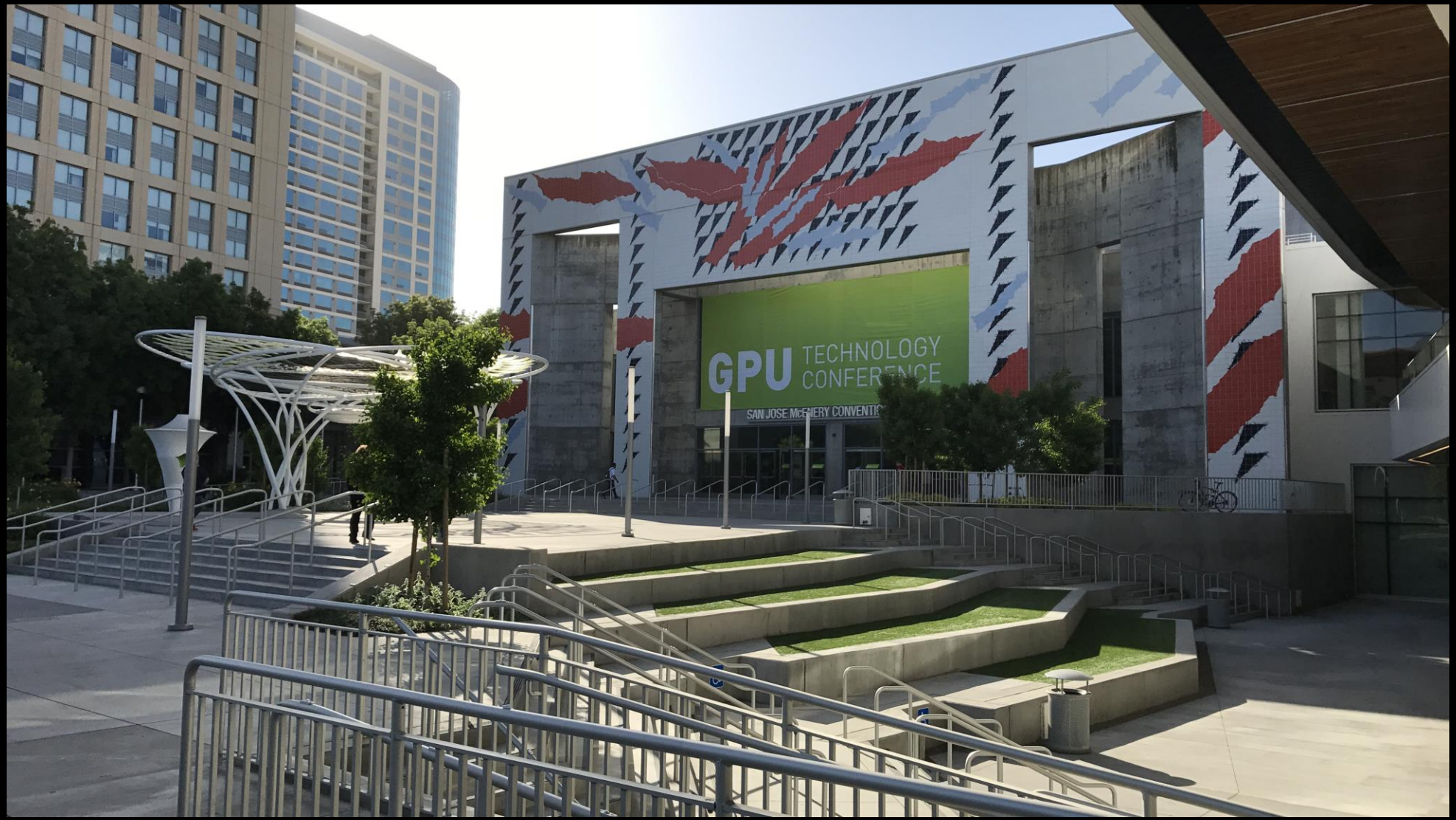
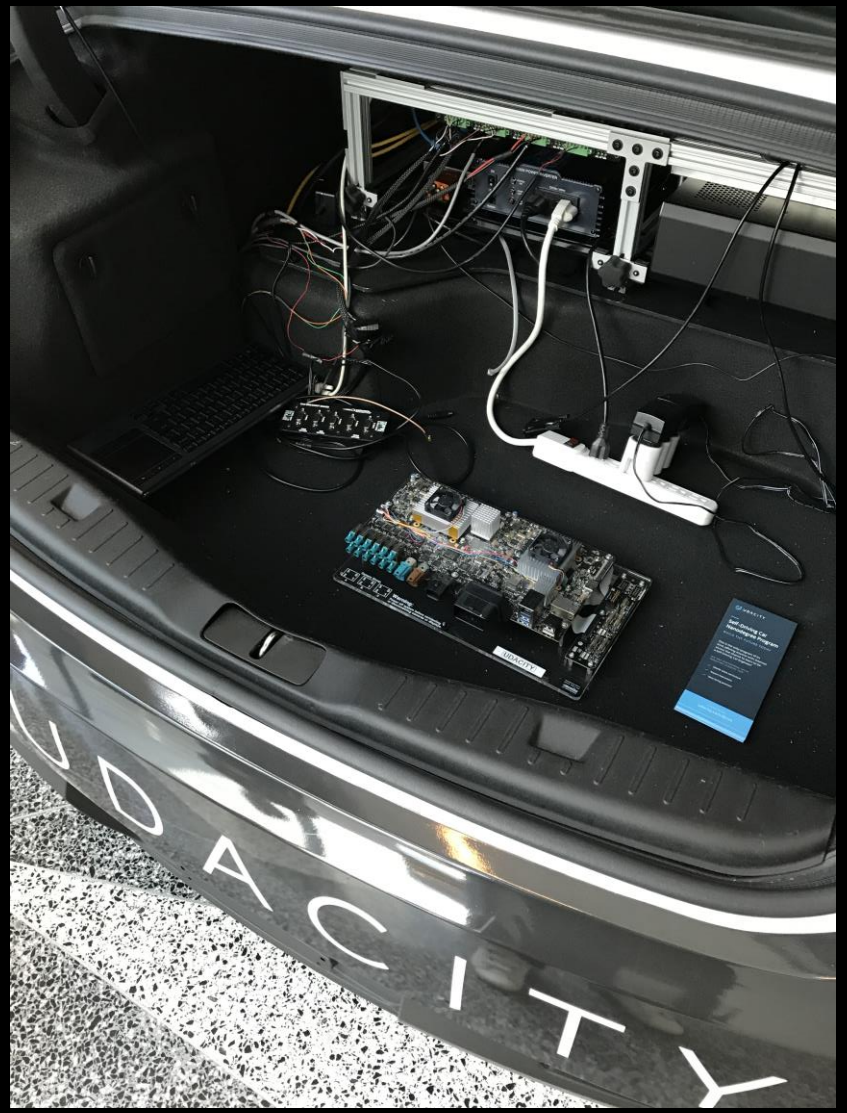
GTC 2017
オートモーティブ最新情報

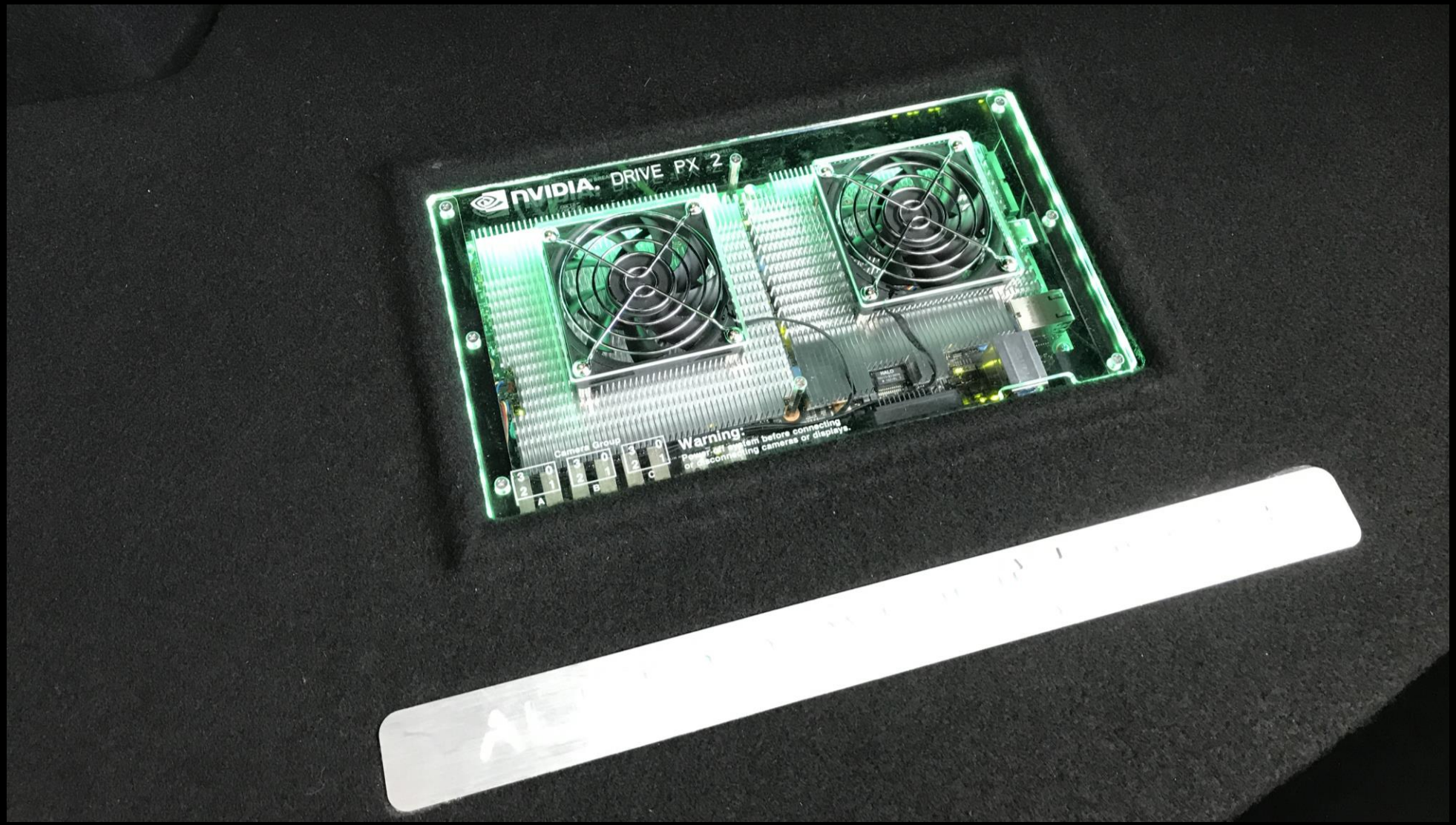
室河　徹
ソリューション アーキテクト (オートモーティブ)
NVIDIA



SJCC ENTRANCE




Pedestrian



NVIDIA BOOTH @ EXHIBITION HALL

Video BB8 Lombard

Video PACCAR

Automotive Talks @ room 210D

DRIVEWORKS

Dennis Lui, Miguel Sainz, Gaurav Agarwal

8th May 2017

NVIDIA

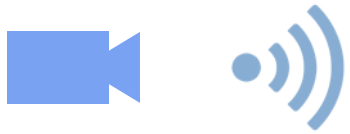
DRIVEWORKS — SOFTWARE DEVELOPMENT KIT (SDK)

