Horizon Robotics

Beyond Perception: Recent Progress on Autonomous Driving

Ming Yang
Co-founder & VP, Software

Dynamic & intensive (crazy) competition

Horizon Robotics

2016/3, $1B

GM ← CRUISE

2016/10, $0.68B

UBER ← OTTO

2016/10, $47B

QUALCOMM ← NXP

2017/1, spin off

Google → WAYMO

2017/3, $8B

SAMSUNG ← HARMAN

2017/3, $15B

intel ← MOBILEYE

2017/3, partner

BOSCH + NVIDIA

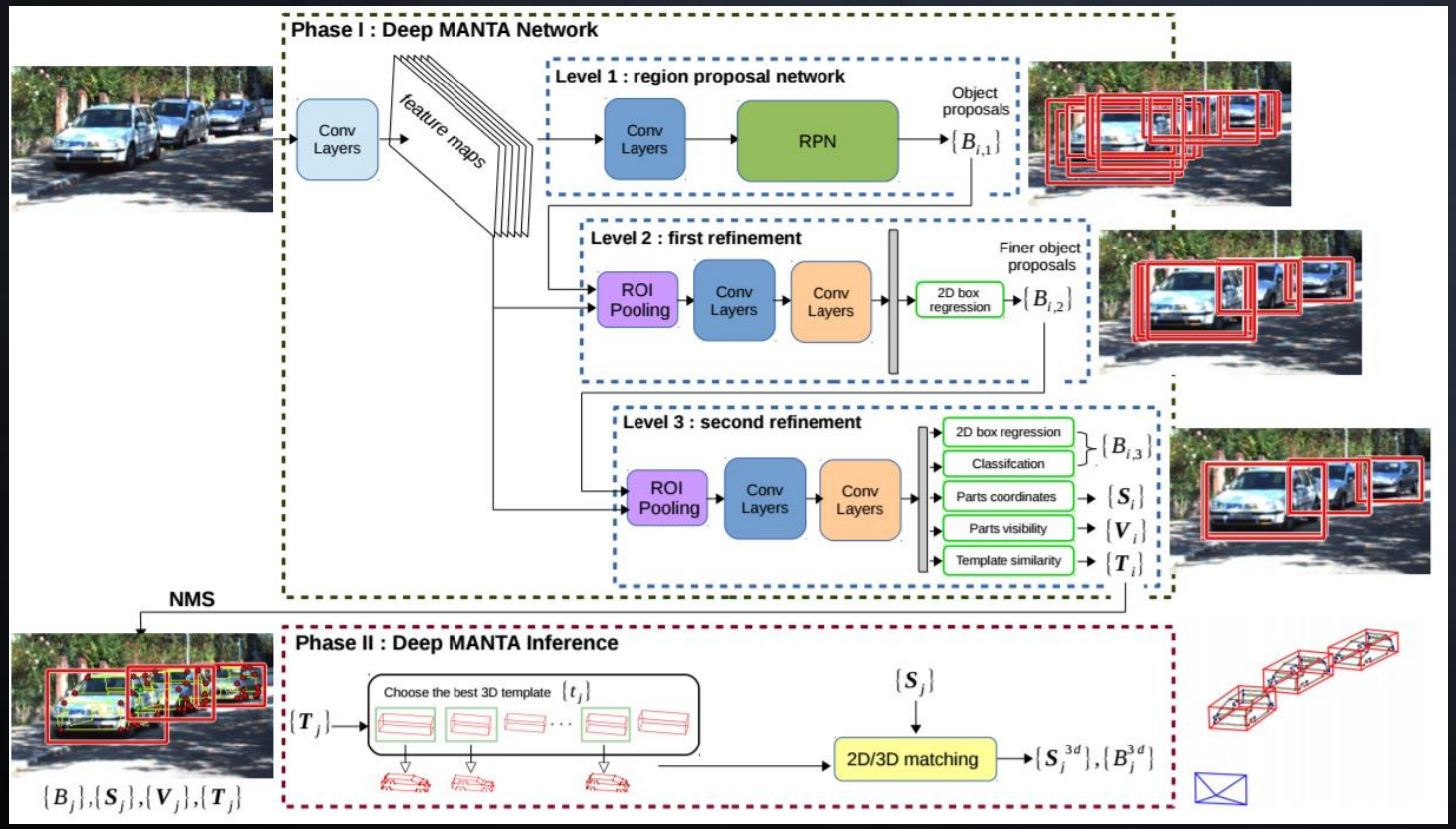
TESLA

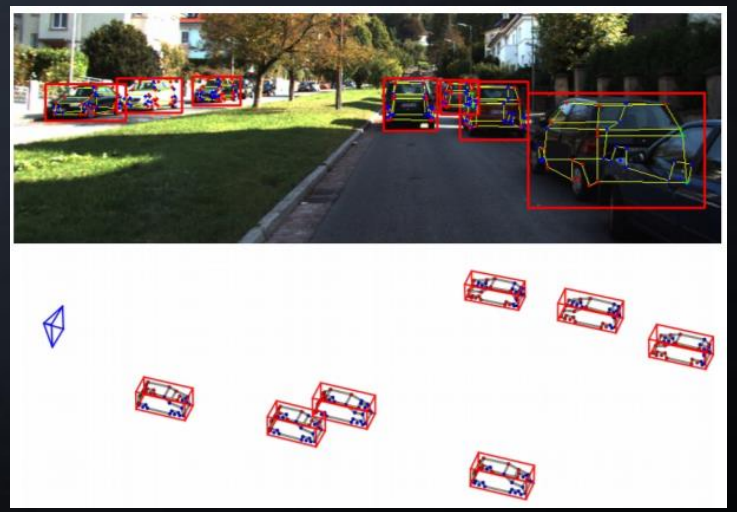
Progress

- Detection beyond bounding box
- End-to-end learning for driving
- Simulation & reinforcement learning
- Sensor fusion / information integration
- Hardware platform and infrastructure

