Managed Lanes: Challenges and Opportunities for Connected and Automated Vehicles (CAVs)

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Costa Navarino, Messinia, Greece
29-31 May 2019
Background: Automated Driving in Managed Lanes

Automated Highway Systems (AHS) Demo ‘97
I-15 Managed Lanes, San Diego

- Automated Check-in/Check-out
- Lateral and Longitudinal Controls
- Automated merging/diverging
- Malfunction Management & Analysis
Operation of Connected Vehicles (CACC)

Field Tests

ACC: Speeds/Accelerations  *(Not Connected)*

CACC: Speeds/Accelerations  *(Connected)*
Lane Capacity vs. CACC Market Penetration

Basic Freeway Section

Merging Section
Freeway Speeds vs. CACC Market Penetration

SR-99 Freeway CA
Existing Volumes
4 am - 12 noon
CAVs in Managed Lanes

- Designation of selected lanes as CAVs only lanes
  - market penetration (MP)
  - Operating conditions

- Higher lane capacities on CAV only lanes
  - Coordination with merging traffic

- Exclusion of manually driven vehicles improves safety and facilitates testing of automation options

- Higher lane throughput by CAVs offers potential for user discounts

*Introduction HOV I-10, Los Angeles, 1974*
Impacts of Operational Strategies on Freeway Lane Capacity with CACC

Managed Lanes (ML) strategy
Works best:
- 40% CACC with 1 ML
- 60% CACC with 2 ML
- 80% CACC with 3 ML

VAD: Vehicles Awareness Device, DLC: Discretionary Lane Changing
Modeling CAVs: Challenges and Opportunities

- **Existing Traffic Models Luck Features to Account for Changes due to CAVs**
  - Simplified assumptions on CAVs car-following, lane changing models
  - Car-following model for mixed traffic
  - Interactions with manual driven vehicles
  - Macroscopic traffic flow relationships

- **New Models Needed to Leverage Technological capabilities, and Capture Emergent Interactions**
  - Operational and communication protocols
  - Modeling platoon streams for CAVs
    - Platoon stability
    - Impacts of latency