NDIA/SBA: NSF I/UCRC FOR VIRTUAL PROVING GROUND SIMULATION

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National Advanced

Driving Simulator

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OUTLINE OF TALK

- Overview
- Applications
- NADS Technologies
- Extending M&S Capabilities

NATIONAL ADVANCED DRIVING SIMULATOR

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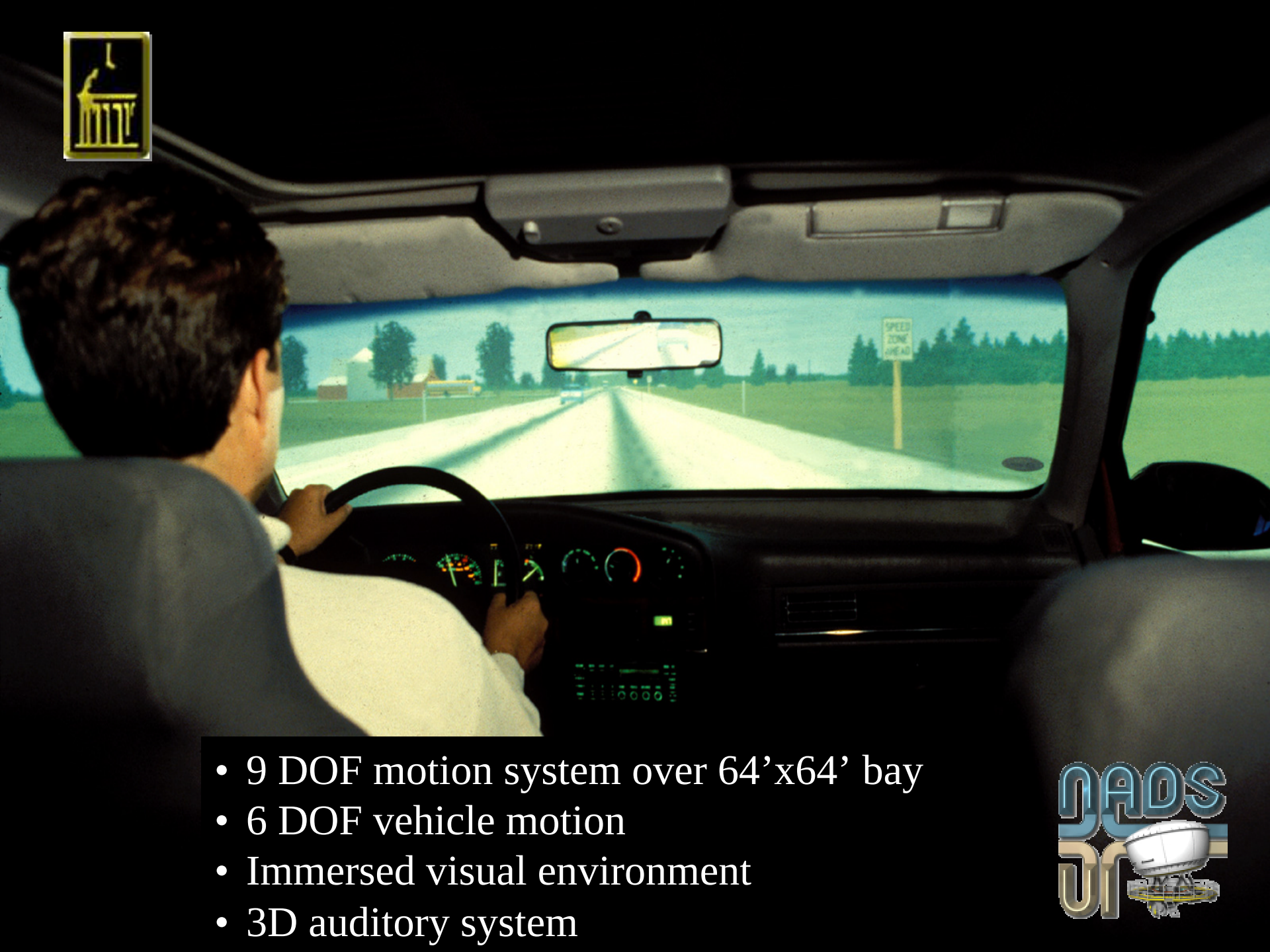

