Advanced Safety Vehicle Research Activities

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Background
Road Traffic Accidents in Korea

No. of Deaths per 10,000 Vehicles

Domestic Vehicles Sold in Korea

Surge in Vehicles

No. of Vehicles (X 10,000 units)


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Road Traffic Accidents & Government Policies

Highest Number of Deaths in 1991 (13,429)

No. of Traffic Accidents

No. of Deaths in Traffic Accidents

Vehicle Inspection System (1981)

Vehicle Safety Standards (1994)

Child Protection Zone (1995)

Seat Belt & Prohibition of Cell Phone Use (2001)

Speed Enforcement Zone

Location Adjustment of Traffic Lights

Tougher Penalties for Drunk Driving (2009)

Road Safety System in the Making

Increase in Death Toll

Decrease in Death Toll

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2-4 December 2014, Bangkok

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Road Traffic Accidents Data (2012)

No. of accidents & fatalities by collision types

- **No. of accidents**
  - 223,656 (100%)
  - Pedestrians: 50,111 (22.4%)
  - Motorized Two-Wheelers: 1,256 (23.3%)
  - Unknown: 9 (5.0%)
  - V to P: 162,455 (72.6%)
  - V to V: 11,081 (5.0%)
  - Single V: 2,156 (4.0%)
  - V to Train: 1,977 (37.0%)

- **No. of fatalities**
  - 5,392 (100%)
  - Pedestrians: 1,977 (37.0%)
  - Motorized Two-Wheelers: 1,256 (23.3%)
  - Unknown: 3 (0.5%)
  - V to P: 2,156 (40.0%)
  - V to V: 50,111 (92.4%)
  - Single V: 1,256 (23.3%)
  - V to Train: 1,977 (37.0%)

No. of injuries & fatalities by collision types

- **Pedestrians**
  - No. of injuries: 53,720
  - No. of fatalities: 2,007

- **Motorized Two-Wheelers**
  - No. of injuries: 245,309
  - No. of fatalities: 8,085

- **Occupants**
  - No. of injuries: 35,618
  - No. of fatalities: 1,241

- **Cycles**
  - No. of injuries: 908
  - No. of fatalities: 81

- **Unknown**
  - No. of injuries: 2,807
  - No. of fatalities: 81

Source: KoROAD 2012 Annual Report
Advanced Safety Vehicle Research Project
Overview

- Type of Research: Consortium (14 organizations), Managed by TS
- Period: Dec. 2009. to June 2016 (7.5 years)
- Budget: 28.5 million$ (government: 21.3 million$, private: 7.2 million$)

Goals

- Develop safety assessment technologies for advanced safety vehicle to help reduce deaths and casualties from car accidents

### Roadmap of ASV Project

#### Yearly Funding (Unit: thousand$)

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<th>'10</th>
<th>'11</th>
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2009 (1st Stage)
- Impact speed adaptive seat
- Side impact protection
- ACC / AEBS for commercial vehicle
- LDWS
- AFLS
- e-Call

2012 (2nd Stage)
- Passenger safety in the back seats
- LKAS
- AEBS for passenger car
- ESC for commercial vehicle
- BSD
- BS
- e-Call

2015 (3rd Stage)
- Active pedestrian protection
- Dynamic rollover protection
- ADC
- AEBS for passenger car
- ESC for commercial vehicle
- In-depth research (1st stage)
- Alcohol interlock
- Power measurement
- B/C analysis
- Devices for active safety assessment
- Electronic safety assessment

2017
- Car to car crash test
- Drowsy driving prevention
- Night vision
- Autonomous driving safety
- In-depth research (2nd stage)
- Active accident assessment
- Crashworthiness for ASV
Rear Seat Passengers Safety

Goals

- Develop assessment technologies to improve impact safety for passengers in the back seats
- Develop assessment technologies to improve impact safety for passengers in the back seats including children and adults