Detection beyond bounding box

- Single images => 2D location, parts, pose, 3D estimation



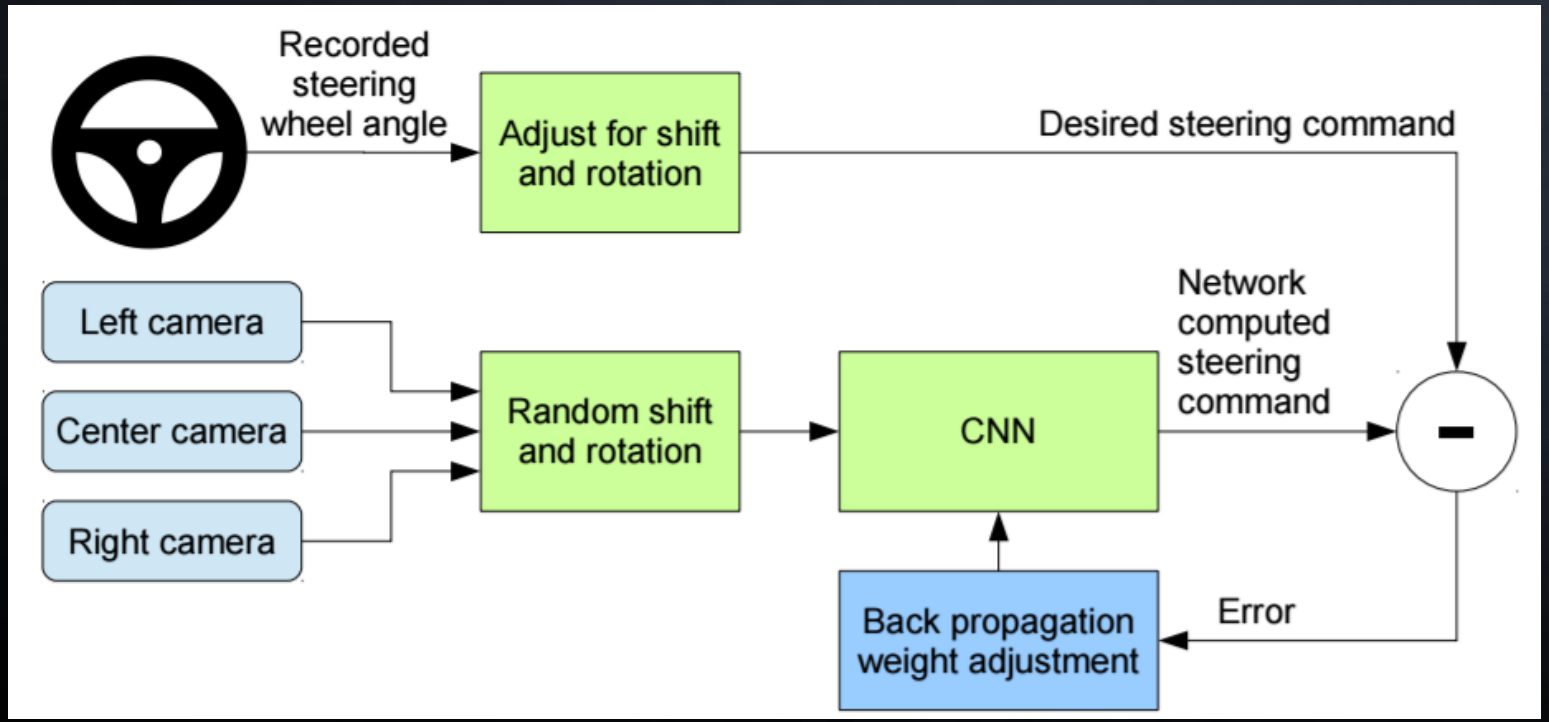