- 9 DOF motion system over 64’x64’ bay
- 6 DOF vehicle motion
- Immersed visual environment
- 3D auditory system

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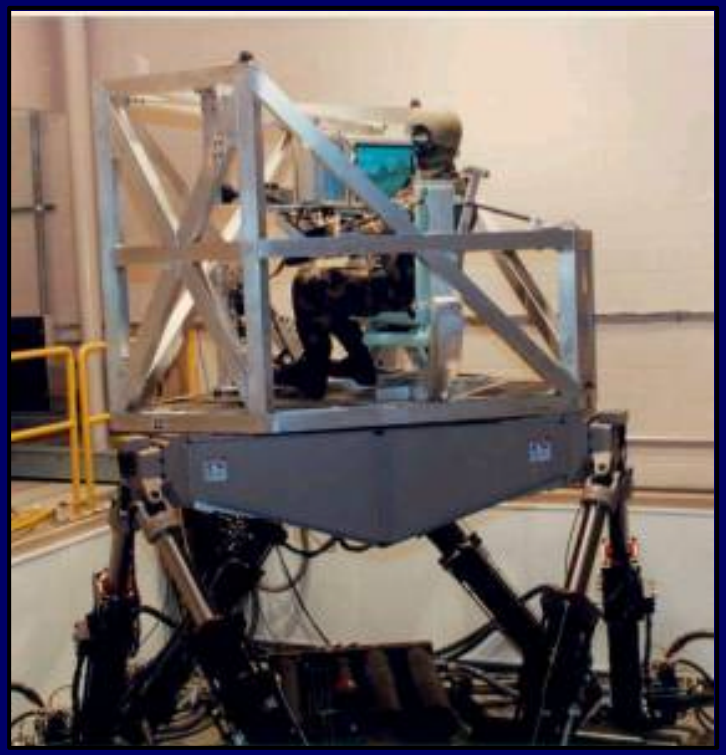
APPLICATIONS AND IMPACT

