Ushr Company History

Ushr - Autonomous Driving

Industry leading & 1st HD map of N.A. Highways (220,000+ miles)
  • Highest Accuracy (3-8cm globally geo-referenced)
  • Highest Quality AQL .5 (99.5%) – AQL .1 (99.9%)

LIDAR Point Cloud Processing Techniques
  • Automated Feature Extraction Techniques
  • Machine Vision and Machine Learning

Scalable data acquisition and frequent updates
  • Proprietary collection / fleet
  • Frequent updates (quarterly, monthly, weekly)

Investment/Funding
  • Closed Series A round in November - $10mm
  • Investors – Enertech Capital, GM Ventures, Emerald Technology Ventures, Forte’ Ventures
Ushr Products

On-Vehicle Map Database

- Ushr - ADM
- Custom
- ADASIS
- Road Segments
- Road Connections
- Road Objects
- Road Cross-sections

On-Vehicle Software

- Active Drivers Map (e-horizon API)
- Vehicle Localization
- Change Detection
- Other Standards (ADASIS)
Autonomous Driving Evolution

Navigating Roads Safely = More Time Behind The Wheel

Infotainment Systems And Other Electronics “Assist” The Driver

Controlling The Vehicle Is The Driver’s Job

Software And System Glitches Are Not Critical And Can Often Be Resolved Without Affecting Vehicle Operation
Autonomous Driving Evolution

Navigating Roads Automatically & Safely Involves; Sensors, Data Fusion, Decisions, And Vehicle Control

ADAS Systems Must Continually Evolve And Approach New Levels Of Safety, Redundancy And Quality

System Glitches = Customer Dissatisfaction

How Well All Of This Is Done Determines Trust And Technology Adoption
Autonomous Vehicle Value Proposition

Must Drive Better Than Humans
Sensor Fusion Is Essential
Map = Longest Range Sensor
Allows Vehicles To “See” The Road Ahead
  - Pavement Markings
  - Geometric Data
  - Road Objects
  - Derived Data
Applies To All Level Of Autonomous Vehicles

Sensors + Software + Memory (Map) = Knowledge
Autonomous Vehicle Map Challenges

Strategies, vehicle systems, and performance vary
Data needs are different (highways, arterial, local)
Must be ready before customer’s ask for it
Must be updated as frequently as possible
Must include lane by lane level details
Quality levels must meet AQL .1 (99.9%)
Manual map creation methods are not good enough

Acquisition, Processing, And Map Publishing Techniques Must Evolve To Satisfy Autonomous Vehicle Requirements
HD MAPS: Hybrid Set of Attributes

GPS Navigation Map
- Road level accuracy
- GPS accuracy (1-3m)
- Road level routing, Landmarks, Points of Interest
- Fleet of vehicles to capture
- Requires multiple sources to update changes

Civil Engineering Maps
- Survey Grade accuracy road design (<10cm)
  - Road Geometry (Position, slope, etc.)
- Highly detailed 3D Object CAD design
  - Lane level detail (Road bed and roadside)
  - Road Markings and objects (paint, sign, etc.)
- Time consuming collection and feature extraction
  - Traditionally 10x the cost of navigation maps
- Localized projects 1-20 miles long

HD Maps for AD/ADAS
- Lane Level Routing
- Geometric Attributes
  - Trajectory, Slope, Curvature
- 3d Road Objects
  - Signs, Barriers, Etc
- Validation For Safety Cases
- Tools: Manually -> Automated
- Updates -> Real Time
The Delicate Balance Between Humans and Machines

**Humans**
- Good at higher level logic (Validation)
- Filter false occurrences to direct resources
- Present validation a streamlined result

**Machines**
- Performs remedial and repetitive tasks
- Promotes true consistency, repeatability and scalability
- Benefits true traceability

**Map Creation**

The Balance for Optimal Map Creation Comes from The Strengths of Humans and Machines Producing A Mixture of Algorithm Sets (infused with Deep Learning)
Core Elements to Map Creation

Process Steps

- Data Planning and Acquisition
- Creation and Annotation
- Change Detection
- Map Update
- Vehicle Update

Verification and Validation

Tools / Techniques

- Automated Calibration
- Point Cloud Creation
- Road and Marking Classification

- Mixture of Machine Learning and Hand-tuned Ensemble of Algorithms to Increase Confidence
- Anomaly Detection – Errors and Changes
- Multi-layered QC and Traceability

- Multi-layered Database Approach
- Manual and Automated QC Regression
- Errors are Fixed in Pipeline not in Map

With The Right Process And Tools, Map Creation Is Simply About Categorizing Road Geometry And Objects
Automated Highway Creation

Road Geometry Describes the Drivable Area in Detail
Automated Lane Detection

At First Glance, Lane Detection Appears Trivial. Numerous Udacity Courses Teach Deep Learning Tutorials
Automated Lane Detection

Machine Learning Algorithms Must Robustly Handle A Wide Range Common Real World Scenarios In Order To Create A Usable Map
Automated Extraction

Classic Machine Vision

Deep Learning

State Of The Art Accuracy Requires State Of The Art Algorithms
Automated Road Object Detection

Object detection varies based on road type.

Highways may defined with a 100 attributes, where urban local roads may require 500 attributes

Object classification and detection and localization need to work harmoniously

Varying the process of object detection and classification can yield improved accuracy and speed
Automated Road Object Detection

Road Objects Describe How to Traverse the Road
Derived attributes play an important part in making autonomous vehicles drive safer.

Potential vehicle collision zones, vehicle virtual paths through intersections, # of lanes, and safe stopping zones, etc.

As autonomous vehicles evolve, data sources will converge to provide more information so the vehicle can make emergency decisions.
Verification and Validation

Machines (learning) cannot learn to do this all by themselves.

Humans will be needed to resolve complex corner cases.

Quality must be designed in versus checked in.

Validation requires map makers to find the optimal balance between humans and machines for the desired output.

Simulation techniques have a place in meeting this challenge.
Safe Autonomous Driving

- Safety = Knowledge
- Knowledge = Sensors, Software, and Memory
- Transient obstacles will increase occurrences of unpredictability
- Autonomous vehicles are a balance of performance, quality and cost
  - OEM’s must carefully manage the adoption of technology change
- Customers will require new relationships with suppliers
  - Unique attributes based on their system performance
  - Crowd Sourced data for only their vehicle fleet
- Vehicle simulators will change the way the AV features are validated

“We are what we repeatedly do. Excellence, then, is not an act, but a habit.” Aristotle