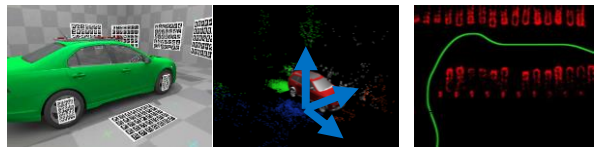
USE CASES

Autonomous Driving

Data Acquisition

APIs (> 450 AND GROWING)





DESIGN PHILOSOPHY

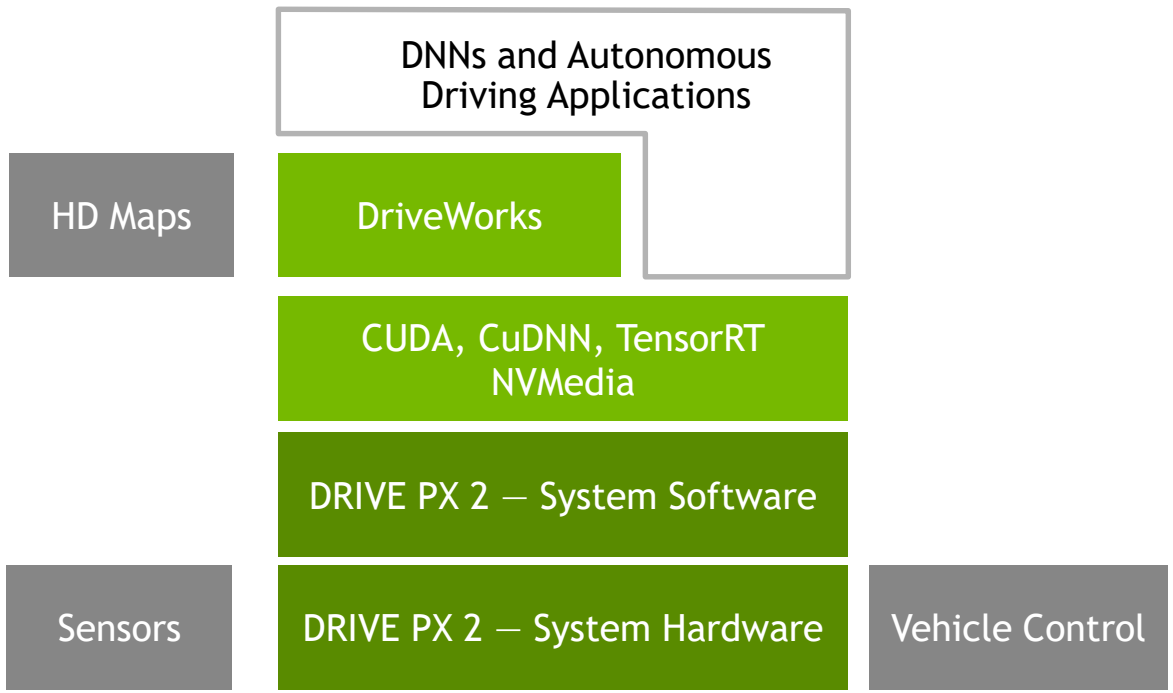
Modular

Scalable

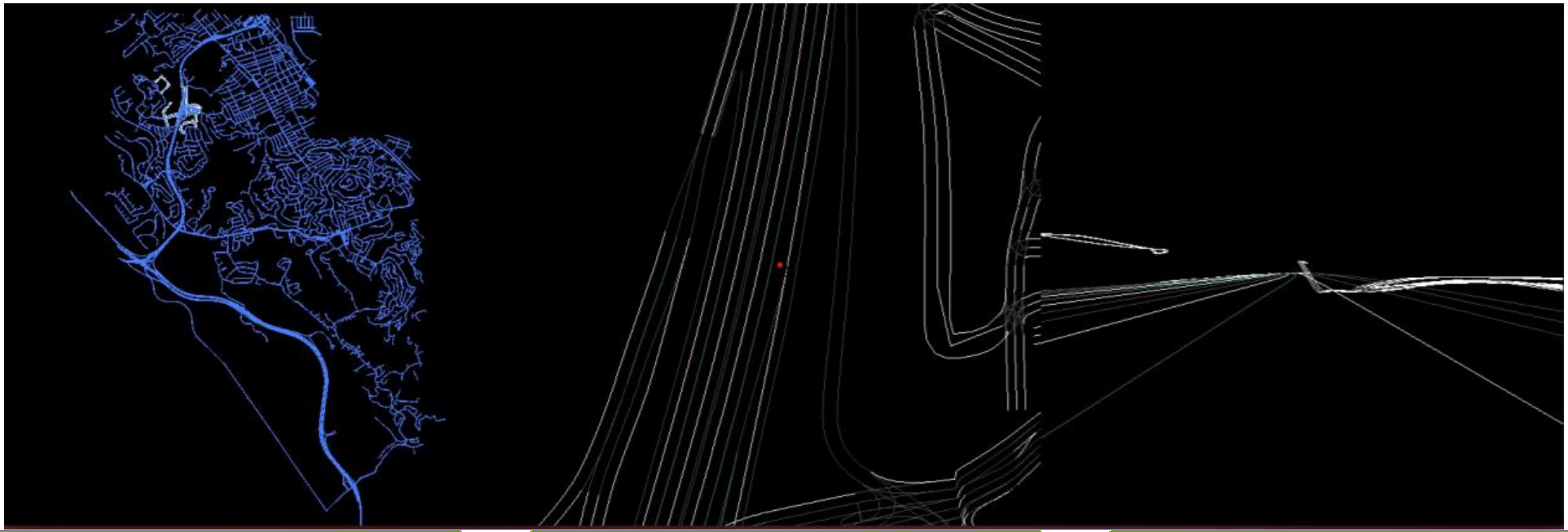
Optimized for GPU

Rapid prototyping & production

DRIVE PLATFORM WITH DRIVEWORKS



HD MAP API



MAP OVERVIEW	TOP VIEW	GPS PATH
Overview of complete map data	Top view of the current location	Car driving along the GPS path

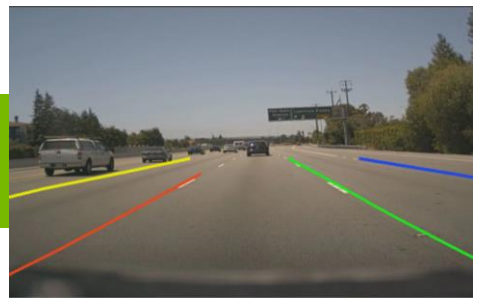
PERCEPTION DNN SAMPLES

Deep Neural Networks

DriveNet

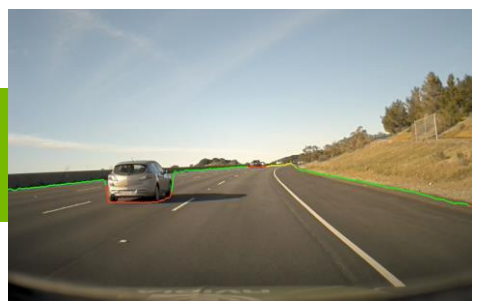
Multi-class detection: Cars, Trucks, Pedestrian, Bicycles/Motorcycles, Traffic Signs*

LaneNet



Lane Detection

OpenRoadNet



Freespace Detection

Video: Multi-class Object Detector

Video: Lane Detector

Video: Free-space Detector

Video DNN on DPX2

AUTONOMOUSTUFF

Enabling the Future of Transportation

BUILDING AN L4 AUTONOMOUS DRIVING R&D PLATFORM

"Drive-PX2 on Wheels"

Wolfgang Juchmann, Ph. D.
VP of Business Development

Supplier of components and services that enable autonomy

Video: DRIVE PX2 On Wheels

Step 2: Perception Kits

"Drive PX2 on Wheels"

- **Vision - 11 cameras**
  - 2x front camera (Sekonix): 120 FOV medium + 60 FOV long range
  - 1x 60 FOV rear long range
  - 2x 120 FOV blind spot cameras
  - 2x 120 FOV forward facing for Lane keeping (Training)
  - 2x 60 FOV Long range Cross Traffic cameras
  - 2x 120 FOV side facing for Turn
- **Radar configuration:**
  - 6x long range (Continental)
- **Lidars configuration:**
  - 1x Front bumper (Lux 4L)
  - 2x Roof mounted (Velodyne VLP)
- **Inertial navigation:**
  - Novatel SPAN IGM-A1
  - XSENS Mti-G710

source: nvidia

Pre-configured by AutonomouStuff

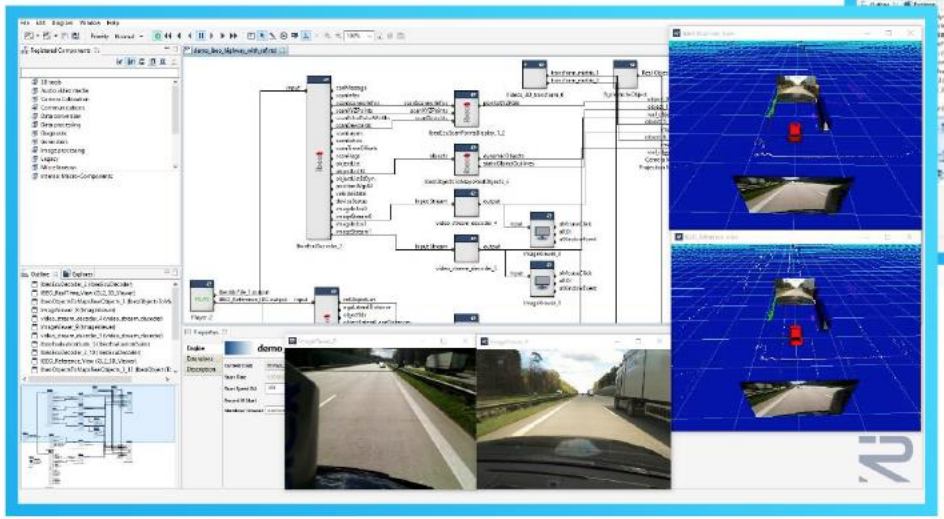
Design your autonomous vehicle applications with NVIDIA DriveWorks components on RTMaps

