Driver Assistance System
(Lane Keep Assist System)

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Honda intelligent Driver Support System (HiDS)

Honda’s proprietary Driver Assistance System

Adaptive Course Control system + Lane Keep Assist System
Block Diagram of HiDS

- Lane-recognition unit
- EPS ECU
- LKAS control unit
- ACC control unit with built-in millimeter-wave radar
- Operation state indicator/Warning
- Combimeter
- Brake, wipers, turn-signals, resume/cancel, headway distance setting, LKAS-OFF
- Torque sensor
- Steering angle sensor
- Wheel speed sensor
- Yaw rate sensor
- Throttle DBW
- Brake actuator

VSA: Vehicle Stability Assist / ECU: Electric Control Unit
Functions of Adaptive Cruise Control (ACC)

Controlling vehicle speed and headway distance to a preceding vehicle

Control Range:
- Forward Speed: 45-100 km/h
- (in Japan) Acceleration: < 0.08G
- Deceleration: < 0.2G

1. Constant-speed drive
2. Deceleration
3. Vehicle following
4. Acceleration drive
Outline of Adaptive Cruise Control (ACC)

Principle Functions

- Keeping track of relative speed & headway distance via radar
- Calculating appropriate vehicle speed
- Setting target vehicle speed
  - Throttle control
  - Brake control

Radar covering

Millimeter-wave Radar
Functions of Lane Keep Assist System (LKAS)

Assistance in providing optimum steering movement to keep the vehicle in the center of its lane.

Control Range (in Japan)
- Forward Speed: 65-100km/h
- Lateral G: < 0.2G
- Road Radius: > R230m

Lane Departure Warning
Honda Assistance System Philosophy

- **Background**
  The Driving Assistance System is under development to reduce the driver’s work load.

  - **Driving Assistance System**
    - Assistance effect expected
    - Assistance gain large

- **Effect and Benefit**
  - Reduction workload
  - Decrease in motivation

- **Purpose**
  - To avoid decrease in driver motivation
  - To maximize the benefits of Assistance System
Outline of Lane Keep Assist System (LKAS)

Operational Principle

1. Lane Recognition
2. Desired-path Calculation
3. Assistant torque Calculation for lane keeping
4. Driver’s steering operation
5. Joint steering between system and human driver

Highways
C-MOS Camera

Image processing (Road recognition)

- Road curvature
- Vehicle position
Desired path
Outline of Lane Keep Assist System (LKAS)

Interaction between Human and System
Human Machine Interaction System

HiDS

Assist/not-assist evaluation

Assistant torque

Driver

Steering torque

Interaction

Detection

Assistance

Steering

It regards the driver’s operation as the driving intention when assisting steering operations.
HiDS Operations (video image)
Evaluation of HiDS Effectiveness

- Physical Evaluation (Steering Torque)
- Mental Evaluation (Mental Tension)
- Margin Evaluation (Eye Movement)
- Subjective Evaluation (Questionnaires)

Reduce both physical and mental workloads
Physical Evaluation Results

Fig-1 PSD of Steering Torque

Steering Torque PSD [N-m]

- Conventional
- HiDS

Frequency [Hz]

Steering Torque is reduced

Physical workload is reduced
Mental Evaluation Results

Fig.2-1 Driver’s Mental Tension (Conventional)

Fig.2-2 Driver’s Mental Tension (Using HIDS)

Higher number of tension peaks

Mental tension is decreased

Mental workload is reduced

SPL: Skin (electric) Potential Level
There was a concern that such a near automatic system combining the ACC and the LKAS may adversely affect driving.

- Will HiDS contribute to a decrease in wakefulness?
- Will HiDS discourage drivers’ motivation to drive?

Not at all
HiDS does not contribute to a decrease in wakefulness.

Fig. 3  Visual Reaction Time

- Response Time [m sec]
  - Before (Conventional)
  - After (Conventional)
- Before (Using HiDS)
- After (Using HiDS)

- Wakefulness decrease
- No decrease

9.4% up
HiDS does not discourage drivers’ motivation to drive.

To utilize the assist function, drivers must continually steer the vehicle.
Conclusion

HiDS is a human-centered, new-concept driving support system requiring a driver’s operation as a prerequisite.

**New Concept**

1. Human driver and the system must cooperatively drive together
2. Interaction between human and system

HiDS lightens drivers’ workload without reducing their wakefulness and motivation to drive.

HiDS contributes to prevent “careless” or “absent-minded” accidents due to fatigue from long-time driving.