Transmitted by chairman of IHRA/ITS

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Design Principles for Advanced Driver Assistance Systems: Keeping Drivers In-the-Loop

IHRA-ITS

UN-ECE WP.29 ITS Informal Group

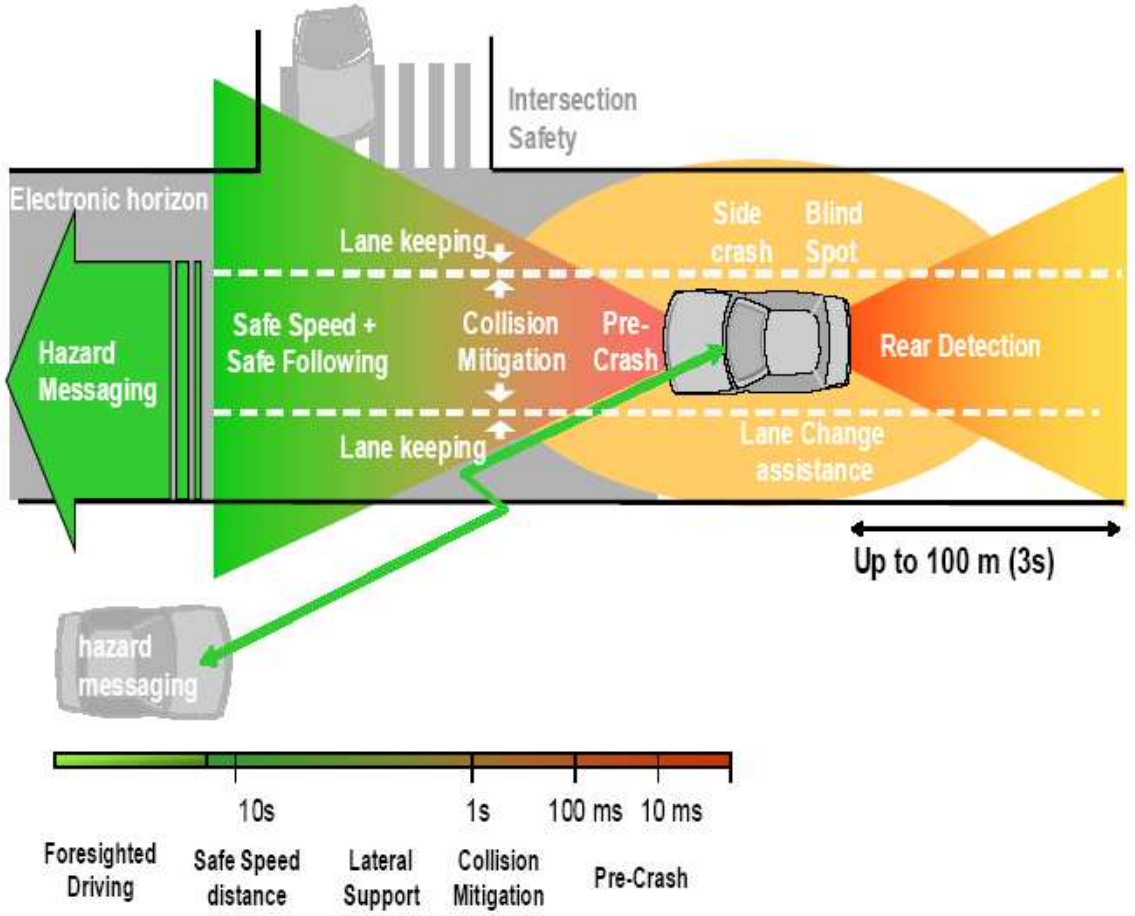
Geneva, March, 2011

Outline

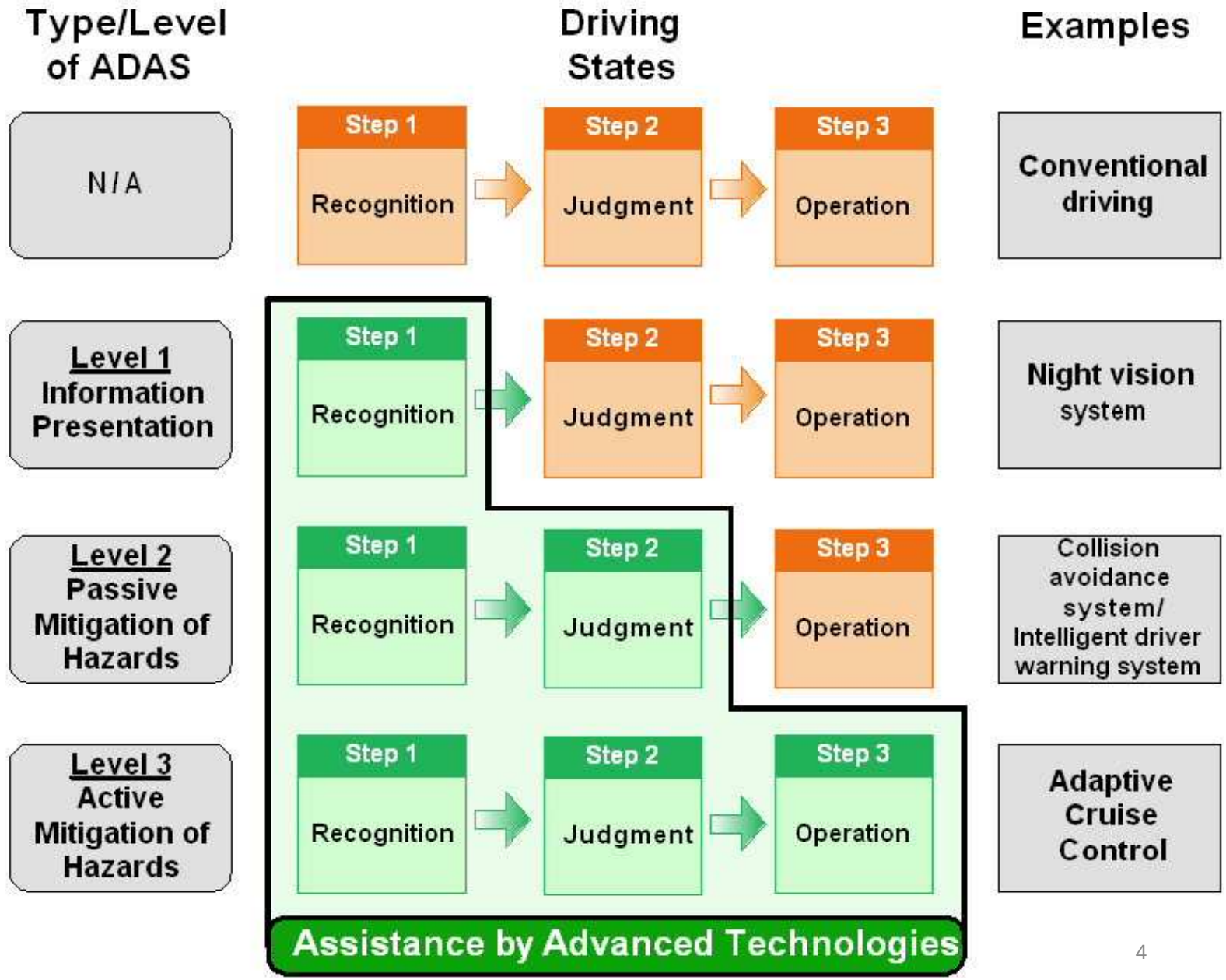
1. Trends in driver assistance technology
2. Safety concerns
3. Design principles for control
4. Summary

Advanced Driver Assistance Systems

- Collision warning and automatic braking
- Adaptive front headlights
- Lane departure warning
- Lane keeping assistance
- Blind spot
- Driver monitoring
- Speed alert
- Assisted parking
- Overtaking assistance
- Signal violation warning
- …. Cooperative systems
- V2V, V2I, V2X