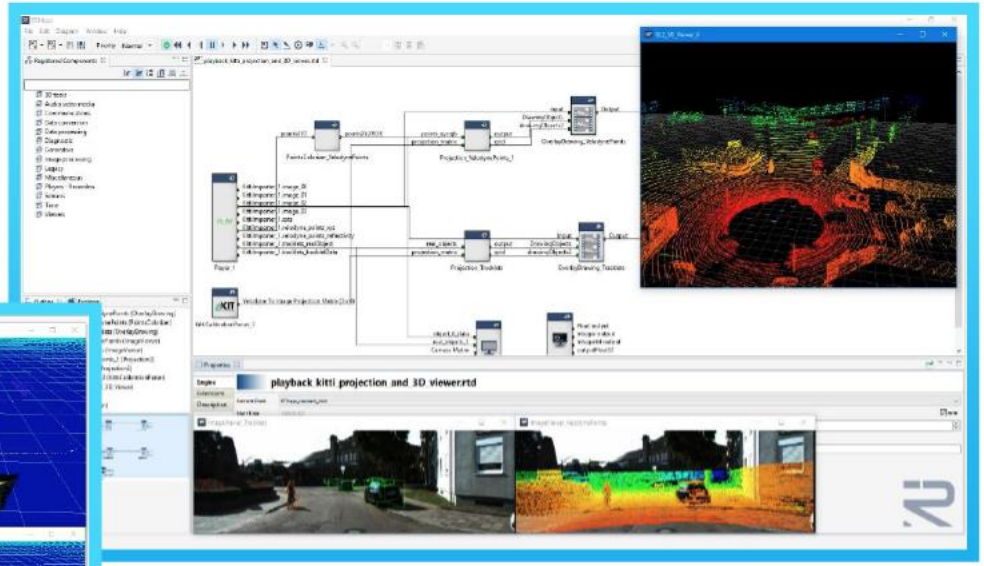
INTEMPORA
MULTISENSOR SOFTWARE SOLUTIONS

Nicolas du Lac
CEO, Intempora

Features

- Graphical interface
- Large library of off-the-shelf components
- Record / Playback





- Optimized (multithread, pre-allocated buffers, copyless)
- Preserves time coherency

RTMaps & NVIDIA DriveWorks

*

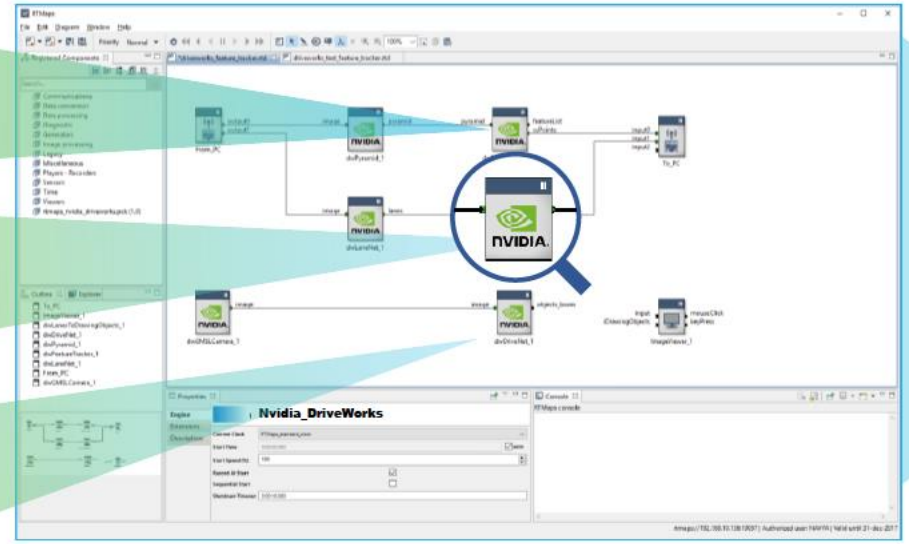
NVIDIA. DriveWorks Components (C++ / CUDA) | RTMaps | NVIDIA. DRIVE PX 2

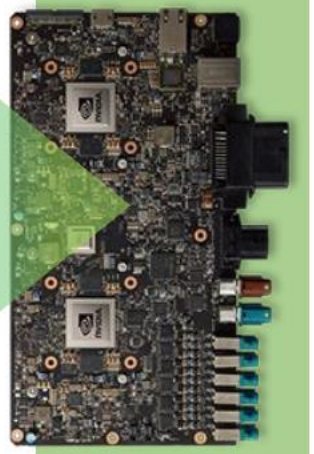
DriveNet

LaneNet

Feature Tracker

etc...





*Easily deploy on target with RTMaps Remote Studio (SSL)

Video: RTMaps Demo

ZENRIN
Maps to the Future

Highly Efficient HD Map Creation: Accelerating Mapping Process with GPUs

May 10, 2017

ZENRIN Co.,Ltd.

Maps to the Future

Massive volume of data!

ZENRIN
Maps to the Future

→Maximum Approx. 1TB of data per car per day

High Resolution 2D Image
>30M pixel

Dense Point Cloud Data
>700,000 points/sec

Other Sensor Data

Mapping Japan is an extraordinary task...

ZENRIN
Maps to the Future

Road Length: 1,218,772 km

Traffic Signals: 207,000 units

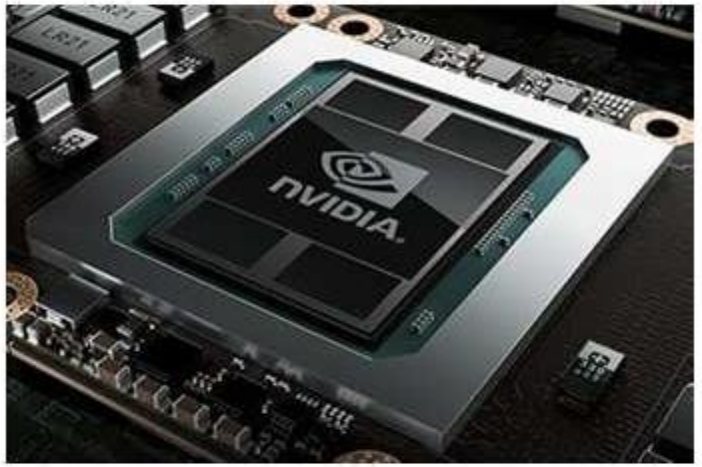
Traffic Signs : 9,790,000 units

Ref. WHITE PAPER ON TRAFFIC SAFETY IN JAPAN 2016, Cabinet Office

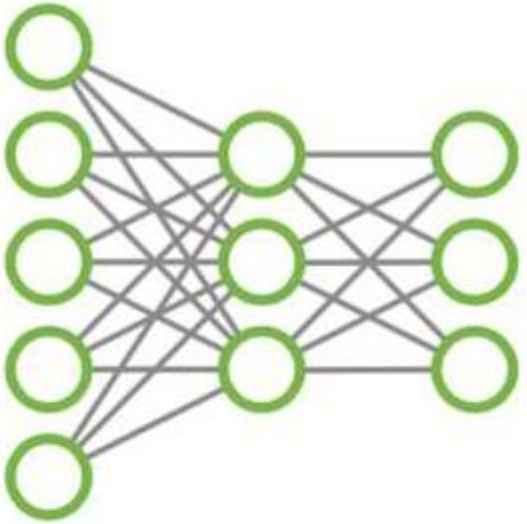
How?

ZENRIN
Maps to the Future

GPU



AI (DNN)

