Improving Road Safety Through Autonomy: Challenges and Opportunities

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Massachusetts Institute of Technology

The Road to Zero Coalition, January 26th, 2017
My Background

Education:
• University of Pennsylvania, BSEE (1987)
• University of Oxford, DPhil (1991)

History of MIT Positions:
• MIT Sea Grant AUV Lab (1991-1996)
• Dept. of Ocean Engineering (1996-2004)
• Dept of Mechanical Engineering 2005-present
• Artificial Intelligence Laboratory (2002-2004) and CSAIL (2005-present)

Current Positions:
• Samuel C. Collins Professor, MIT MechE & MIT CSAIL
• Director of Autonomous Driving Research, Toyota Research Institute

Research Interests:
• Self-Driving Vehicles; Mapping and Localization; Marine Robotics
MIT DARPA Urban Challenge Team (2006-2007)
MIT DARPA Urban Challenge Team (2006-2007)

Leonard et al., JFR 2008; Karaman and Frazzoli, IJRR 2011; Huang et al., AR 2009
MIT Land Rover LR3 (Talos)

- **Blade cluster**
  - 10 blades each with two 2.33GHz dual-core processors ➔ 40 cores

- **A lot of sensors**
  - Applanix IMU/GPS
  - 12 SICK Lidars
  - Velodyne (~64 Lidars)
  - 15 radars
  - 5 cameras

- **6 kW generator**
2007 Urban Challenge Results

Initially: 89
Site Visit: 53
Invited to NQE: 35
Qualified: 11
Finished: 6

CMU 1st place
Stanford 2nd place
Virginia Tech 3rd place
2007 Urban Challenge Results

Initially
Site Visit
Invited to NQE
Qualified
Finished

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CMU 1st place
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MIT 4th place
2007 DARPA Urban Challenge – Collision between MIT and Cornell
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Perception-based Navigation
(Albert Huang & Seth Teller)

Curb Detectors
Road paint detectors

Lane centerline estimator

RNDF

Lane tracker

Team MIT qualifying event run with sparse waypoints / online road estimation
Dmitri Dolgov, a Google engineer, in a self-driving car parked in Silicon Valley after a road test.

By JOHN MARKOFF
Published: October 9, 2010

MOUNTAIN VIEW, Calif. — Anyone driving the twists of Highway 1 between San Francisco and Los Angeles recently may have glimpsed a Toyota Prius with a curious funnel-like cylinder on the roof. Harder to notice was that the person at the wheel was not actually driving.
Potential Benefits of Self-Driving Vehicles

• Safety
  – Over 5 Million vehicle crashes per year in the US
  – 93% of accidents have human error as a primary factor
  – Over 30,000 fatalities in the US due to traffic accidents per year

• Increased Road Network Efficiency

• Recovery of Time Lost due to Commuting

• Reduced Need for Parking in Cities

• Radically New Models for Personal Mobility and the Distribution of Goods and Services

Questions for Self-Driving Vehicles

• Technological
• Economic
• Employment
• Ethical
• Legal
• Security
• Energy and the environment