EU Project - Prevent


Type/Level of ADAS
Driving States
Examples
N/A
Step 1
Recognition
Step 2
Judgment
Step 3
Operation
Conventional driving
Level 1 Information Presentation
Night vision system
Level 2 Passive Mitigation of Hazards
Collision avoidance system/ Intelligent driver warning system
Level 3 Active Mitigation of Hazards
Adaptive Cruise Control
Assistance by Advanced Technologies

Human Factors Needs

- Awareness and understanding of current system status
- Understanding of system functions and limitations
- Proper instructions, supporting materials and accurate marketing
- Optimal driver workload and task engagement
- Consistent ‘look and feel’ to limit interoperability issues
- Identify factors that affect appropriate trust and system reliance
- Design in fail-safe modes
- Identify potential unsafe side effects of behavioural adaptation and design for any reasonably foreseeable misuse.

In-the-Loop Performance

In-the-Loop

- the driver is involved in the driving task and is aware of the vehicle status and road traffic situation.
- driver plays an active role in the driver-vehicle system.

Out-of-the-Loop (potential negative consequence of automation)

- Reduced situational awareness - driver is not immediately aware of the vehicle and the current or developing road traffic situation.
- not actively monitoring, making decisions or providing input to the driving task.
- diminished ability to detect system errors and manually respond.

Overview of Control Principles

- The International Harmonized Research Activities (IHRA) working group on Intelligent Transport Systems (ITS) has been providing support to the UN-ECE WP.29 ITS Informal Group.
- The following draft control principles were prepared for WP.29.
- These basic principles are intended to identify automation issues and help to avoid drivers being out-of-the-loop and unprepared to manage safety-critical situations.
- The principles are structured in relation to Control, Operation and Display under Normal and Critical driving situations.
- Based on research evidence, international standards and best practices.

Scope of Control Principles

- These principles cover the basic driver interface and intervention capabilities for active vehicle control systems.
- These principles may also be relevant to automation that provides information and warnings to drivers.
- These principles apply to systems that support elements of the driver's task.
- These principles also apply to systems that can actively change vehicle speed and direction.

Principles: Control Elements

1. Normal Driving Situations

- The driver should be able to easily and quickly override system actions at any time under normal driving situations and when crashes are avoidable.

2. Critical Driving Situations

- When the crash is determined to be unavoidable, the system can take actions to try to mitigate the crash severity.
- When a loss of control is determined to be unavoidable, the system can take actions to try to regain stability and control.
- When it determines that driver performance is impaired, the system can take actions to avoid or mitigate collisions.

Principles: Operation Elements

- For systems that control the vehicle under normal driving situations, the driver should have a means to turn it OFF manually and to keep the system in the OFF state.
- Drivers should be informed of the conditions that result in system activation and deactivation.
- Drivers should be informed of the conditions when system operation is different or is not guaranteed.

Principles: Display Elements

- It should be clear to the driver what assistance systems are installed on the vehicle.
- For systems that can be turned OFF, the driver should be able to easily determine the system state.
- The driver should be provided with clear feedback informing them when the system is actively controlling the vehicle.
- Drivers should be notified of any transfer of control between the driver and vehicle.
- If action is not available due to a failure, the driver should be informed.
- If symbols are used to notify the driver, a standard symbol should be used when available.

Summary

- Automation should provide users with safe, comfortable, convenient and efficient mobility.
- This document describes some of the human factors issues and needs associated with driving task automation.
- It sets out some basic principles that will help to optimize system performance and avoid drivers being out-of-the-loop and unprepared to manage safety-critical situations when they are needed.
- When the advanced driver assistance systems control or support elements of the driving task, drivers should be fully aware of the performance and limitations of those functions.
- These basic principles were prepared by the IHRA working group on Intelligent Transport Systems (ITS) to support the activities of the UNECE WP.29 ITS informal group.

Thank you