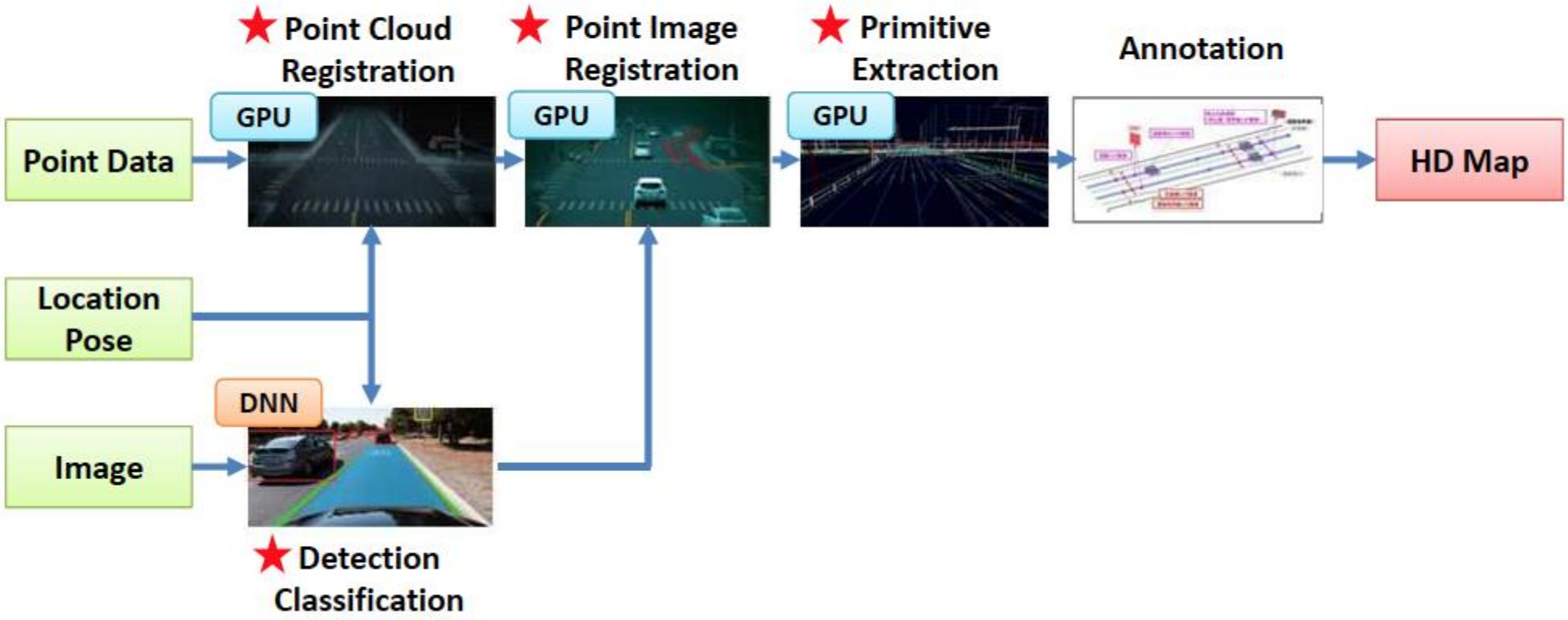


*DNN: Deep Neural Network

Concept of the new HD map creation pipeline

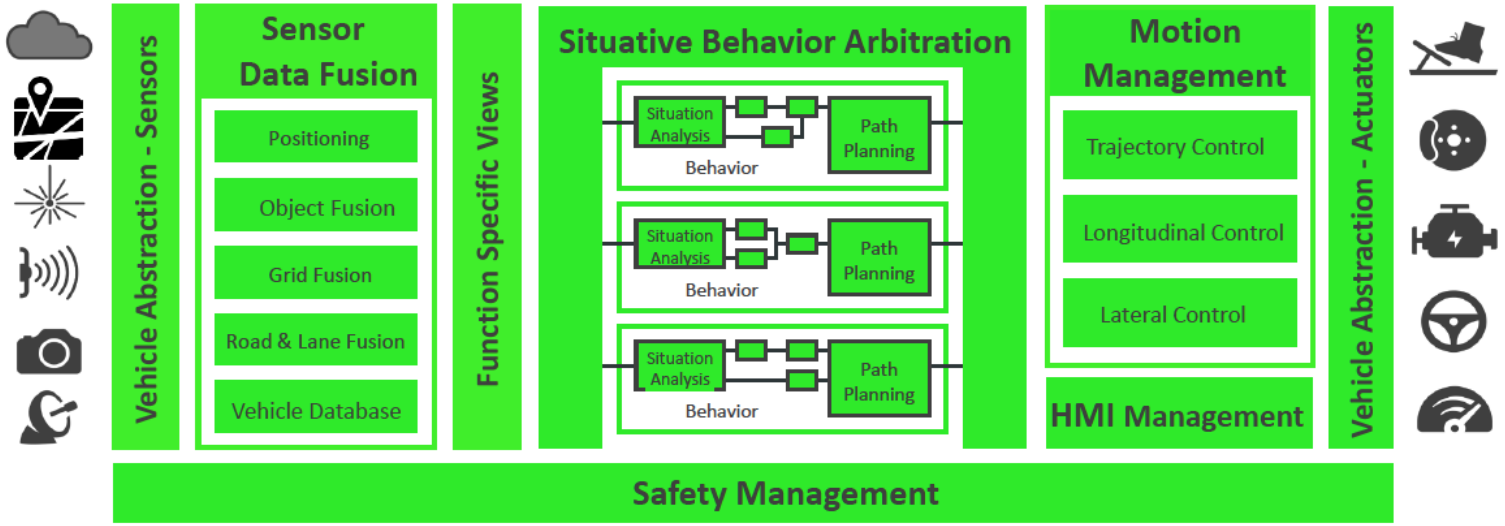
ZENRIN
Maps to the Future

★: MapWorks Modules



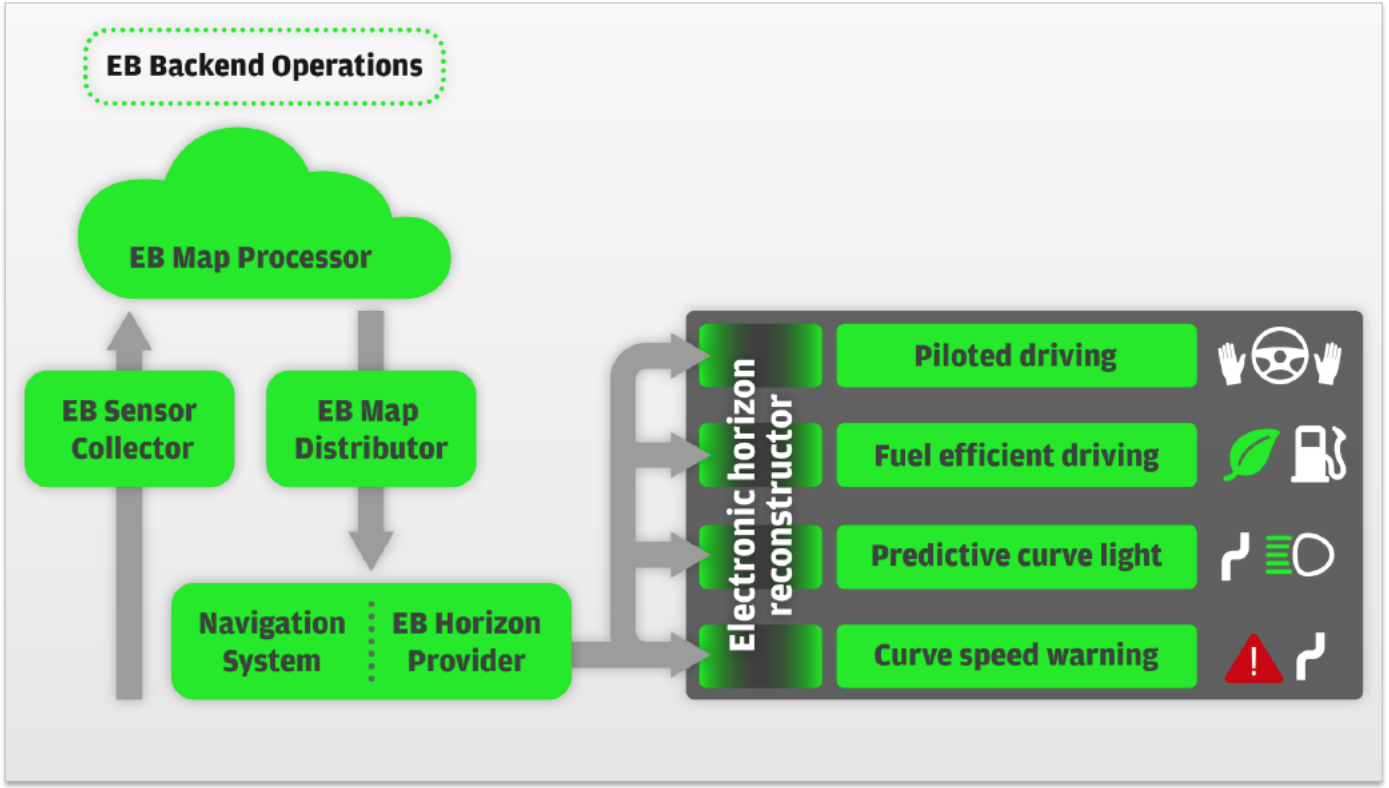
Crowdsourcing 3D Semantic Maps for Vehicle Cognition

Software Framework for ADAS and Automated Driving



Interfaces for	Integrated safety concept	Interfaces for
• Interoceptive sensors – wheel ticks, steering angle, accelerometers / gyros • „Smart“ environment sensors – point clouds, object lists • ADASISv2/3 for map, SENSORIS for cloud	• System health monitoring and diagnosis • Safe-state triggering • Options for redundant environment model and functions (e.g. minimal risk	• Kinematic vehicle components • Instrument cluster • Infotainment display www.open-robinos.com

Maps boost ADAS and Automated Driving

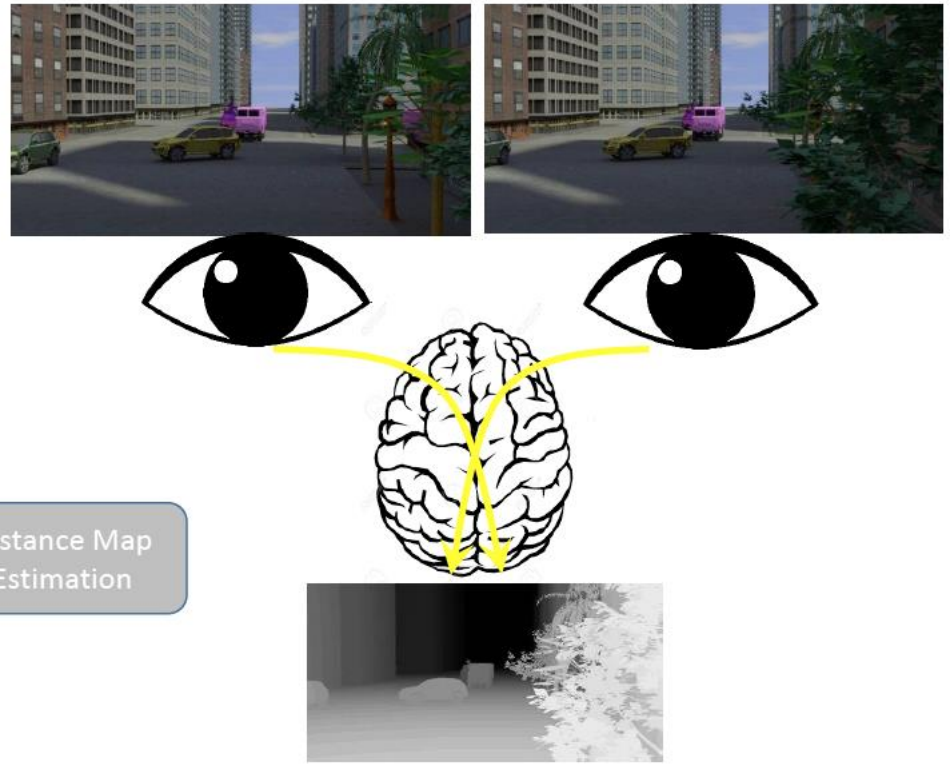


S7348: Deep Learning in Ford's Autonomous Vehicles

Bryan Goodman
Argo AI
9 May 2017

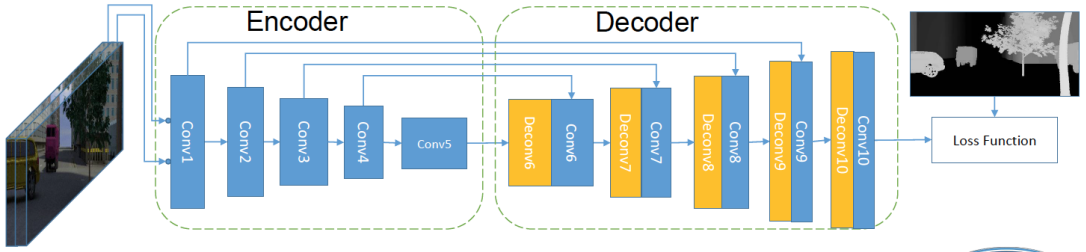
Deep neural networks for stereo matching

- The brain can estimate the distance of an object using the visual information from two eyes.
- We can use deep neural networks



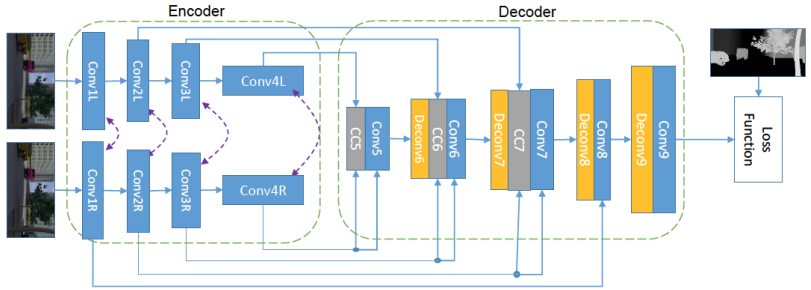
Proposed deep convolutional neural network

- AV driving requires an intelligent distance map estimation, which filters out the objects not of interest.
- Network I
  - General network
  - Encoding and decoding layers
  - Retain objects of interest in the training data sets



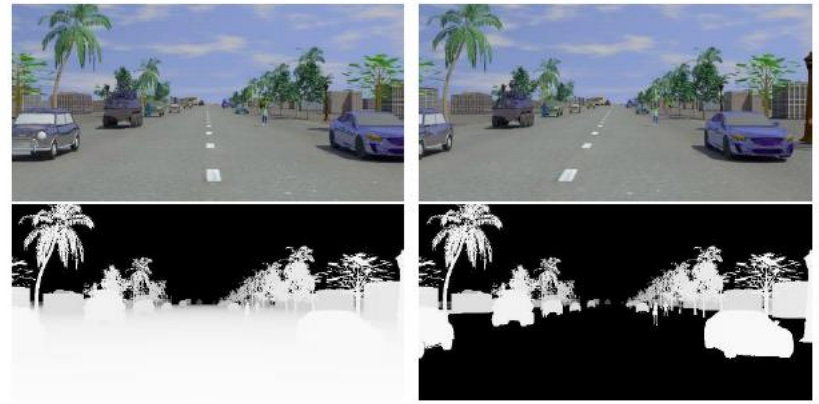
roposed deep convolutional neural network II