- 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

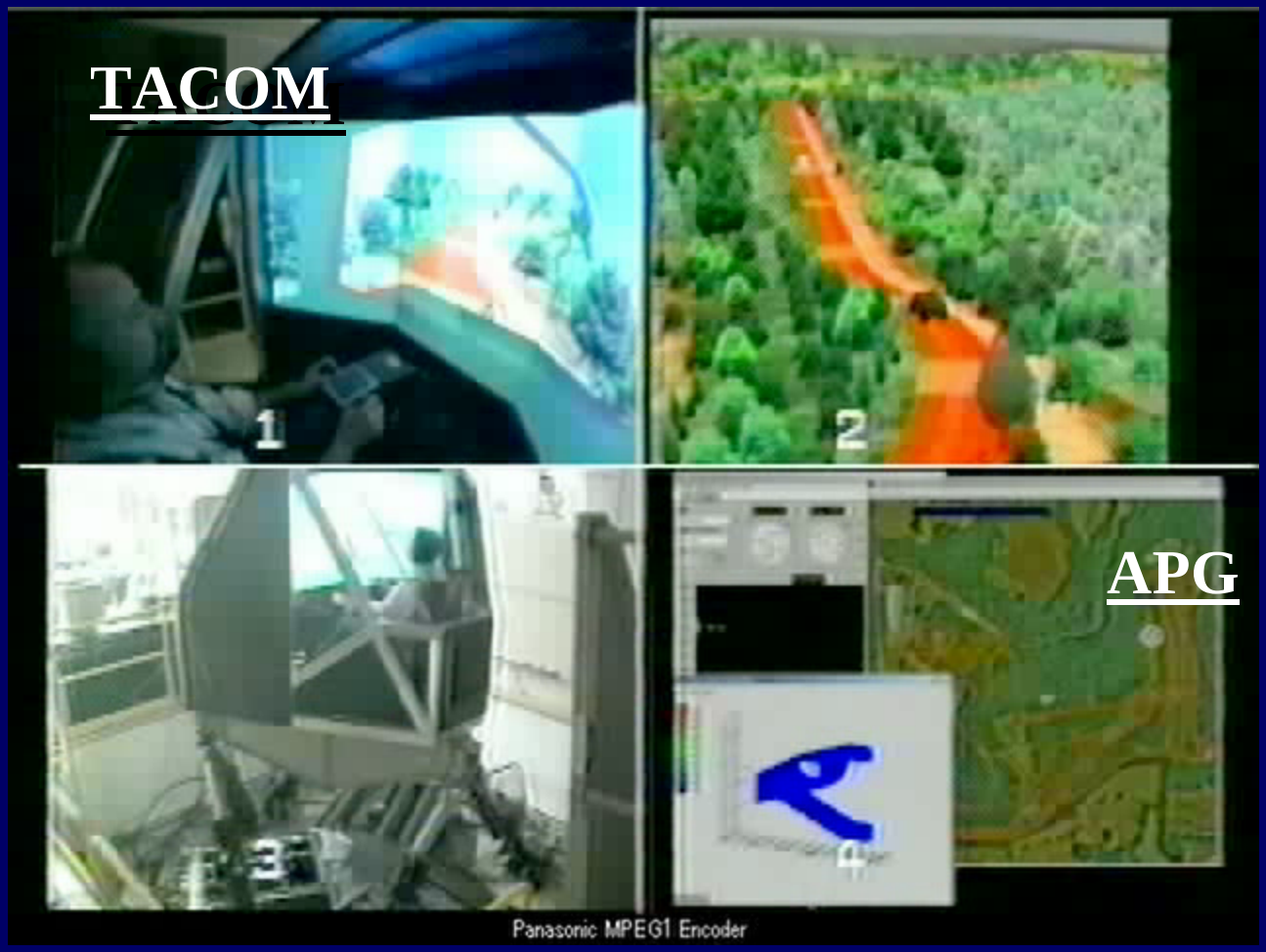
NETWORKING ADVANCED DRIVING SIMULATORS

Army Ride Motion Simulator



National Advanced Driving Simulator

COMMON DATABASES: TACOM & NADS



COMMON DATABASES: TACOM & NADS

VIRTUAL PROVING GROUND

TEST TRACK

NADS TEST

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NADS INSTRUMENT

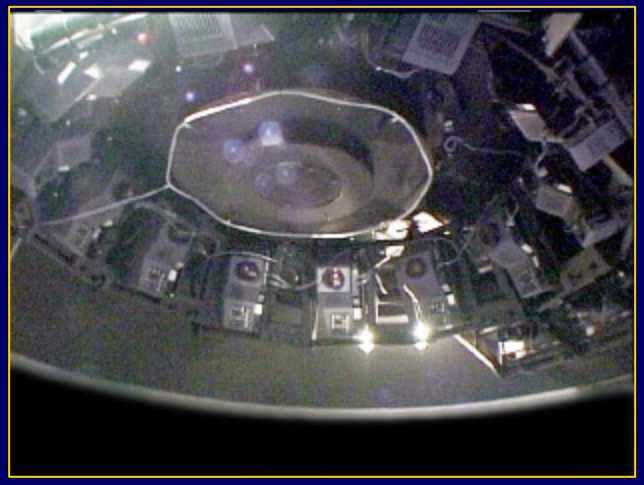
- Prime contractor (TRW)
  - System integration
- Visual system (E&S)
  - Harmony IG
- Motion system (MTS)
  - Motion and vibration system
- Vehicle cabs (DRI)
  - Road & vehicle feel
- Audio system (I*Sim)
  - 3D Sound
- SDM

