Improving Commercial Fleet Safety and Performing High-Def Mapping At the Same Time

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GTC, March 2018

The Safety Challenge

Road Accidents are the leading cause of loss of life & property

- [Globally] est. 1.25M fatalities annually
  WHO
- [US] ~$800B financial loss due to road accidents in 2010
  NHTSA, “Traffic Safety Facts”, Feb, 2015
- 94% of accidents are due to driver related reasons
  NHTSA, “Traffic Safety Facts”, Feb, 2015

The Dynamic Mapping Challenge

L2+ to L5 autonomous vehicles leverage HD maps that need to be updated frequently.

- [US] ~$2B estimate to HD-Map the US once using existing approaches
  - Raquel Urtasun, Uber ATG, NIPS Dec 2016

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Netradyne Solution

- A Deep Learning AI driven IoT solution focused on improving commercial vehicle & driver safety
- And in the process continuously collect vast amounts of rich, vision based data

Leverage this data to create

- Dynamic HD Maps

Driveri™

Vision-Based IoT Driving Monitoring System

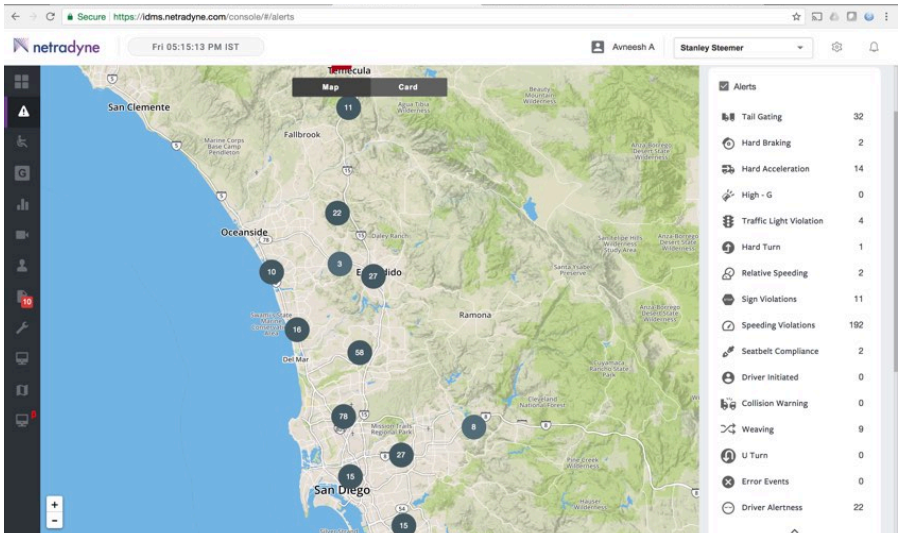
NVIDIA TX1
Deep Learning Processor

Storage
Up to 50 Hours of Video on device

Quad HD Cameras
360 Degree,
120 dB HDR

Inertial Sensors
9 Axis Accelerometer, Gyro, and Magneto sensors

Communication Channels
4G LTE / Wi-Fi / BT / GPS
Integrated with CAN Bus (J1939/OBD II)



*Driveri™ uses **Edge Computing** to analyze every second of driving*

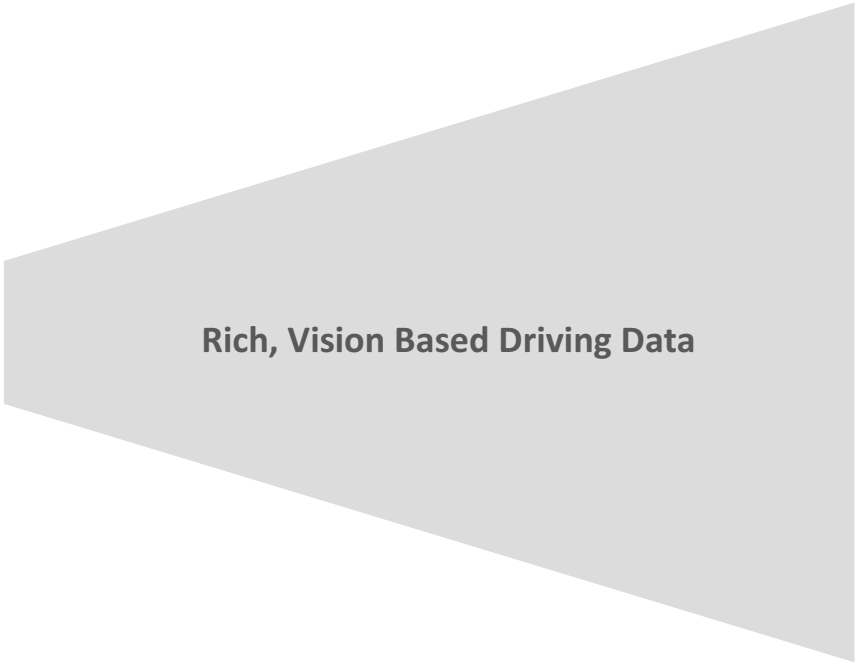
The most extensive collection of Rich, Vision Based Driving Data

Several million and growing …

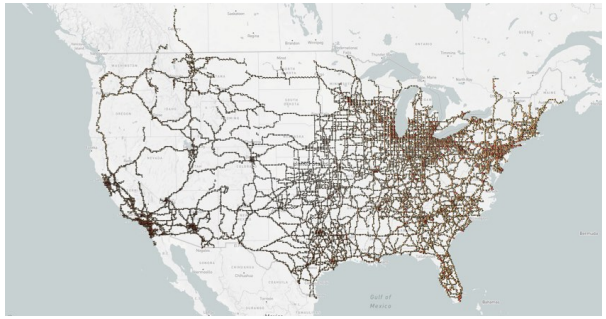
Ride Sharing

Commercial Fleets

22M US, 150M globally



Dynamic 3D HD Maps



In 2018:	100M miles/month
In 2020:	1B+ miles/month

Real-time edge-computing to fully analyze the visual scene.