- Specialized network
- Encoding and decoding layers
- The cross correlation layers force the network to look for correspondence on the epipolar line
- The weights in the encoding layers are shared



Performance on synthetic and real stereo data

- Synthetic data generation
  - Generate 14,000 pairs of RGB stereo images
  - Synthetic distance maps are only generated for the objects of interest, e.g. cars or pedestrians
  - Gaussian noise added to the stereo images

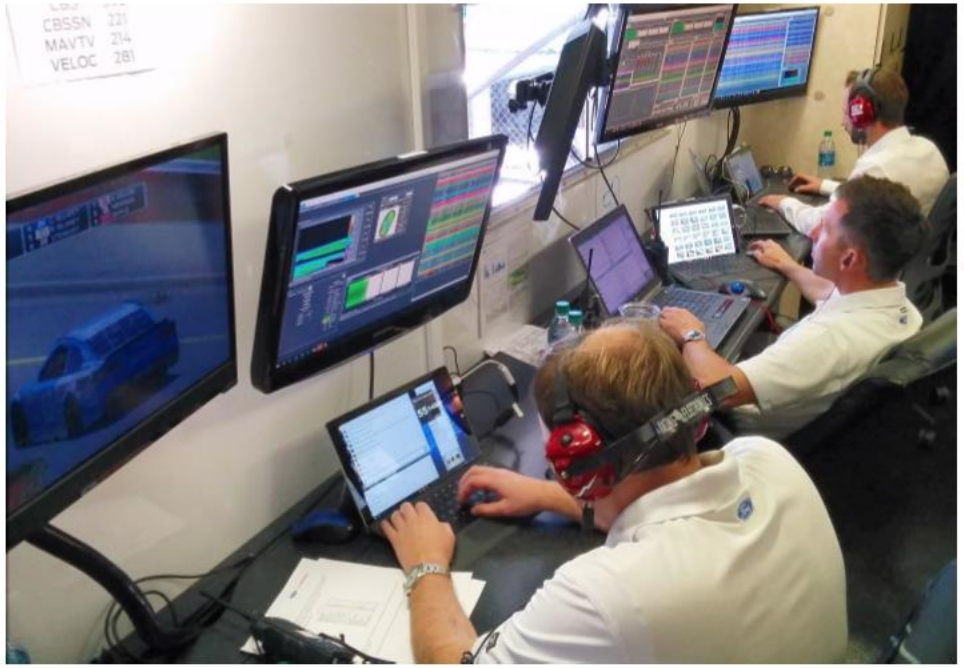


Performance on synthetic and real stereo data

- Fine tuning with LIDAR data sets
  - Project LIDAR point clouds onto the camera images
  - The baseline and optic axes are not the same as the synthetic data

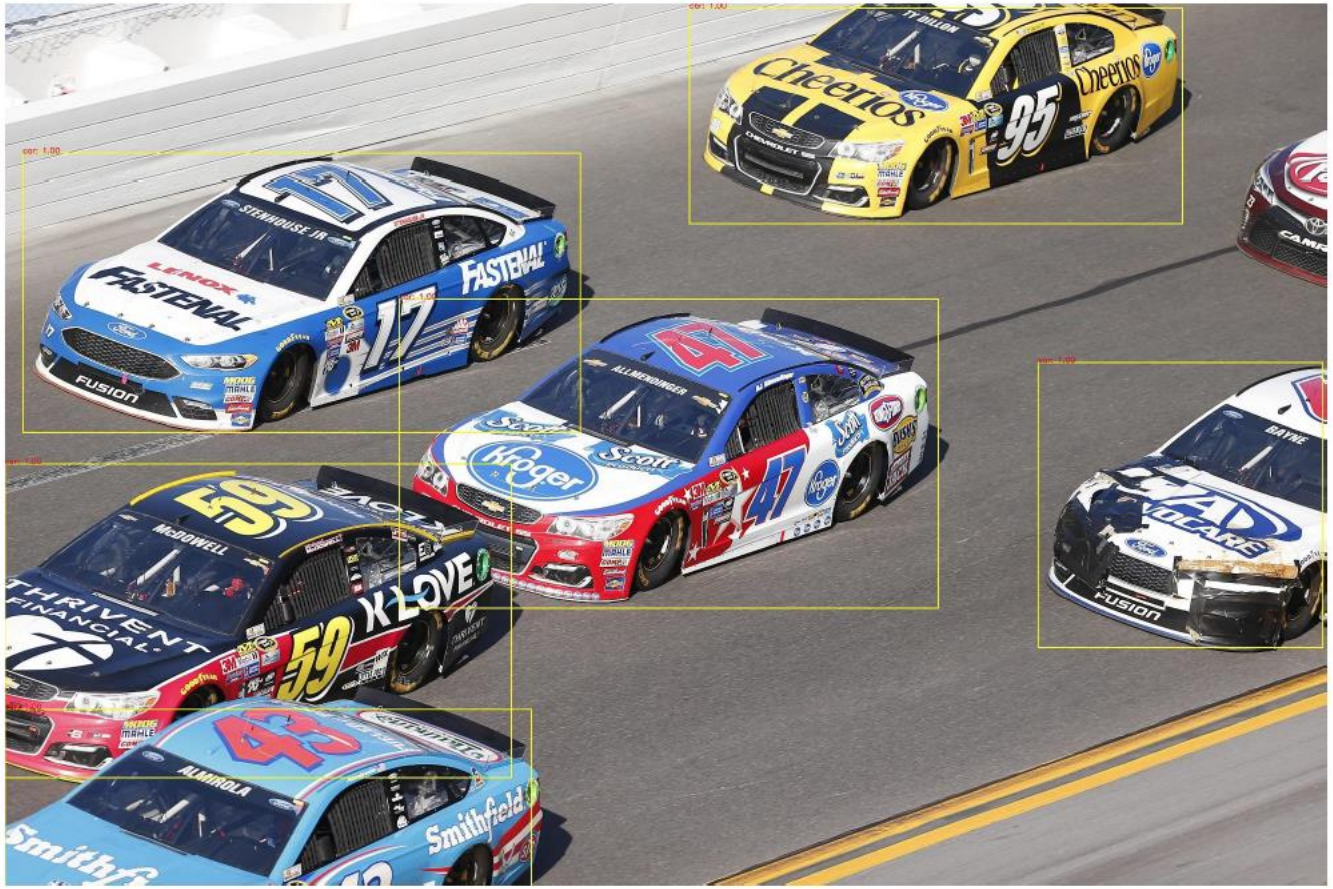
Left camera | Right camera | Network I | Network II

Classifying NASCAR images



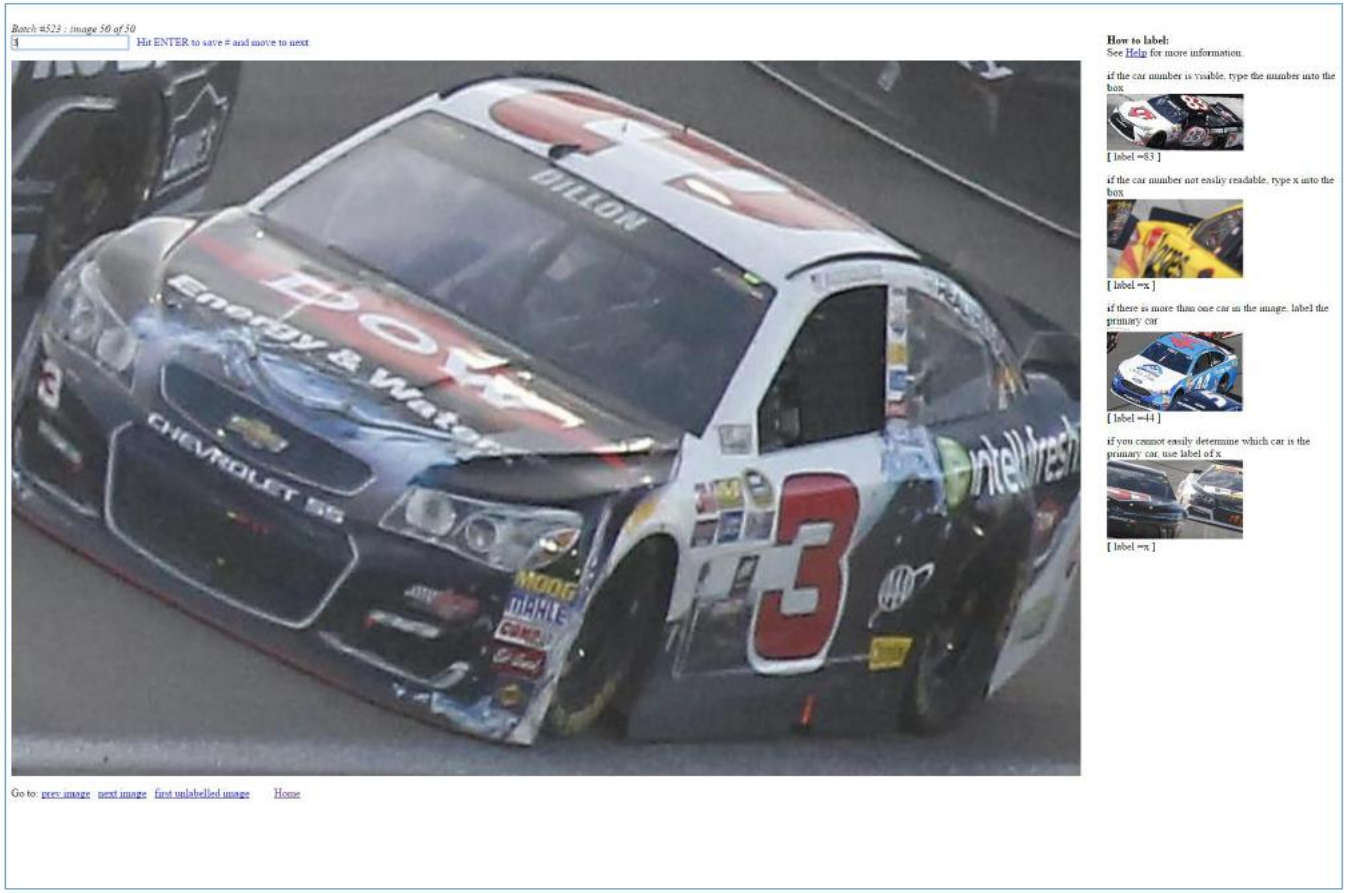
The Ford team reviews pictures during the race

