Driving Toward Crashless Cars

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Devices to Improve Safety

Three levels of automation

Warnings
1. Blind-Spot Detector
   - warns when vehicles occupy adjacent lanes
2. Backover Detection
   - warns driver of unseen obstruction or person
3. Forward-collision Warning
   - detects potential crash and sounds an alarm
4. Lane Departure Warning
   - sounds alarm when car strays from lane
5. Traffic-Sign Recognition
   - sounds an alert as car encounters changed traffic rules
6. Automatic Pedestrian Recognition
   - points out pedestrians or animals on the roadway ahead

Control Takeover Conditions
- Backover Detection
  - ...brakes automatically if necessary
- Lane Departure Prevention
  - Stops car from changing lanes when it discerns a hazard coming from behind in the next lane
- Automatic Braking
  - Senses potential collision and applies brakes without driver input
Six stages of collision

Sixth Sense for Drivers?

Formation Driving

First generation automation
- ABS
- Traction control systems (TCS)
- Enhanced Stability control (ESC)

Control Takeover
- Who has control?
- How does the driver know?
- What are the control processes?
- What is the driver’s role (speed, but not lane keeping?)
- ... and then?
  - How does the driver get control back?
  - How does the driver know control has been given back?

Known cognitive issues with automation
- Supervisory control
  - Hidden state, uncommanded mode changes
  - User mental model of system behavior (prediction)
- Vigilance, out of the loop, complacency
- Trust in automation – a goal or a threat?
- Clumsy automation (it does the easy stuff, hard stuff is left to the human)
- Symbolic action specifications give rise to unexpected errors (KAL 007)
- Authority and Responsibility (Airbus vs. Boeing)
- Unanticipated additional training costs
Known issues with warnings

- Distinguishing different meanings
- Multiple warnings overlap
- Prioritizing attention
- Context sensitive warning suppression
- Spurious warnings – cry wolf
- Warning draws attention away from the problem (TCAS display, rather than the window)