Work scopes

- Analyze data on accidents involving passengers in the back seats
- Analyze injury mechanism for passengers in the back seats, including children and adults
- Research into how to assess impact safety for passengers in the back seats, including children and adults
- Develop draft assessment standards for impact safety for passengers in the back seats

Methods and standards to assess impact safety for passengers in the back seats

Review of assessment methods and pilot application
Pedestrian Safety: Active Hood & Pedestrian Airbag

Goals

- Develop assessment technologies for active pedestrian protection systems
  - Active hoods and pedestrian airbags
- System design and production
- Assessment and testing on real cars
- Determination of assessment factors for injury interpretation and analysis
- Development of interpretation model

Work scopes

- System design/production
- Assessment and testing on real cars

Determination of assessment factors for injury interpretation and analysis

Simulation model

Pedestrian Safety: Active Hood & Pedestrian Airbag

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Dynamic Rollover

Goals

- Reduce injury of occupants in dynamic rollovers
  - Development of assessment technologies for dynamic rollover safety

Work scopes

- Rollover test using a real car equipped with dynamic rollover assessment devices
- Test using a real car equipped with static rollover assessment devices
- Development of a model to assess and interpret rollovers

Test using real cars (dynamic)

Test using real cars (static)

International joint research

Vehicle body deformation and human injury
In-depth Research for Vehicle Accidents

**Goals**
- Build up data from in-depth research and analysis of traffic accidents
  - Establish a system for in-depth study on traffic accidents in Korea and build database
- Cooperation with GIDAS and iGLAD and establishment of an in-depth analysis system for local traffic accidents
- Defining standardized methods to determine and record the degree of injuries of accidents
- Collection of data on accidents and injuries for storage in database

**Work scopes**
- International cooperation and installation and operation of DB server system (hardware)
- Development of database (software) that allows for world-class, in-depth research and analysis of car accidents
- Building up database containing accident types and medical records

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**Database Structure**

- **Hierarchical Structure**
  - LEVEL 1: ACCIDENT
  - LEVEL 2: ROAD USER
  - LEVEL 3: PERSONS
  - LEVEL 4: INJURIES
B/C Analysis of Safety Features

Goals
- Benefit-cost analysis for advanced safety vehicles
  - Calculate social and economic cost and benefits for advanced safety vehicles and study their feasibility
- Effect assessment of active pedestrian safety protection
- Effect assessment of system integration for advanced safety vehicles
- Effect analysis of human injury database and application

Work scopes

Effect assessment of active pedestrian safety protection
- Effect assessment using test data that is Real car and simulation
- Economic feasibility study based on cost and benefits in terms of road safety
- Sensitivity analysis based on changes in costs for pedestrian protection systems

Effect assessment of system integration for advanced safety vehicles
- Assessment of effects of system integration for advanced safety vehicles

Effect analysis of human injury database and application
- Development of a model to estimate AIS index using human injury database
- Estimation of injury AIS index using existing traffic accident data and use the index
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**Automatic Emergency Braking System**

- Develop safety assessment technologies for AEBS installed on passenger cars
  - Develop assessment system for passenger car AEBS and recommend safety standards

- Research in response to international standards, creating assessment environment
- Developing real car-based AEBS algorithm and defining assessment process
- Production of test vehicle for passenger car AEBS and prototype controls
- Development of standards and technologies for system assessment

**Goals**

**Work scopes**

- Strategy to meet int'l standards
  - Assessment environment

- Implementation of real car-based AEBS algorithm
  - Defining assessment process

- Preparation of a test vehicle
  - Production of prototype controls

- Assessment through virtual drive
  - Assessment technologies using unmanned target vehicles

**Goals**

**Work scopes**

- Strategy to meet int'l standards
  - Assessment environment

- Implementation of real car-based AEBS algorithm
  - Defining assessment process

- Preparation of a test vehicle
  - Production of prototype controls

- Assessment through virtual drive
  - Assessment technologies using unmanned target vehicles
Lane Keeping Assistance System