Results – Boxing the Cars



Classifying NASCAR images

Next – determine car number: labeled ~30k images

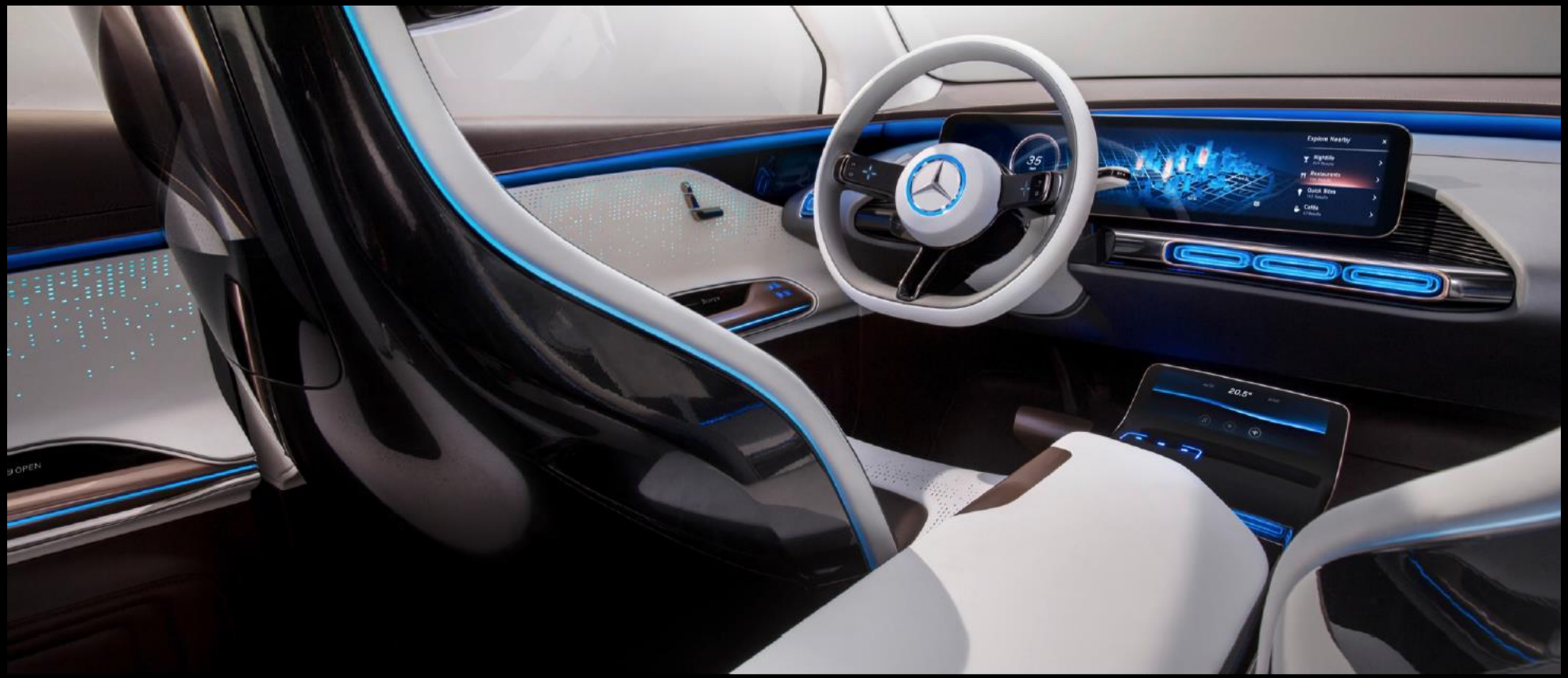


Inspecting the Neural Network

Activated Filter

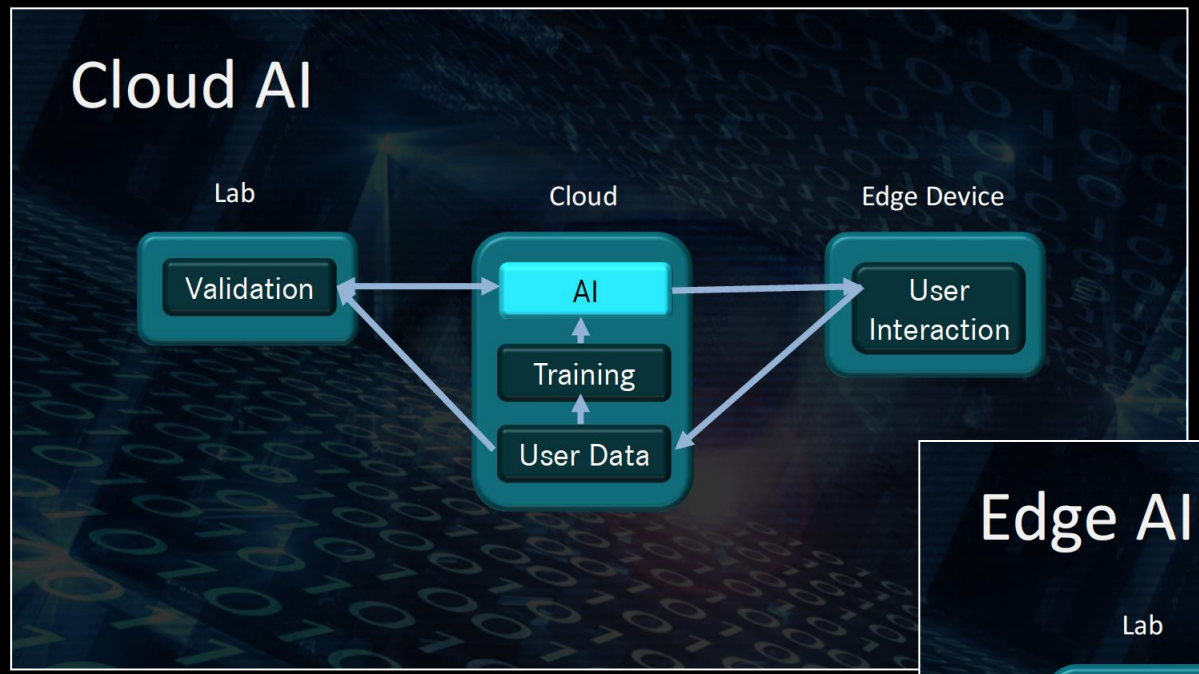
Input Image

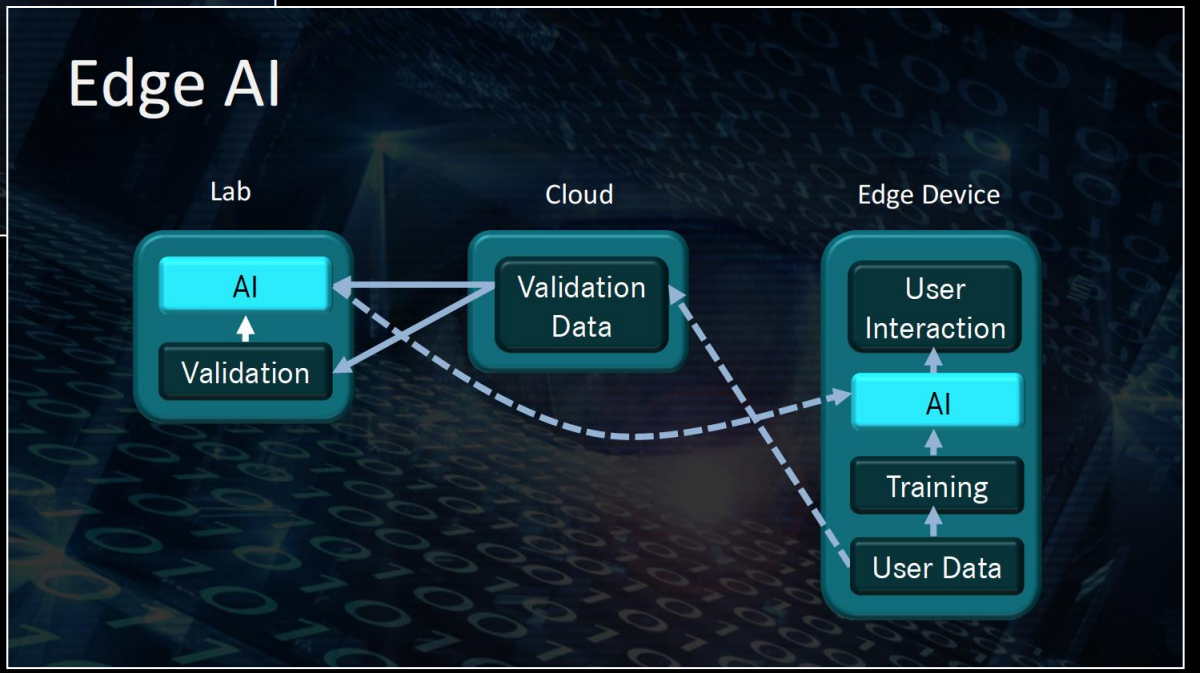
The Model is not a black box. We can see that it is detecting the numbers – important for robustness when the paint changes



Edge-AI for Intelligent User Experience

Kal Mos VP, Mercedes-Benz R&D NA





- Having model uncertainty is important for instant decision making in the Edge
- Getting model uncertainty estimates in deep systems can be based on Monte Carlo sampling methods using dropout
- Doing this with parallelization works well on a GPU.

GTC 2017

AUTOMATED TRUCK DRIVING AND PLATOONING WITH DRIVE PX 2

San Jose, 9th May 2017

Dipl.-Ing. (FH) Devid Will, M.Sc., Dipl.-Ing. Jens Kotte

Forschungsgesellschaft Kraftfahrwesen mbH Aachen

Motivation

Truck related efficiency topics (focus EU)

fka

Energy Efficiency

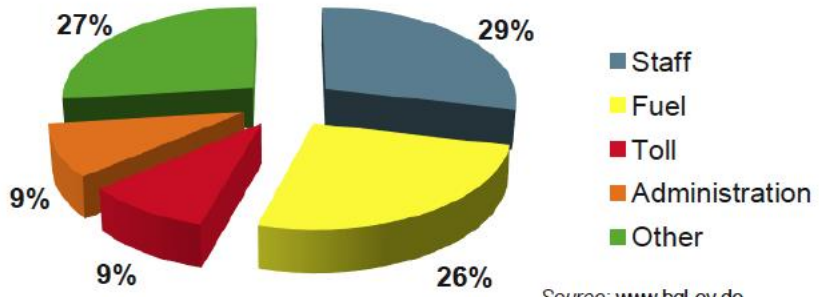
Source: dieterblasl

Traffic Efficiency

Source: t-online.de

Cost Efficiency

Average Portions of Costs in 2013 (Germany)