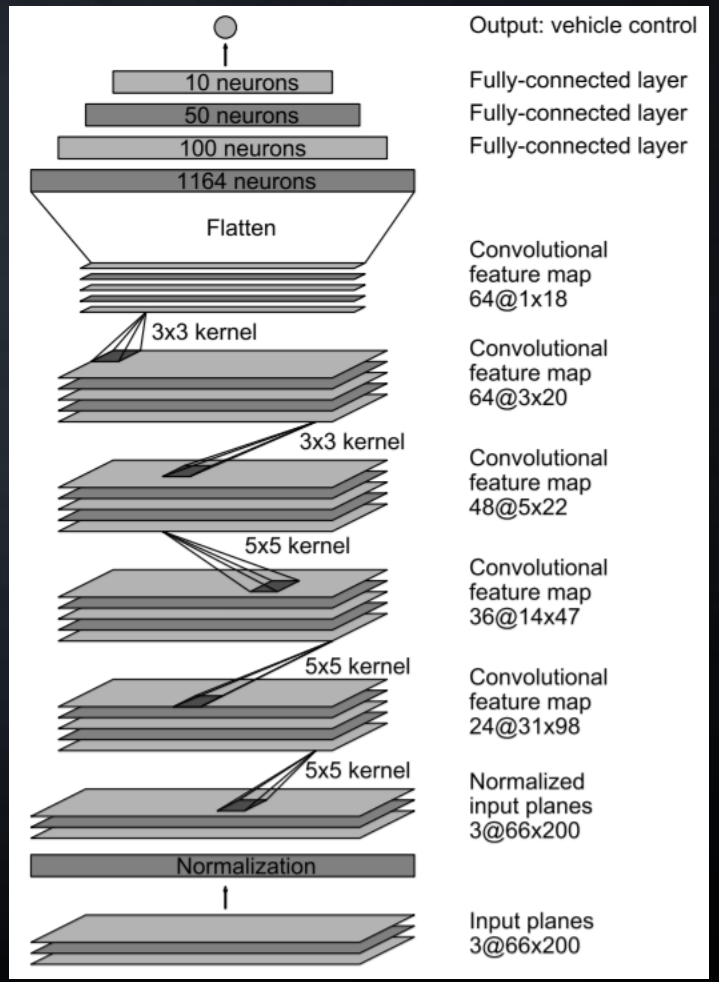
Monocular 3d object detection for autonomous driving, X. Chen, etc., CVPR 2016

