Truck CACC System Development

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11/18/2015
Outlines

- Overall System Structure
- System Modeling and Control
- Fundamental Scenarios
- Low Speed CACC Video
- Mode Transitions for Different Scenarios
- 3 Truck CACC Test at Low Speed
- Challenges CACC in Public Traffic
- Videos
Overall Control System Structure

PATH
Linux Laptop

PATH
PC-104
QNX RTOS

Volvo XPC: sensor data processing

Dual Antenna

DSRC radio

Ethernet

J-Bus

Fused sensor data

J-Bus interface

Engine/brake control commands

PATH

Video recording computer

Tablet DVI

Wide angle Lidar

Ethernet

PC-104

Fused sensor data
Added Hardware

Emergency switch to cut-off link with J-Bus

PATH Laptop for system development

5 Hz GPS
Old PC-104 running QNX real-time operating system currently in use

New PC-104 computer to run QNX real-time operating system
Added Hardware
Built-in Radar and Video Camera
Control System Modeling and Control

Volvo Truck Modeling & Control System Structure

- Air
  - Turbocharger
    - Engine Driving
      - Engine
        - Exhaust
          - On-board Sensors
            - Control System
              - Vehicle speed
                - Tire slip effect

- Automatic Transmission with 12v gears and Random shift
  - Propeller shaft
    - Drive shaft
      - Final Driving Gear

- Desired torque
  - J1939

- Wireless Comm. System
- Vehicle speed
- J1939
- On-board Sensors
- Desired torque
Fundamental Scenarios

- Cruise Control for Vehicle 1 (no preceding vehicle):
  - Transition between manual & automatic
- Vehicle 2 Adaptive Cruise Control (ACC – not using wireless communicated data)
  - Vehicle 1 manual speed control
  - Vehicle 1 automatic speed control
- Vehicle 2 Cooperative Adaptive Cruise Control (CACC – using wireless communicated data)
  - Vehicle 1 manual speed control
  - Vehicle 1 automatic speed control
- 3 Truck CACC
Control Logics for Different Scenarios

Transitions between Driving Modes

- Transition from CACC to manual
- Transition from Manual to CACC
- Transition from CACC to ACC
- Transition from ACC to CACC
- Transition from manual to ACC
- Transition from ACC to manual
3 Truck CACC Test at Low Speed
Challenges CACC in Public Traffic

- Different vehicle types: dynamical capabilities varies a lot
- Manually driven vehicles: driver behavior differences
- Reliability in detection and communication
- Delays in truck dynamics
- Cut-in & cut-out by other manually driven vehicles
- Flexibility in maneuverability
- More reliable control for safety:
  - needs control to be more stiff
  - quick response
- Driver comfort, fuel economy & flexibility in maneuverability
  - control to be softer
- ...

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