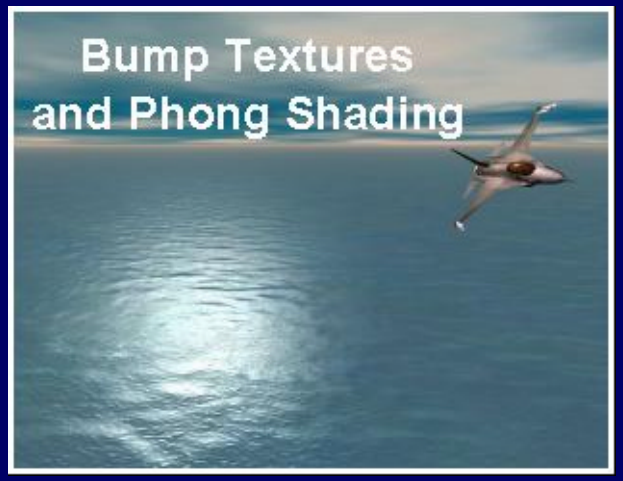
NADS SIMULATOR

NADS 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

Motion Subsystem	Axis	Specification		
Component		Displacement	Velocity	Acceleration
		±ft	±ft/sec	±ft/sec^2 (± g)
X-Y	X	32	20	20 (0.6)
X-Y	Y	32	20	20 (0.6)
Hexapod	Z	2	5	32 (1.0)
		±deg	±deg/sec	±deg/sec^2
Hexapod	Pitch	25	45	120
Hexapod	Roll	25	45	120
Turntable	Yaw	330	60	120
		±in	±in/sec	±lbf
Vibration	z	0.2	8	1