Deep MANTA: A Coarse-to-fine Many-Task Network for joint 2D and 3D vehicle analysis from monocular image, F. Chabot, etc., CVPR 2017

End-to-end learning for self-driving cars

- Images => steering wheel angle
- Trained on 72 hours videos, 98% self driving

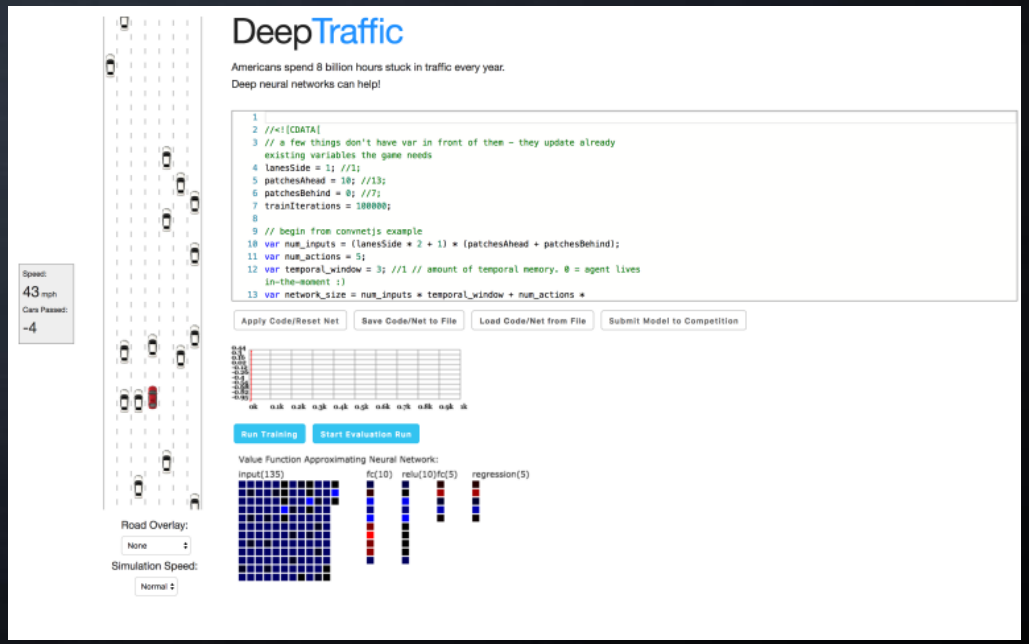




End-to-end learning for self-driving cars, M. Bojarski, etc., NVIDIA, 2016/4.

Simulation & reinforcement learning

- Photorealistic computer game (GTA5) => data label
- Reinforcement learning => motion planning strategy



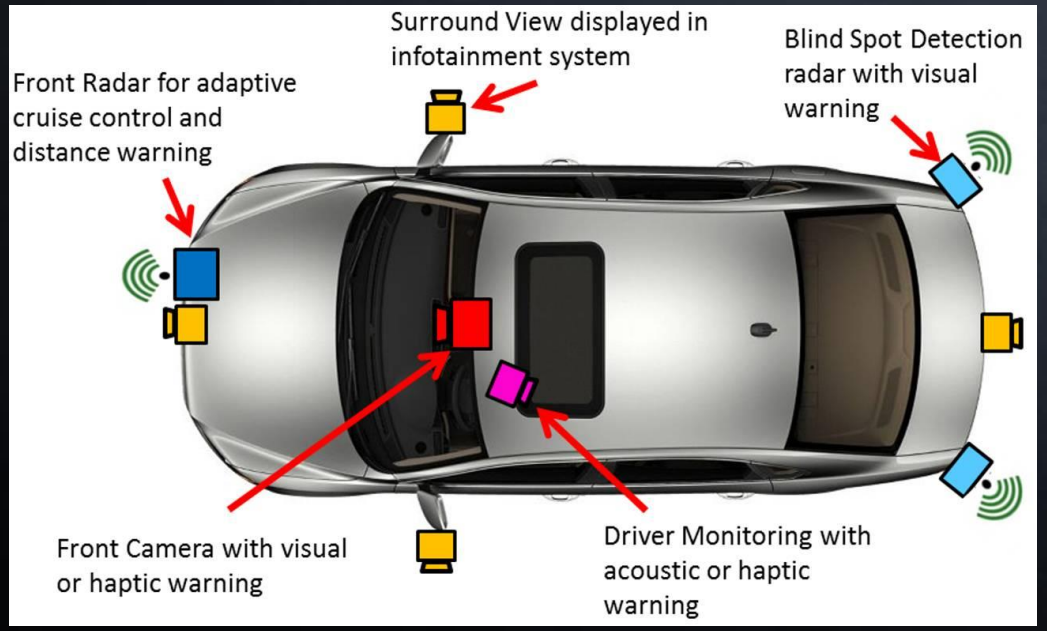
Driving School II Video Games for Autonomous Driving, A. Filipowicz, 2016/5

