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Nav, VII, CICAS-V, and Beyond: Understanding Driver Behavior has Just Begun

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The Evolution of Driving

Attribute	Then	Now
Top Speed	Model T 45 mph	Typical 120 - 200 mph
Control	Manual (Brute Force)	Power Assist (Active, ABS, DSC)
Comfort	Open Carriage	Driver Cockpit
Complexity	??? 8000 vehicles	4 M miles or roads 237 M vehicles
Distractions	Radio	Too many to list…
Information	What you can see	Verge of infinite

Information Displays:
The Good, the Bad, and the Ugly

Helps the Driver

- Relevant
- Timely
- Easy to perceive
- Easy to understand
- Easy to find

Hurts the Driver

- Irrelevant or ambiguous
- Poorly timed
  - Interrupts
  - Distracts
  - Information overload
- Difficult to perceive
- Difficult to understand
- Difficult to find

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History of Navigation Research

- 104 - 1980s: Paper Maps
- 1980s: Electronic Maps (ETAK Navigator)
  - Are electronic maps better/worse than paper?
  - Is route-guidance an enhancement or requirement?
- Early 1990's: Route Guidance (Ali Scout)
- Mid 1990's: Modern GPS Navigation (PathMaster)
  - Are they safe to use while driving?
  - Screen design, font size, input method
  - Driver Errors
- Today: All major automakers have Nav systems
  - Real-Time Traffic Information
  - Voice Interfaces

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Transportation Benefits

If drivers know where they are going…

- Reduced travel time (less time lost) / congestion
- Confidence/Ability to reroute around traffic even if unfamiliar with an area
- Less time scanning for navigation related signs = more time scanning for hazards
- Less erratic behavior
- Lower driver workload

Ambiguous/Poorly Timed Information

Video Of Driver Using Prototype Navigation System

- Some information is not always better
- Easily fixed with HF studies

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Poor Usability Safety Consequences

- Missed Turns / Wrong Turns
- Longer eyes-off-the-road time
- Increased distraction
  - Fixation on the system rather than the road
- Increased driver workload
- Abrupt or unsafe maneuvers
  - Abrupt lane change
  - Hard braking
  - Erratic maneuvers (is it here?)

Technology & Information

| Technology Advancement	New Information to Drivers
GPS & Mapping	Position & Route Guidance
EdMap (Enhanced Maps)	Speed Monitoring, RDW, CSW
Radar, Lidar, Ultrasonic, Video	FCW, RDW, SOD/SCA
Eye Tracking	Drowsy Driver / Distracted Driver
V2V & V2I Communications (DSRC)	All of the above plus... Intersection collision avoidance Real-time traffic conditions Stopped traffic ahead Weather conditions & hazards ???

Communication Revolution

Vehicle Infrastructure Integration
- California VII Testbed
- 40+ Roadside Units
- Intersections/Freeways
- Application Partnerships
  - Safety
  - ATIS

CICAS-V
- Using VII RSE
- In-Veh RLR Warning
- Future intersection warnings
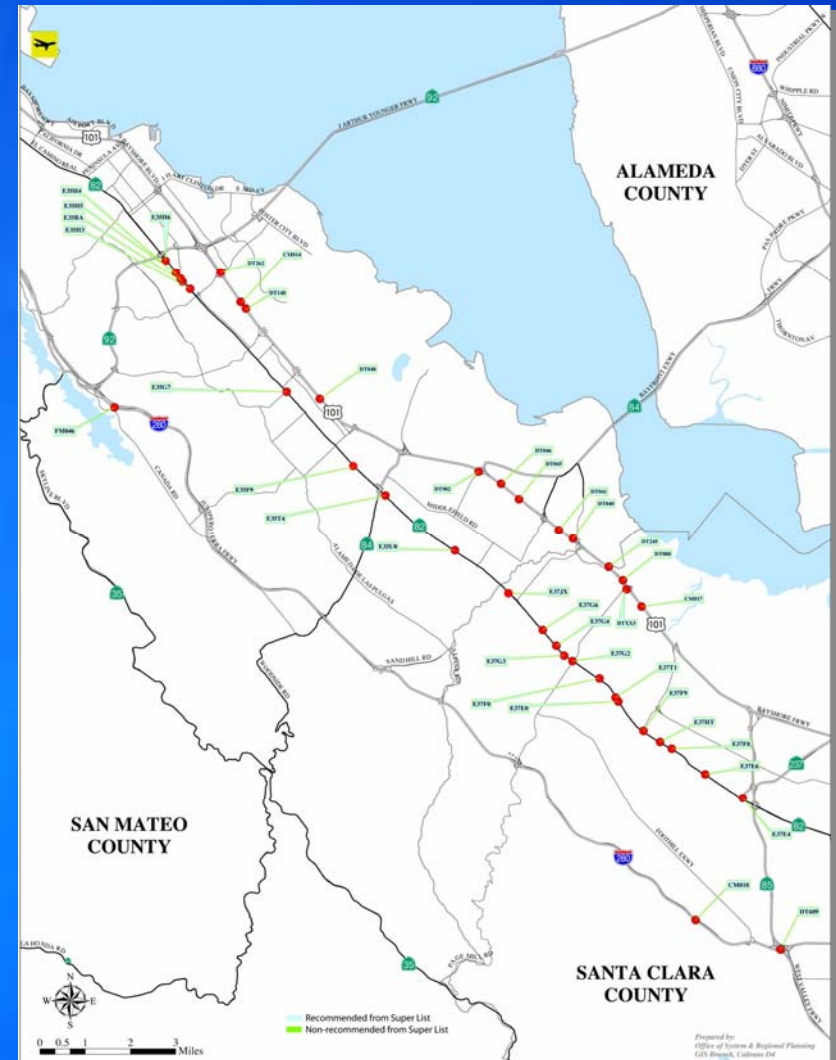
Future HF Challenges

1. Designing optimal information conveyance
   - Content
   - Modality (auditory/visual/haptic & roadside vs. in-veh)
   - Timing
2. Integration of warnings (15+ warnings discussed)
   - Prioritization
   - Discrimination
3. Integration of vehicle- and infrastructure-based warnings
   - Compatibility
     - Content
     - Timing
   - Trust

Summary

- The task of driving is evolving
- The quantity of information that can be provided to drivers is increasing with technology
- Poor usability can easily negate any positive effects of providing better information to drivers
- Further increases in safety will only come from understanding drivers
  - Easy or common sense solutions have been applied
  - Crash causation is complex
  - Solutions to one problem $\Rightarrow$ cause another

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