Source: www.bgl-ev.de

Staff Efficiency

Source: stuttgarter-zeitung.de

Technology transfer passenger vehicle to truck
Examples for challenges

fka

Dimension Variations

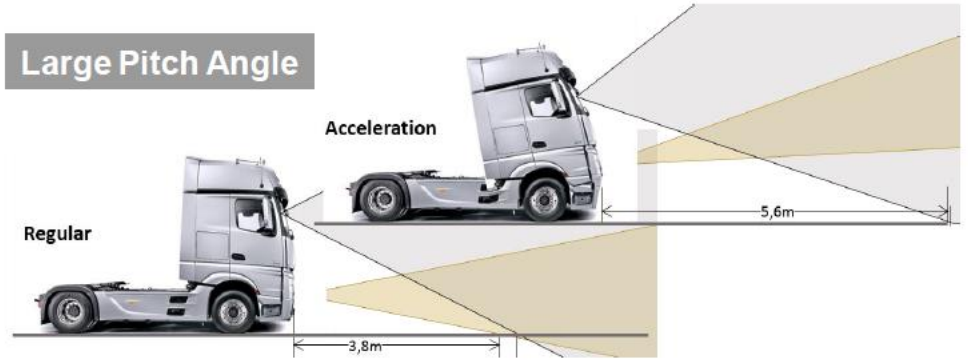
Source:mercedes-benz.co.uk

Configuration Variations

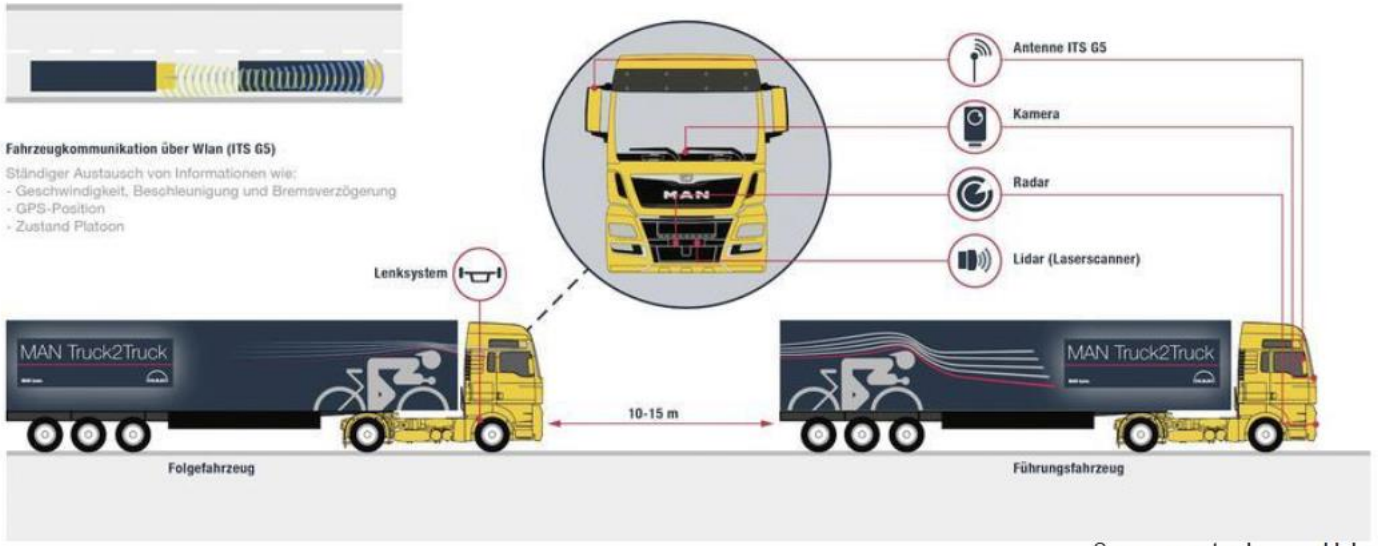
Source:fahrzeugbilkder.de

Source:beschriftungscenter-fuechsl.de

Large Pitch Angle



Platooning
Overview & goals of platooning system



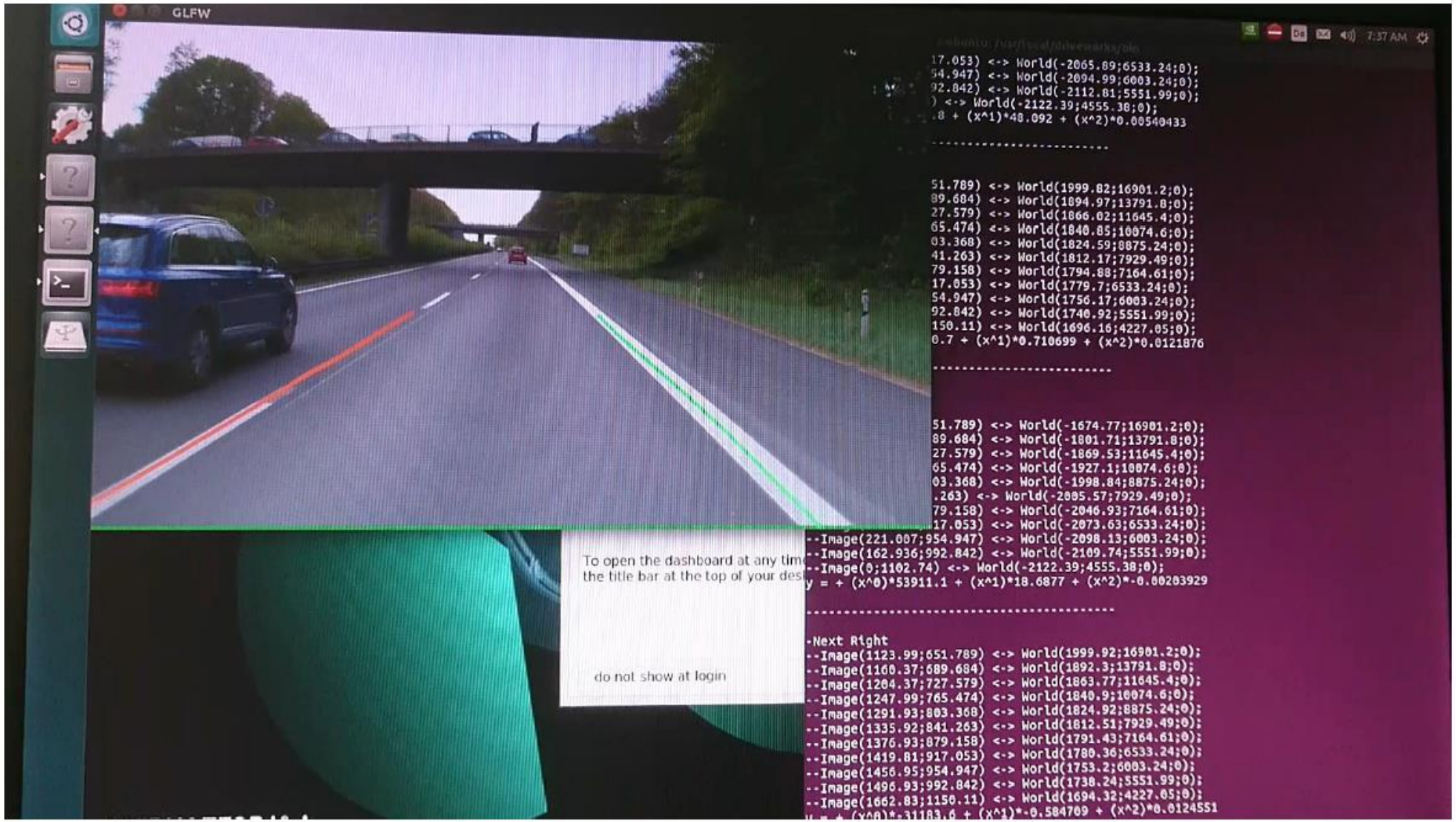
Source: man-truckers-world.de

Goals

- Improvement of **safety** due to longitudinal and lateral guidance
- **Relieve and support** for professional drivers
- Improved **road space**
- Optimization of **traffic flow**
- Reduction of **fuel consumption** due to slipstream driving

NVIDIA LaneNet

Running on Drive PX 2 with parameter extraction

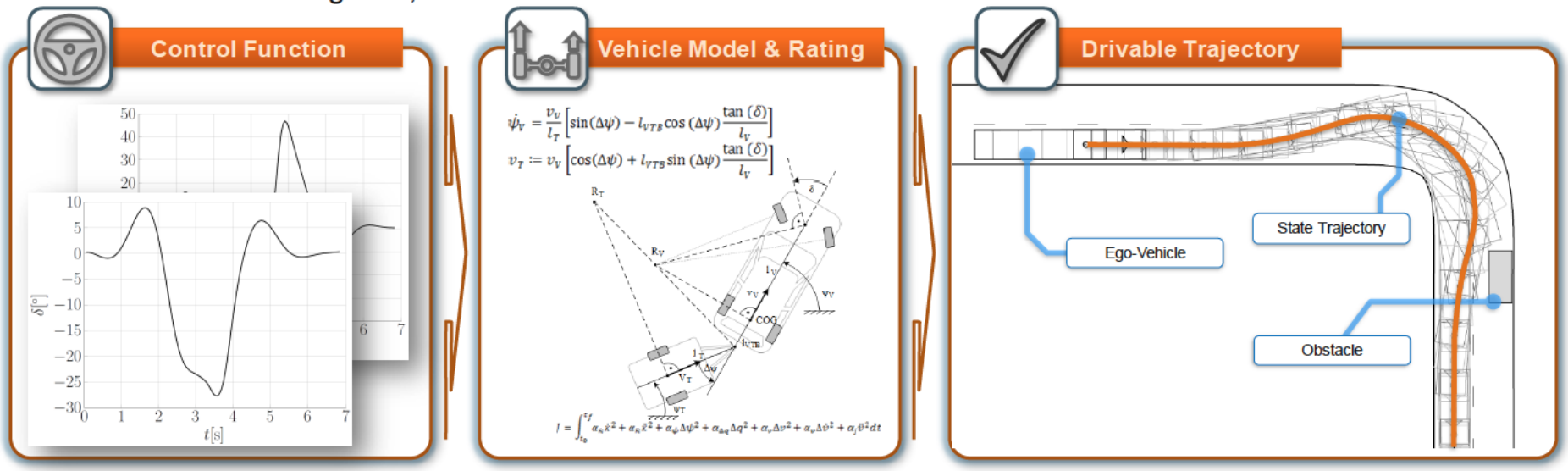


Motion Planning for Assisted and Highly Automated Cars/Trucks

Trajectory Planning

Simplification of the trajectory planning problem

- Find a suitable **control function**, i.e. a steering and speed profile, which
  - guides the vehicle in a **safe** and **comfortable** manner through the environment
  - **respecting** vehicle's and environmental **constraints**, e.g. max steering angle, collision avoidance, vehicle tilting limit, road friction



TOWARDS SCENE UNDERSTANDING UNDER CHALLENGING ILLUMINATION CONDITIONS FOR ADAS

SRINIVAS K S S, PRATYUSH SAHAY, RAJESH BISWAL

NVIDIA GPU TECHNOLOGY CONFERENCE (GTC) 2017

HARMAN

INTRODUCTION

HARMAN

- Fatality rate per mile of travel is three times higher in night-time compared to day

Almost half of all road traffic deaths are among 'pedestrians, cyclists and motorcyclists'.

Source: WHO

- Driver Assist systems using thermal vision

- Range (200-300m)
- $$$
- Available in luxury segment - ~14%
- Less effective in warmer temperatures

Can we provide an affordable Night Vision System for most car segments?

