Improving Commercial Fleet Safety and Performing High-Def Mapping At the Same Time
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
- 94% of accidents are due to driver related reasons

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
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

- **Quad HD Cameras**
  - 360 Degree, 120 dB HDR

- **NVIDIA TX1**
  - Deep Learning Processor

- **Inertial Sensors**
  - 9 Axis Accelerometer
  - Gyro
  - Magneto sensors

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

- **Storage**
  - Up to 50 Hours of Video on device

**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

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 Phoenix Coverage

Netradyne San Diego 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
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 park?’

‘Where to stop?’

Probability of traffic light violation
Example Generated Map