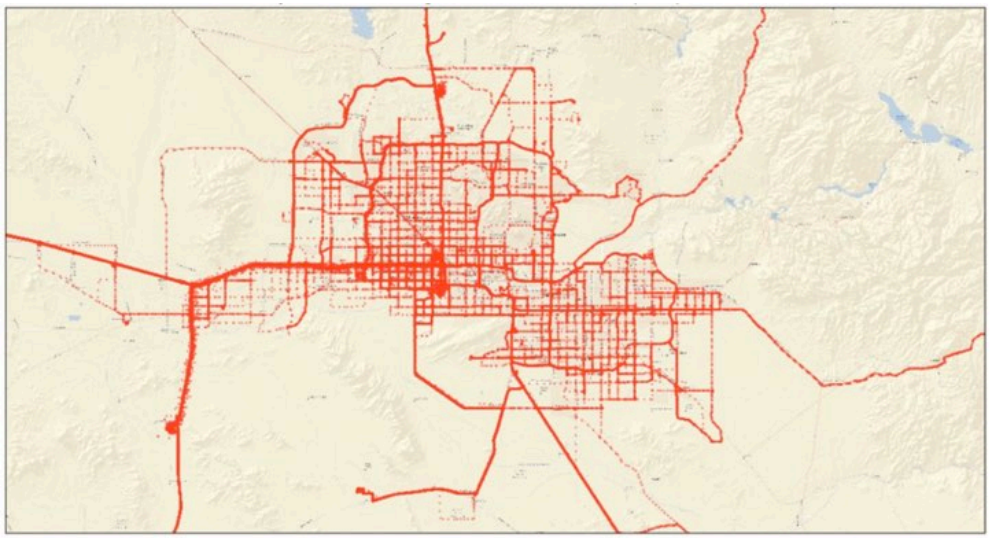
Scene Examples

Netradyne US Miles Analyzed via IDMS

Netradyne Miles Analyzed – Urban Coverage

Netradyne San Diego Coverage

Netradyne Phoenix Coverage



Dynamic 3D HD Maps

Autonomous Driving with Dynamic HD Maps

- Autonomous cars (Level 2-5) use HD maps to understand the road environment
- Maps need to be updated **dynamically** to reflect changes in the road environment
- Sometimes the road geometry needs to be inferred
  - **Inferred lanes** when lanes are poorly marked
  - **Stop location** for stop signs, traffic lights
  - Intersections can be very challenging

Current Methods for Generating HD Maps

Test Vehicles with LiDAR

- Very expensive. Dynamic updates of hours/days/weeks impractical
- Not enough information to provide 'inferred' road geometry.

Crowdsourcing from autonomous cars

- It will be a very long time before there is sufficient penetration of autonomous cars to provide a comprehensive crowd-sourced map.
- No means to gather human driving patterns to aid in map-making

Netradyne Dynamic 3D HD Maps

- **Method:** Generate real-time, crowd sourced, “High Definition” maps using the commercially deployed Driveri devices.
  - 3D localization with target <10 cm relative accuracy
- **Dynamic Update:** Develop SLAM approaches to crowd source and quickly update for accidents, road construction, and other changes.
- **Inferred Drivable Surface:**
  - Use Deep Learning & crowd-sourcing to generate accurate ‘inferred’ lanes & road boundaries even when the lane markings are poor or absent.
  - Use crowd-sourced analysis of human driving patterns to aid in inferring the road geometry.
- **Edge Computing:** Real-time, edge computing. Small BW usage

First Person View of SLAM-based Mapping

Everyday objects & lanes become navigation landmarks


STREET_LIGHT
STREET_LIGHT
SIGN_BUS_STO
SIGN_BIKE_
FIRE_HYDRANT
RM_PED

Detecting marked & inferred lanes

Visible / Inferred Lane
Road Boundary
Ego Left / Ego Right
Yellow
Carpool

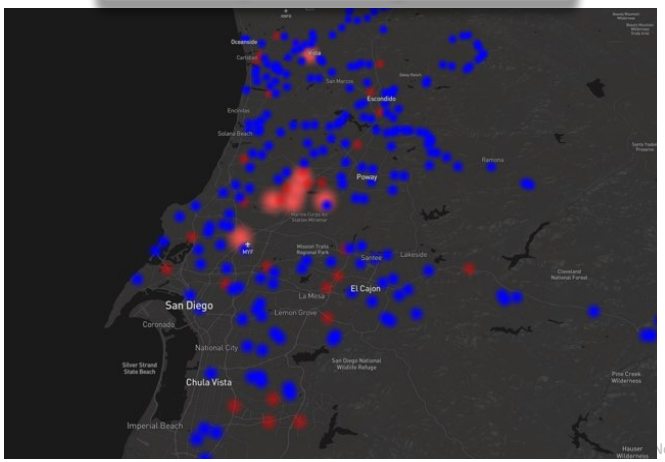
Crowd-sourced Behavioral Models for HD Maps

- Learn the implicit 'Rules of the road' from human-drivers
- Co-exist with human drivers

'Where to stop?'

'Where to park?'

Probability of traffic light violation



Example Generated Map

Thank you

Web: www.netradyne.com