Inter-Vehicle Safety by Transponder Based Localization

Fahrzeug-Fahrzeug-Sicherheit durch transponderbasierte Ortung

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Phases of Sensorrevolution

**Ko-TAG**

**Phase I**
Monitoring of vehicle and driver behaviour for risk assessment

**Phase II**
Monitoring of the vehicles adjacencies to detect imminent dangers

**Phase III**
Gathering of detailed information of the spacious environment to enhance the drivers awareness of imminent dangers

“feel”

“see”

“communicate”

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Inter-Vehicle Safety by Transponder Based Localization
• Localization and tracking of visible and occluded objects
• Calculation of possible path of collision
• Driver information and driver warning
• Intervention into vehicle dynamics (partially/full autonomous braking)

→ Driver assistance and collision avoidance in crossing traffic situations
360°-Detectability (passive localization)

- Vehicle is detectable all-around
- Active localization only in forward direction
- Main intersection (accident-) scenarios addressable
- Basic system setup (localization unit, antenna, tags) same as VRU-Setup
- Vehicle integration effort identical to VRU system
Driver warning, intervening systems

- Situational action plan required
- Reliable collision detection required
- Humans (often) react different to machines ("sometimes it is better to speed up than to brake")
- Wrong reaction could lead to disaster
Uncoordinated Actions

[Source: youtube.com]
Differentiation between closed approach and imminent collision requires reliable calculation of errors.
Trigger Algorithms

Crossroads scenarios

Circular driving

Contrive

- Preselection of „endangered“ objects (TTC, closed approach)
- Tracking of critical vehicles
- Consideration of errors (positioning, motion) (if so with default values)
- If risk of collision (ROC) is stable ➔ triggering the action concept / warning strategy
Action Concept and Warning Strategy

**Action Plan:** detect – inform – warn – alert – intervention

**Scenario:** The system detects a potential risk of collision (ROC) with an estimated time-to-collision ($t_{ttc}$) of $\leq 5$ sec which is increasing and valid until $(t_0 - 2)$.

- **Step/Phase:**
  - **Step 1:** Cyclic localization (~20ms) (**detection**, tracking, prediction, collision risk calculation)
  - **Step 2:** Visual **information** on existing ROC
  - **Step 3:** Audio-visual **warning**
  - **Step 4:** Audio-visual **alert**, seat-belt tensioner, autonomous **braking**

**Time to Collision:**
- $t_0 - 5$
- $t_0 - 4$
- $t_0 - 3$
- $t_0 - 2$
- $t_0$
Real-Life Scenario

[Source: youtube.com]
Vehicle Integration

Test vehicles: S-Class (W221), smart (MC451)

- Hardware and software architecture development
- Identification of necessary interfaces
- Realization
Guard System for All-around Safety

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Vehicle Integration Localization Unit (OBU)

- Localization Unit
- antenna array
- air pipe
- cooling fins
- cross member
- connectors OBU
- On-Board Unit (OBU) (localization unit)
- antenna array
- Bumper
- case (rapid prototyping)
Vehicle Integration
Vehicle Control Components
Vehicle Integration
Human Machine Interface (HMI)

- collision warning
  - permanent light
  - flashlight
  - buzzer

Headunit-Display (Visualization)

Additional (Debug-) Display

Trackball Keyboard

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Inter-Vehicle Safety by Transponder Based Localization
- TAG-Management
- Risk management
- Trigger algorithms
- Tracking
- Vehicle control (CAN)
- HMI
System Vehicle Integration
User Interface

Vehicle display (HMI)

Probe vehicle B within detection zone

Movement tube of ego-vehicle

Detected probe-vehicle A with potential collision risk

Detection zone

Predicted path

Ego-vehicle

Danger zone

System active

Risk of collision

Tagdata
Type: Smart
vrel: 35 km/h
Size: 2,8x1,8m
ttc: >5s

...
System for „All-Around Safety“ realized in S-class test vehicle
Join our demo tomorrow
Thank you for your attention!