COOPERATIVE ADAPTIVE CRUISE CONTROL: CRITICAL HUMAN FACTORS ISSUES AND RESEARCH QUESTIONS

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Problem: Travel Congestion
• Over $100B in lost time/fuel due to travel delays in urban areas in 2010¹
• Average annual commuter delay in 1982, 14 hours; by 2020, 41 hours¹
• New roads/lanes cannot match ever-increasing travel demand

Solution: Technology
Cooperative Adaptive Cruise Control (CACC), uses dedicated short-range communications to permit vehicle-to-vehicle and vehicle-to-infrastructure coordination.

✓ Faster, automated vehicle longitudinal control
✓ Shorter following distances
✓ Increased throughput
✓ Improved string stability²
✓ Reduced fuel usage and emissions

CACC uses DSRC*, allowing vehicles and infrastructure to communicate directly.

Potential Issues
CACC has been demonstrated to be technically feasible but faces several human factors-related issues that may impact its acceptance, utilization, effectiveness, and safety.

1. Automation
• Successful use of automation relies on appropriate understanding of its purpose, operation, and performance³
• Incorrect trust in automation leads to misuse, disuse, and abuse⁴
• Automation changes human role, becomes monitor
• Misuse or over-reliance places driver at higher risk

Key Research Questions
• How does traffic density affect choice to utilize CACC?
• Does the number of travel lanes affect choice to utilize CACC?
• Does available preset time gap options affect CACC utilization?
• How does a driver enter/exit a CACC platoon?

Dedicated Short-Range Communications

* DSRC stands for Dedicated Short-Range Communications.
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### 2. Workload, Distraction, and Situation Awareness

- Reduced workload provides spare mental capacity
- Could improve driving-related tasks
- Could invite engagement in non-driving-related secondary tasks

Secondary task engagement can distract and negatively affect a driver’s situation awareness (SA)

Studies have shown drivers’ tendency to over-rely on automation rather than maintaining necessary SA

**Key Research Questions**
- How does use of CACC affect workload and SA levels?
- Are drivers more likely to engage in secondary tasks while utilizing CACC?
- Does driving behavior or performance change during CACC driving? During secondary task engagement?

### 3. Driving Behavior

Inaccurate human perception may have major effects on general driving behavior, such as lane-changing and car-following.

- Humans not good at assessing relative speeds in adjacent lanes
- Frequent lane changes disrupt CACC platoons and reduce string stability benefits
- Drivers follow larger vehicles at shorter gaps though visibility is reduced
- Humans overestimate their own capabilities and underestimate those of others

**Key Research Questions**
- How willing are CACC drivers to remain in platoon as nearby lane conditions vary?
- Does comfort level change with CACC experience, vehicle position in platoon, or varying traffic density?
- How comfortable is a driver with a following vehicle at a short time gap?

### Summary

CACC has the potential to dramatically improve highway throughput and relieve traffic congestion. It is technically feasible, but its success depends highly upon addressing the numerous human factors-related issues identified that could affect its acceptance, efficacy, and safety.

### References


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