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http://www.nads-sc.uiowa.edu
OUTLINE OF TALK

• Overview
• Applications
• NADS Technologies
• Extending M&S Capabilities
NATIONAL ADVANCED DRIVING SIMULATOR
NATIONAL ADVANCED DRIVING SIMULATOR
• 9 DOF motion system over 64’x64’ bay
• 6 DOF vehicle motion
• Immersed visual environment
• 3D auditory system
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APPLICATIONS AND IMPACT

• Highway Safety Requires Fundamentally New Research Tool
  – Over 90% of crashes involve human error
  – Highway crashes in US kill over 40,000 persons per year, at a cost of $230 billion

• Reduction in Time-to-Market
  – Requires evaluation of driver-in-the loop early in the product design and development phase

• High-Quality Vehicles Requires Engineering Fidelity Virtual Proving Grounds (I/UCRC Objectives)
DRIVER RESPONSE IN CRITICAL MANEUVER
NETWORKING ADVANCED DRIVING SIMULATORS

Army Ride Motion Simulator

National Advanced Driving Simulator
COMMON DATABASES:
TACOM & NADS

TACOM

APG
COMMON DATABASES: TACOM & NADS
VIRTUAL PROVING GROUND
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NADS INSTRUMENT

- Prime contractor (TRW)
  - System integration
- Visual system (E&S)
  - Harmony IG
- Motion system (MTS)
  - Motion and vibration systems
- Vehicle cabs (DRI)
  - Road & vehicle feel
- Audio system (I*Sim)
  - 3D Sound
- SDM
VISUAL SYSTEM

• Harmony image generator based photorealistic visual environment
  – Field of view, 360-degree (H), 40-degree (V)
  – 21,000 polygons, 60 Hz
  – 250:1 contrast ratio
  – 1.1 (high resolution inset), 3.5 (forward) and 7.5 arc minute per optical line

• Correlated with other sensory stimulus
# Motion and Vibration

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<th>Motion Subsystem</th>
<th>Axis</th>
<th>Specification</th>
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<td>Velocity</td>
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<tr>
<td></td>
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Specifications include:
- **Displacement**: ±ft
- **Velocity**: ±ft/sec
- **Acceleration**: ±ft/sec²(±g)
- **Rotation**:
  - ±deg
  - ±deg/sec
  - ±deg/sec²
- **Translation**:
  - ±in
  - ±in/sec
  - ±lbf
NADS CABS

- Four actual vehicle cabs (Malibu, Taurus, Cherokee and Freightliner truck cab)
- Interfaced with full range of standard, optional and new design vehicle instrumentation
- Interfaced with data collection, reduction and verification
CONTROL FEEL SYSTEM

• Steering, Brakes, Clutch, Transmissions and Throttle in Response to Driver Inputs, Vehicle Motion, and Tire/Road Interaction

• Cruise Control, Power Steering, Existing Drive Trains, ABS.

• High Bandwidth Cueing Feedback
DATABASE AUTHORING TOOLS

- Commercial, Industrial, Rural, and Residential
- Three-Dimensional Objects
- User-Friendly Scenario Definition and Control Tools
TILE-BASED DATABASES
TILE MODULES

660 feet
NADSDYNA

- Multi-body Vehicle Dynamics
  - Software for real-time vehicle simulation
- Vehicle Body Preprocessor
  - Components
  - Joint Library
    - Standard and Composite
  - Force Element Library
    - TSDA and RSDA
  - No automatic redundant constraint checks
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HIGH MOBILITY MULTIPURPOSE WHEELED VEHICLE (HMMWV)
HMMWV MODEL

SPHERICAL JOINT
TRANSLATION JOINT
REVOLUTE JOINT
DISTANCE CONSTRAINT
STNTHETIC
ENVIRONMENT EXAMPLES
STNNTHETIC ENVIRONMENT GENERATION/ACQUISITION
SYNTHETIC ENVIRONMENT ACQUISITION

- Software Tools
- Dynamic Terrain Modeling and Simulation
- Geo-specific Database
- Ground Truth Acquisition Tool
STNTHTETIC ENVIRONMENT EXAMPLES
DEERE PROVING GROUND
COLLABORATIVE ENGINEERING ENVIRONMENT
INTELLIGENT TRANSPORTATION SYSTEM APPLICATIONS
SUMMARY

• High-fidelity Simulator for Highway Safety Research

• Driver-in-the Loop Simulation: Reducing Time-to-Market
  – Precision Motion Systems
  – Realistic Synthetic Environment
    • Visual and auditory system
    • Virtual environment modeling
    • Synthetic environment acquisition and rendering
  – Real-Time Dynamic Simulation
  – High Fidelity Dynamic Simulation
  – Driver model