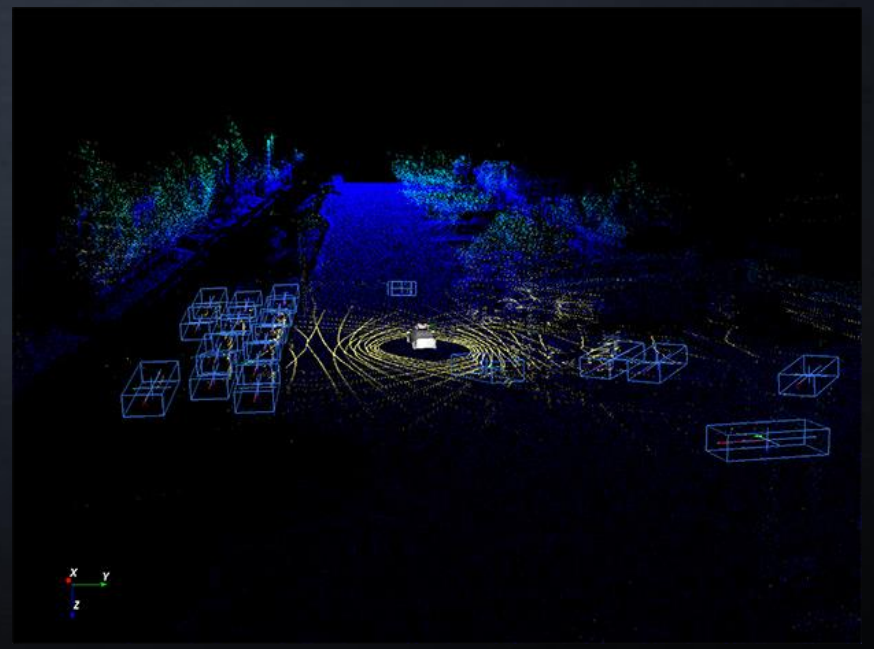
Playing for Data: Ground Truth from Computer Games, S. Richter, etc., 2016/8

Deep Traffic, http://selfdrivingcars.mit.edu/deeptrafficjs/

Sensor fusion / information integration

- CAN, Lidar, Radar, IMU, Ultrasound, Video sequences
- High-resolution map, V2X communication with the environment