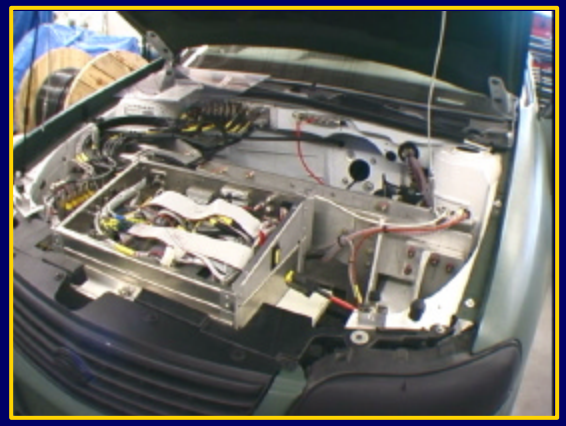
NADS CABS

- 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



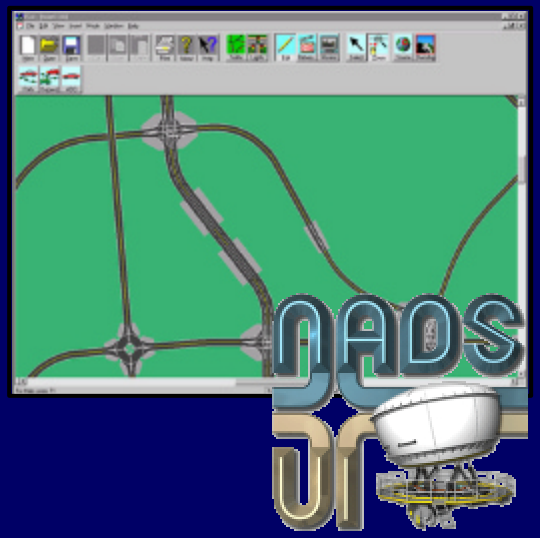

CONTROL FEEL SYSTEM

- 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

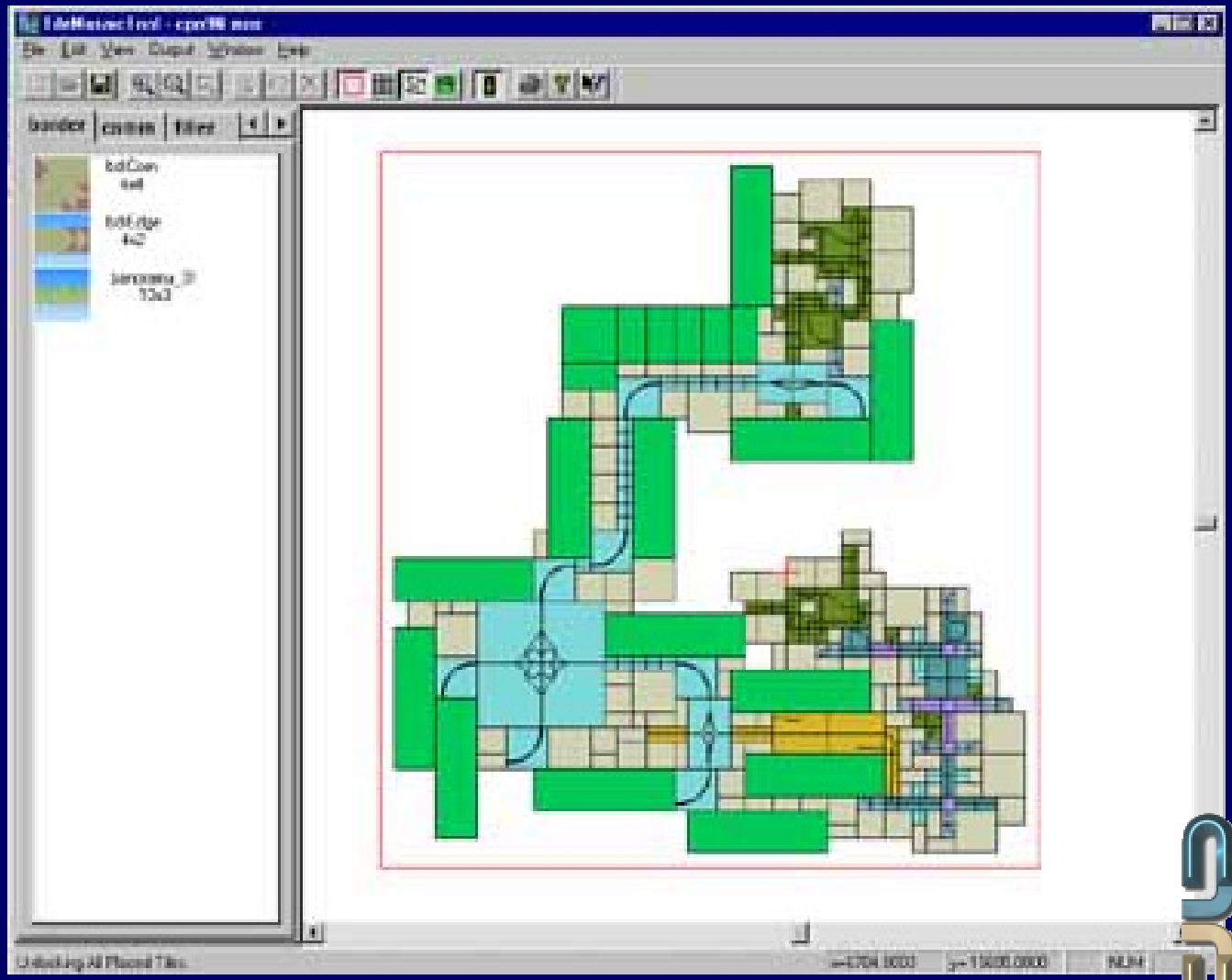


DATABASE AUTHORING TOOLS

- Highway Traffic Control: Multiple-lane, High Density Traffic and Roadway Weather Environment
- Commercial, Industrial, Rural, and Residential
- Three-Dimensional Objects
- User-Friendly Scenario Definition and Control Tools