Sources: Road Accident statistics from WHO, NHTSA

MULTIMODAL KNOWLEDGE DISTILLATION

TEACHER-STUDENT LEARNING

HARMAN

RGB

Conv1 Conv2

Thermal

Conv1 Conv2

Conv3 Conv4 Conv5

Detect

Teacher network

Bounding Box Classification Loss

Bounding Box Regression Loss

Hint Loss

Conv1 Conv2 Conv3 Conv4 Conv5

Detect

Student network

Bounding Box Classification Loss

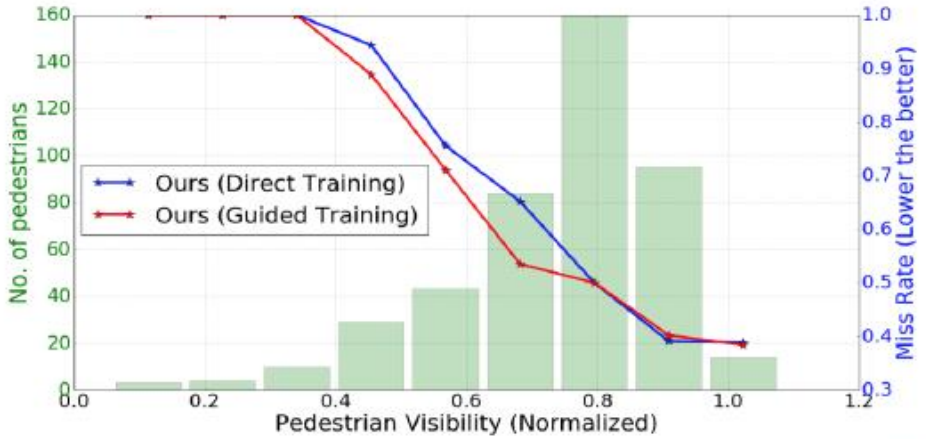
Bounding Box Regression Loss

RESULTS

ANALYSIS

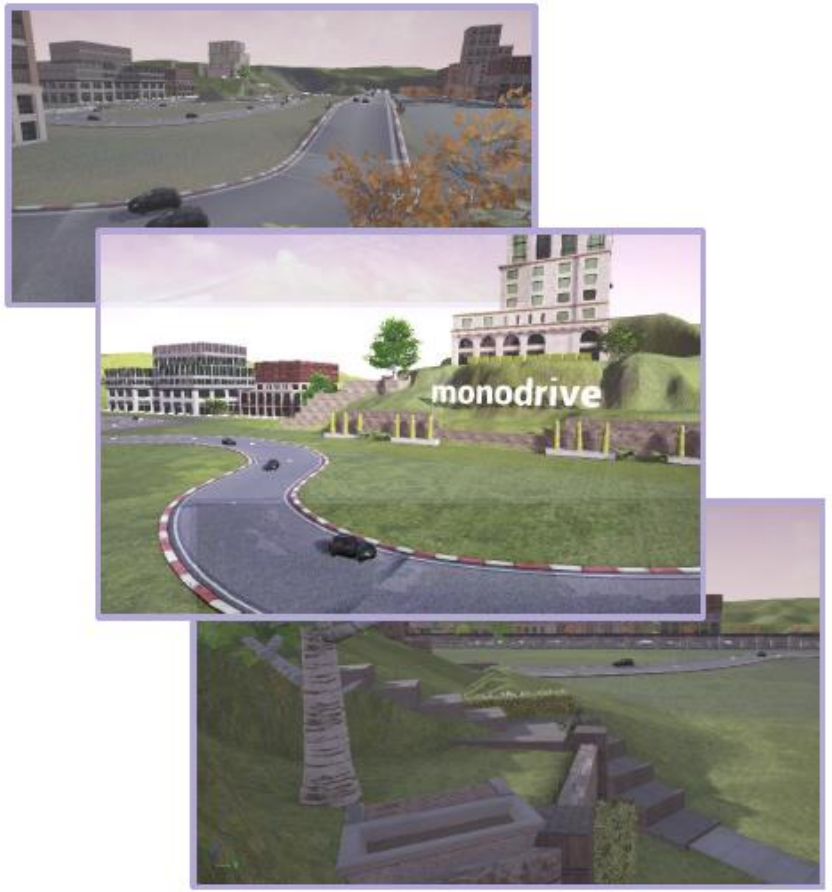
HARMAN

Visibility based Detection Performance



monoDrive tm

Autonomous driving made safe



monoDrive

Solution

- Automate scenario test generation for planning testing
- Deep learning system for automated scenario modification and re-generation.
- Leverages existing gaming systems to enable multiphysics simulation
- Generation of realistic Lidar, Radar, Camera, and IMU sensor information for perceptions system testing
- Enable automated vehicle control performance metrics
- Fast error case regeneration, with derivative regeneration

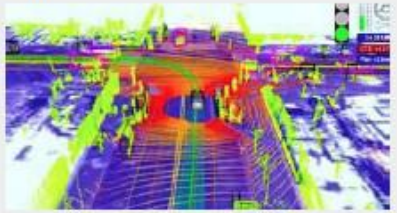
Testing Perception and Planning

Simulation Engine

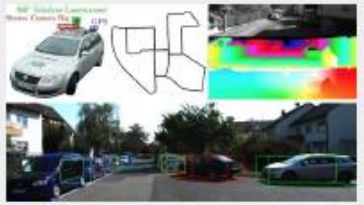
monoDrive

Ground Truth w/ Scene Labeling

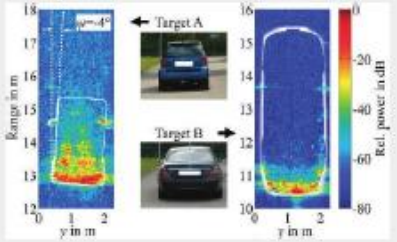
Lidar



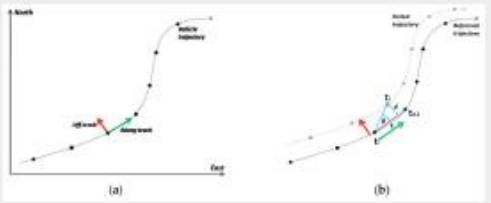
Camera Stereo Vision



Radar



Inertial Measurement Unit (IMU)

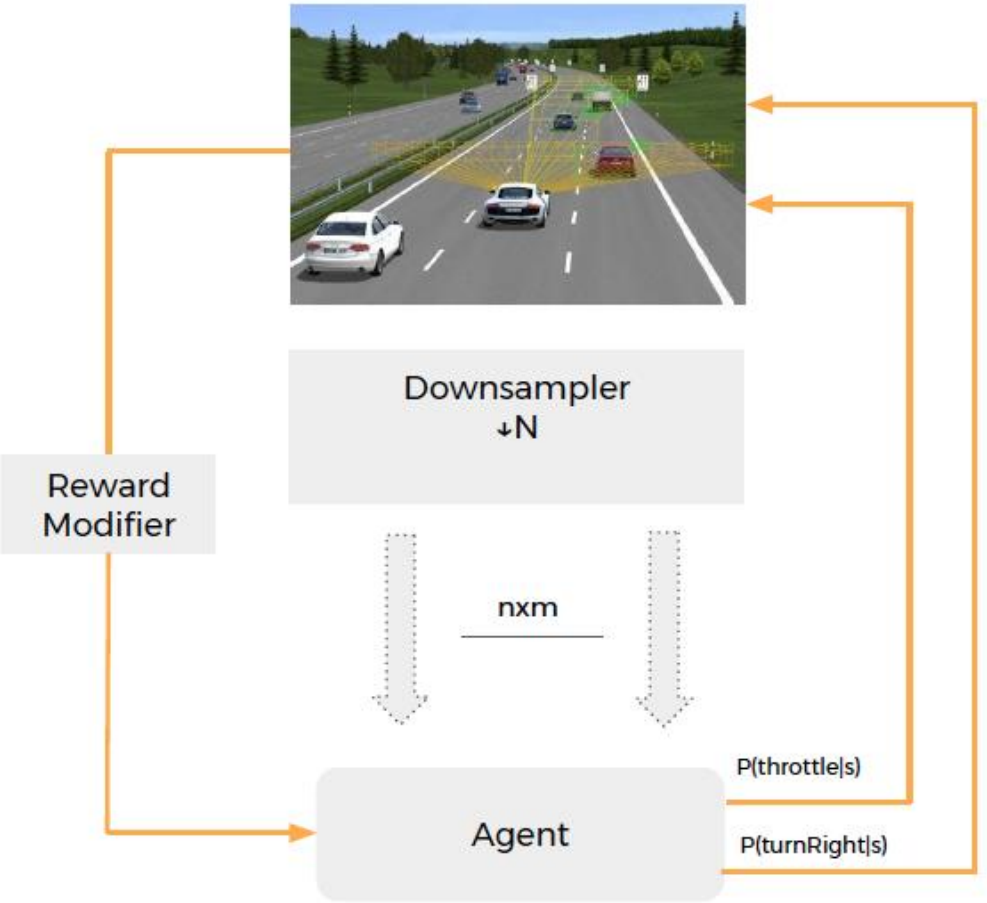


Control System Under Test

monoDrive

Reinforcement Learning

- Simulator Interface
  - Socket-based
  - Python, C++
  - Single simulator instance
- Per Agent Reward Modifiers
  - Library of reward modifiers
- Agent Hyperparameters
  - Continuous action space
  - Multiple concurrent agents
- Downsampling
  - Full resolution -> 80x80
  - Top down view or perspective



monoDrive

Digital Driving License

Jorrit Kuipers

CEO robotTUNER

researcher Delft Technical University

TWT GmbH
Science & Innovation

GTC | May 10, 2017

TRONIS® : The Virtual Environment Towards Prototyping and Testing Autonomous Driving

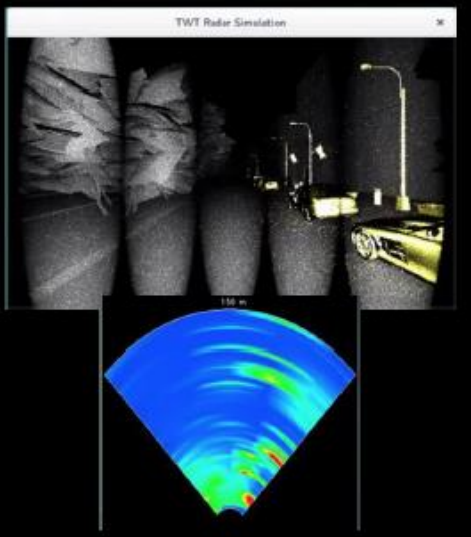
Dr. Karl Kufieta
Dr. Michael Keckeisen

TWT GmbH
Science & Innovation

info@twt-gmbh.de
www.twt-gmbh.de

TWT

TWT Tronis®
Sensors



How to Become a Self-Driving Car Engineer

DAVID SILVER

UDACITY

Nanodegree Program
Term 1

Introduction

Deep Learning

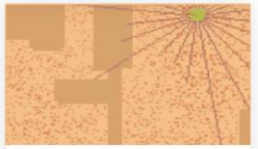
NVIDIA UBER ATG

Computer Vision

Nanodegree Program
Term 2

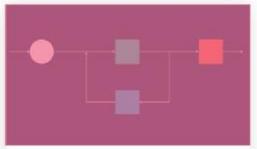
Sensor Fusion

Mercedes-Benz



Localization

Mercedes-Benz



Control

UBER ATG

Nanodegree Program
Term 3

Path Planning

Mercedes-Benz

Advanced Deep Learning

Functional Safety

System Integration

NVIDIA

www.nvidia.com/dli