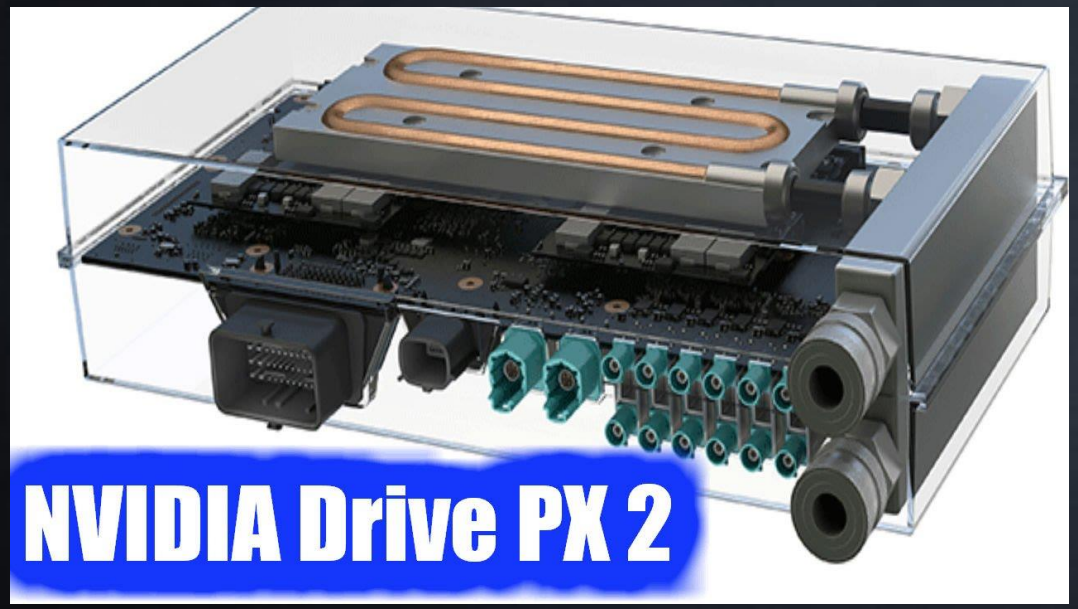


9 cameras + 2 radars + 6 lidars

Drive.ai: rainy night autonomous drive, 2017

Hardware platform and infrastructure

- NVIDIA Drive PX2



Intel GO

Horizon Robotics

- Founded in July 14th, 2015, HQ in Beijing, second R&D site in Nanjing, an office in Shenzhen ， a new office in Shanghai for R&D of autonomous driving.
- About 200 engineers from Baidu, Facebook, Google, Huawei, Nokia, Microsoft, TI, Freescale, NVIDIA
- 40% have oversea experiences, 14% have PhD degrees, 100% are seasoned engineers
- Pioneers of many accomplishments in AI

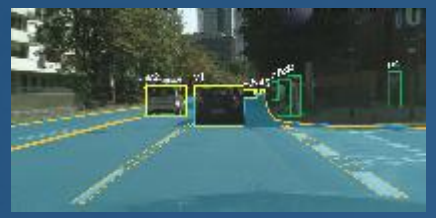
Our solution: multitask DNN plus causality reasoning

Horizon Robotics

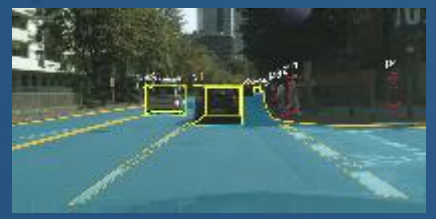
sensory data

camera only, or plus radar / lidar

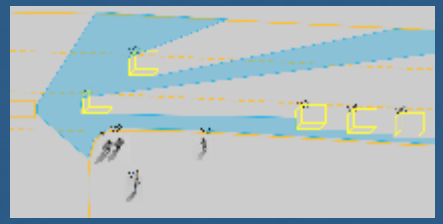
object detection / scene parsing



pose estimation

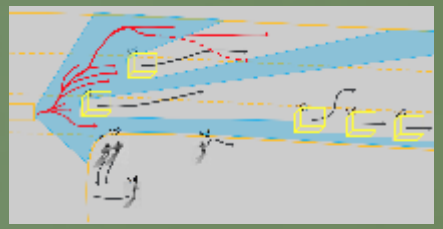


semantic 3D environment model



movement prediction

path planning



object detection, scene parsing, and pose estimation

semantic pixel-to-depth model

a probabilistic time series predictive model

a reinforcement learning model

Causality reasoning integrates expert knowledge and learning

Contact: dream@hobot.cc