measurements of the three laser scanners on the SmarTer vehicle profiling the area in front of the vehicle

Projects Framework



SPARC stands for Secure Propulsion using Advanced Redundant Control. The goal of SPARC is to substantially improve traffic safety and efficiency for heavy goods vehicles using intelligent x-by-wire technologies in the power train. To prove this standardized concept an automotive Software/Hardware platform will be developed that is scalable and usable from heavy goods vehicles down to small passenger cars (sPC) and be integrated therein. SPARC will propose a complete automotive concept of an open system architecture, where software functionalities of different partners can be integrated easily. Two validation vehicles of this architecture will be build and evaluated.

Autonomous Systems Lab
http://www.asl.ethz.ch

Sascha Kolski (sascha.kolski@mavt.ethz.ch)
Roland Siegwart (rsiegwart@ethz.ch)

ETH Zentrum
Tannenstrasse 3, CLA
8092 Zurich, Switzerland