AUTONOMOUS VEHICLE LOCALIZATION BY LEVERAGING CELLULAR CONNECTIVITY

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GENERAL MOTORS
• 2018 Cadillac CT6 Sedan
• Launched Q3 2017 in US and Canada
• Optional Feature
• Safe & Reliable Hands-Off Operation on North America highways
• Level 2 Automation: Driver Assist Feature (0 to 85 mph)
VIDEO

https://youtu.be/_rxW68ADldI
CADILLAC SUPER CRUISE TECHNOLOGY

High definition redundant cameras (front, side, rear)
  • Lane marker identification

Long range and short range radar
  • Object detection

6 DOF MEMS Inertial Measurement Unit
  • Vehicle orientation and motion

LIDAR-surveyed precise map (<10 cm absolute accuracy)
  • Remotely updated over-the-air through 4G LTE

Single-frequency, GNSS corrections through 4G LTE
  • Precise satellite clocks, orbits, atmospheric delay
  • GPS/GLONASS
  • Trimble RTX service
  • 1.8 meter (95%)
CADILLAC SUPER CRUISE MY2018 CONNECTED FEATURES

- Precise map updates
  - Construction areas
  - Fresh road surveys

- Continuous GNSS corrections
  - Reduces errors in GPS/GLONASS signals
  - Supplements camera for lane identification
  - Active whenever ignition is on

- Continuous Super Cruise diagnostics
  - Vehicle system monitoring

- OnStar emergency call
  - Automatic call if driver becomes incapacitated while using Super Cruise

- Over-the-air software updates for critical vehicle controllers
CONNECTIVITY AND AV – FUTURE ROADMAP

V2X Capabilities

- Vehicle-to-Vehicle communication for lane merges and traffic awareness

Issues under consideration:
- DSRC 802.11p vs. Cellular V2X
- Importance of accurate vehicle location
- Vehicle-to-Infrastructure use cases and infrastructure deployment

Precise map creation concept:
- Deliver camera images via cellular to map server
- Precise road segments computed at server and delivered to vehicle
- Vehicle localizes itself to precise road information
- Could potentially provide more timely map updates (requires favorable data transport costs)

5G

- High bandwidth, low latency
CONNECTIVITY AND AV – ENGINEERING CHALLENGES

RF Complexity and Interference
- GNSS, cellular bands, DSRC/C-V2x vs. Wi-Fi
- RF noise from nearby electronics (Ethernet, LVDS video, wireless charging)

Fast pace of technology change vs. lengthy automotive development
- Forcing automakers to maximize speed-to-market through new partnerships
- Growing dependence on emerging technology and startups
- Greater use of HIL simulation & modeling
- Add or update Apps through unique General Motors App Framework at scale and with speed

Safety cannot be compromised
- Requires ASIL certification of HW/SW components
- Redundancy will continue to be critical for autonomous vehicles
  - Redundant sensors (camera, Lidar, IMU, GNSS, maps)
  - Redundant communication (multiple carriers, supplement cellular with satellite)
- Leverage GM experience with connected services and technology integration to continue to provide sensor and communication redundancy going forward