Improving Driver Behavior at Rural Intersections:
Issues to be Considered when Designing Stop Sign Assist and Gap Decision Support Systems

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Rural On-Road Crash Risk

Intersections are particularly dangerous
- 16% of rural fatal crashes in US

On rural two-lane roads in MN, 2001-2005...
- 33% of all fatal crashes were at intersections
- 70% of fatal intersection crashes occurred at rural stop-controlled intersections
- 50% of intersection crashes were right angle
- Intersection recognition and gap selection were the major contributing cause

AASHTO, 1997

Preston, 2009
Cooperative Intersection Collision Avoidance Systems – Stop Sign Assist CICAS-SSA

Purpose: investigate the use of “stop-sign assist” decision support systems at rural intersections

- Mn/DOT
- FHWA

“Smart” signs: displayed information changes in real time depending on the current traffic conditions

Information to help the driver make decisions about when it is unsafe to enter the intersection
Cooperative Intersection Collision Avoidance Systems – Stop Sign Assist

Project Milestones

- Identified tasks & information requirements for an infrastructure-based decision support system
- Evaluated four concept interface designs to support drivers’ crossing decisions
- Identified the best interface design (e.g., icons, wording) for 3 best SSA concepts
- Determined appropriate location & angle of rotation for signs at the intersection to ensure high visibility & comprehension by drivers
- Identified best sign concept for real-world deployment through evaluation of driver performance using driving simulation
- Field testing of selected sign at the Minnesota test intersection is currently underway
CICAS-SSA & ITS Institute at UMN

Purpose of *this* milestone was to determine appropriate **Location & Orientation** (angle of rotation) for signs at the intersection to ensure high visibility & comprehension by drivers using a virtual driving environment.
Experimental Environment: HumanFIRST Driving Simulator

- 3-axis electric motion system
- Force feedback steering
- Power-assist feel brakes
- 3D surround sound
- Car body vibration
- 8 channels
- Resolution = 1.96 arc-min/pixel
- Ability to model precise traffic scenarios & reproduce geo-specific locations
Trunk Highway 52 & County Road 9

Geo-Specific Virtual Environment
There is only one useful orientation for signs in Location Set B, so variations in orientation were only examined for Location Set A.
Three possible orientations were shown to participants, representing the full range of possible sign orientation angles:

- **Parallel** “=”
- **45 Degrees**
- **Perpendicular** “+”
Orientation Study

Results indicated that it is best to orient the sign between parallel & 45 degrees

- Takes advantage of the “natural mapping” between a sign & the intersection
- Perpendicular caused more errors
- Parallel was uncomfortable to view
Goal was to compare performance while using signs placed in Location Set A Signs to the same signs placed in Location Set B.
Location Study

Signs located at An had slightly higher accuracy (94%) than signs located at Bn (91%)

Signs located at Bf were reported as more comfortable to view, obstructed traffic less, & easier to see than signs located at Af.
Location Study

Participants were split in their preferences between Set B and Set A.

Actual-size sign mock-ups at the intersection showed that signs at An & Af would increase difficulty of viewing oncoming traffic.

Set B was recommended.
Thank You

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