Human Factor Issues of Driving Assistance Systems

Forum on Advanced Vehicle Safety Technology

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Human Factor Issues of Driving Assistance System

- Background
- Assessment of Pre-Collision Driver Factors
- Current Pre-collision System Capabilities
- Development of a Driver Monitor System
- Development Challenges
- Future Research Needs
Background

- Vehicle
- Traffic environment
- People

Number of casualties vs. Time (20XX)

Zero-fatalities
Potential Fatality Reduction by Safety Devices

Active Safety has a significant potential to reduce fatalities
**Advancement of Active Safety Systems**

- **Active safety**
  - Safe driving
  - Accident avoidance
  - Crash prediction

- **Driver visibility assistance**
  - Adaptive Front light system
  - Blind corner monitor

- **Driver assistance**
  - Lane Keeping assist
  - Lane departure warning

- **Integrated control**
  - Navigation-coordinated shift control
  - VSC I M

- **Autonomous safety support**
  - Forward collision avoidance assist system

- **Improvement of passive safety by prognostication**
  - Pre-collision safety system

- **Dynamic Limit control**
  - ABS
  - Brake assist
  - TRC
  - VSC

In the year 2000, Toyota introduced systems such as:

- **Forward vehicle safety**: Helps in detecting obstacles and avoiding collisions.

- **Lane keeping assist**: Supports drivers in maintaining their lane.

- **Pre-collision safety**: Enhances safety by predicting potential collisions.

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Accident Cause Analysis in Japan

Total fatal/serious injury accidents (61,531 cases)

- Mis-operation: 9%
- Mis-judgement: 20%
- Insufficient attention to the road ahead: 28%
- Inadequate safety precautions: 43%

(Frontal crash; 1,031 vehicles)

- No operation: 39%
- Braking: 44%
- Steering: 6%
- Braking + Steering: 11%

ITARDA Japan 2001
Relative Frequency of Unsafe Driving Acts…
Veridian/ NHTSA

“100 Car Study”
VTTI/ NHTSA

Relevant U.S Accident Data

- Alcohol Impairment: 20%
- Incapac.: 7%
- Vehicle Speed: 21%
- Decision Errors: 11%
- Perceptual Errors: 17%
- Driver Inattention: 24%
- Speed Limit Violation: 21%
- Alcohol: 20%
- Driver Inattention: 24%
- Inattention: 24%
- Incapac.: 7%

n = 732 (NASS)

Braking & Strg: 6%
Braking: 47%
No Avoidance: 47%

n = 15
HMI Principle of Pre-Collision Safety

1. The warning system should only be activated when a collision is imminent.

2. Warnings should be provided at the appropriate time so that the driver can perform an evasive maneuver.
The pre-collision sensor detects forward obstacles and determines in advance whether a crash is imminent.
Driver face direction sensor

- Near Infrared Camera
- Near Infrared LED
- Image Processor
Warning Timing of Advanced PCS

- Monitoring the driver
- Advance warning
- Time to collision
- Collision

Non-Front

Front

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Example of Human Factor Research

Front status

Non-front status
Some Challenges of Developing a Driver Face Monitor

• Robust driving scenarios
• Differentiation of mirror checks and secondary task or outside glances.
• Repeatable, accurate visual images
  – Facial differences
  – Varying lighting conditions
  – Corrective or sunglasses
Future HMI Research Needs Related to AVST

- Improved human models to more accurately define driver mental/physical condition (inattention, drowsiness, drunk,)
- Data regarding human behavior & information needs with cooperative safety systems (V-V, V-I, etc.)
- Pre-collision driver behavior data and interaction with AVST
- Recommendations for optimal stimulus for restoration of drivers’ attention (voice, vibration, smell, etc).
- Enhanced & accessible research databases
END