Presentation Outline

- Field Operational Test Overview
- Collision Warning System Overview
- Program Information
Program Team

- **General Motors**
  - Delphi Delco Electronics Systems
  - Delphi Chassis Systems
  - Hughes Research Laboratories (HRL)
  - University of Michigan Transportation Research Institute (UMTRI)

- **National Highway Traffic Safety Administration (NHTSA) - Office of Vehicle Safety Research**

- **Volpe National Transportation Systems Center**
Program Goals

- Deploy and test a state-of-the-art rear-end collision warning system
- Measure system performance
- Estimate real-world safety benefits
- Obtain information about user acceptance
Program Schedule

Phase I
June '99 - Mar '01
Engineering Development Vehicles → Prototype Vehicle

Phase II
Mar '01 - Dec '01
Prototype Vehicle → Pilot Vehicles
Dec '01 - Feb '02
Pilot Vehicles → Deploy Vehicles
Feb '02 - Jan '03
Deploy Vehicles → FOT
Jan '03 - May '04

June '99
Mar '01
Dec '01
Feb '02
Jan '03
May '04
Forward Vision System

- Estimate road shape, lane width, vehicle heading, and vehicle lateral position within the lane using a video camera.

- Three university teams support Delphi Delco Electronics:
  - University of Pennsylvania
  - Ohio State University
  - University of Michigan-Dearborn
Map-Based Road Geometry Processor

- **Predict upcoming road geometry:**
  - Differential GPS
  - Digital road maps
  - Dead reckoning

- **Dead reckoning from accelerometers augments DGPS during signal outages to update host vehicle position and speed.**
Scene Tracking Processor

- Utilize the trajectories of the preceding vehicles and roadside objects as measured by the radar to:
  - Estimate the upcoming road curvature
  - Distinguish between in-lane and adjacent lane vehicles
  - Determine the heading of the host vehicle in its lane
Forward-Looking Radar

- **Millimeter-wave Monolithic Integrated Circuit (MMIC) Design**
  - Used for both Adaptive Cruise Control and Forward Crash Warning

- **Determines kinematic variables of visible targets**
  - Range (measured), Range-rate (measured), Deceleration (computed)

- **Key Technical Challenges:**
  - In-Lane Threats on Curved, Multi-Lane Roadways
  - False Alarms from Overhead Signs/Bridges
Path Estimation and Target Selection

- Uses the Data Fusion outputs for host path
- Predicts path trajectories for host and targets
- Selects the in-path vehicle of interest, either stationary or moving:
  - Accounts for in-lane weaving and drift.
  - Accounts for lane change maneuvers.
Data Fusion and Threat Assessment

- Fusion of data to estimate host lane geometry, host kinematics, driver distraction, and environment:
  - On-board yaw rate estimator
  - Forward vision system
  - Map-based road geometry processor
  - Scene tracking processor
  - Driver distraction estimator
  - Environmental sensors

- Crash threat assessment
  - Driver warning algorithm to energize displays
Driver-Vehicle Interface

- **Interface Hardware:**
  - Visual Full-Color Head-Up Display
  - Tonal Alert Delivered over Vehicle Sound System

- **Candidate Visual Display Formats:**
  - Single-Stage Imminent Crash Alert
  - Graded Multi-Stage Warning
  - Continuous Display of Safe Following Information
FOT Data Acquisition System

- **Support Field Operational Test Objectives**
  - Crash avoidance estimations
  - User acceptance determinations

- **Present State of Development**
  **Includes:**
  - System Conceptual Design
  - List of Recorded Variables
  - Strategies to Recognize and Capture Critical Events
  - Data Storage and Retrieval Architecture
  - Test and Evaluation of a Rapid Prototype
Program Status

- First Annual Report published Dec 2000
- Prototype vehicle system integration to be completed by end of August
- Verification testing will be conducted this Fall (September-November)
- Interim Report due in January 2002
- Phase II to begin in January 2002
Program Contacts and Information

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- **Program First Annual Report:**