**Goals**
- Develop assessment technologies for the safety of lane keeping assistance system (LKAS)
- Develop safety assessment system for LKAS and recommend safety standards

**Work scopes**
- Establishment of environment for testing and development of assessment & analysis methods
- Development of LKAS assessment modules for development purpose/generic purposes
- Determination of LKAS assessment factors and defining of assessment process

Establishment of SILS-based assessment environment
- Establishment of test roads using real cars
- Securing of equipment and development of analysis methods

Assessment modules for development and generic purposes
- Analysis of fail-safety assessment technologies

Determination of assessment factors and development of process
- Development of LKAS assessment vehicles
Electronic Stability Control for Commercial Vehicle

Goals

- Develop technologies to assess performance of ESC for commercial vehicles
  - Develop performance assessment system for commercial vehicle ESC and recommend performance standards
- Testing to verify the performance of ESC for commercial vehicles (vans, trucks)
- Development of simulation model for real-car based ESC testing and algorithm
- Analysis of technologies to assess commercial vehicle ESC performance and fail-safe technologies

Survey of methods to assess ESC for commercial vehicles

Work scopes

- Development of local assessment method

Assessment process and algorithm

Vehicle dimensions

Regulatory and technological trend

Development of simulation model for real-car based ESC testing and algorithm

WABCO

United Nations

Bendix

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Devices for Active Safety Assessment

Goals

- Assess the safety of active safety vehicles
  - Develop a method and a system to assess safety of active safety vehicles

Work scopes

- Production of low speed and high speed target vehicles
- Stabilization of low/high speed target vehicles

Production of high speed target vehicles

Active vehicle safety test

Stabilization of low speed target vehicles

Design of high speed target vehicles

Testing using real cars
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Electronic Safety Assessment

Goals
- Develop technologies to assess electronic safety for advanced safety vehicles
  - Develop technologies to assess safety from electromagnetic wave and V2X communication safety and analyze security and safety
- Analysis of technologies to guard the security of communication between cars and technologies to ensure functional safety
- Electromagnetic environment, feature interpretation and simulation involving roadside devices
- Establishment of test beds based on communication operation plan and actual assessment

Work scopes

Interpretation of V2V communication environment

Testing of resistance to various types of radio communication through the establishment of a test bed

Coaxial cable

BW : 20 MHz
802.11.b, Ch11, 2.462GHz, 6 Mbps maximum net throughput

Interpretation of communication environment for V2I

Car A
Car B
Power measurement

- Develop technologies to measure the power of advanced safety vehicles
- Recommend draft classification of vehicles according to the method to assess the power of advanced safety cars and actual power

Goals
Alcohol Interlock

Goals

- Develop technologies to assess devices to prevent driving while intoxicated (DWI)
  - Interpret co-relation between BrAC and ABC and assessment devices for DWI and develop assessment technologies

Work scopes

- Development of standards and method to assess DWI
- Development of a system to assess devices to prevent DWI
- Simulation of anti-DWI devices and development of DWI assessment algorithm

- Develop an algorithm to measure and assess DWI
- Develop a method to calculate the level of alcohol in blood considering changes in environment (CO2, temperature, humidity)
- Development of anti-DWI devices

Development of Korean way of assessment and prototyping

Assessment system establishment and simulation-based interpretation of assessment devices

- Development of methods to interpret correlation between alcohol levels for blood and for respiratory system and to assess it
- Development of devices to prevent DWI
Conclusions
Conclusions

- Road accidents are a leading cause of unnatural death and responsible for substantial productivity losses in all countries.

- A successful accident reduction framework needs to address primary vehicle safety as well as infrastructural and behavioural aspects.

- Primary vehicle safety
  - to prevent accidents (active safety)
  - to mitigate injuries to occupants and pedestrians during a crash (passive safety)

- For safer vehicles, R&D of vehicle technologies is essential.
Thank you for your attention.

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