TILE-BASED DATABASES

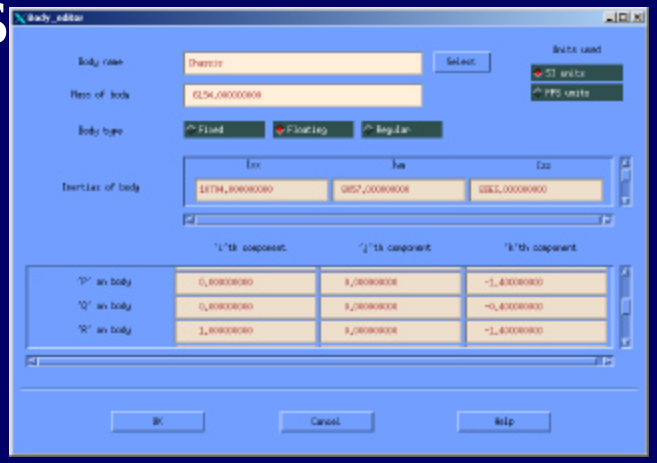


TILE MODULES

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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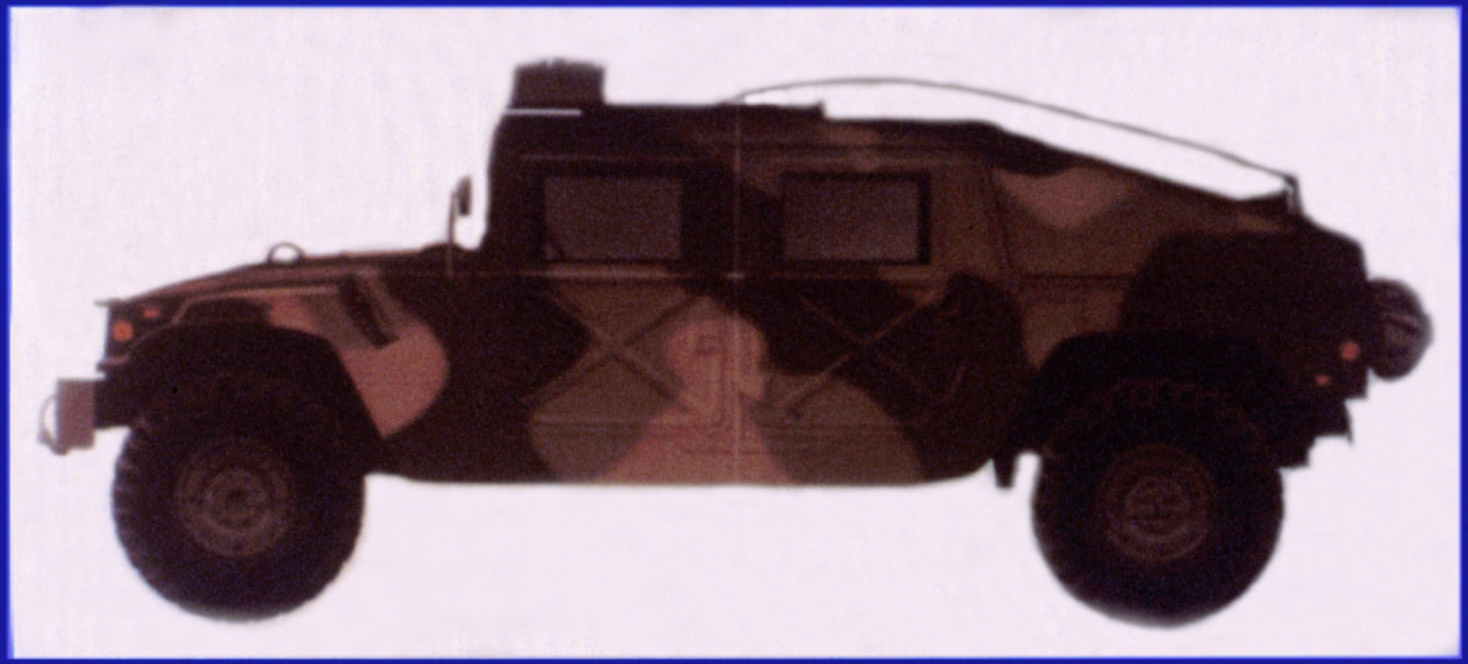
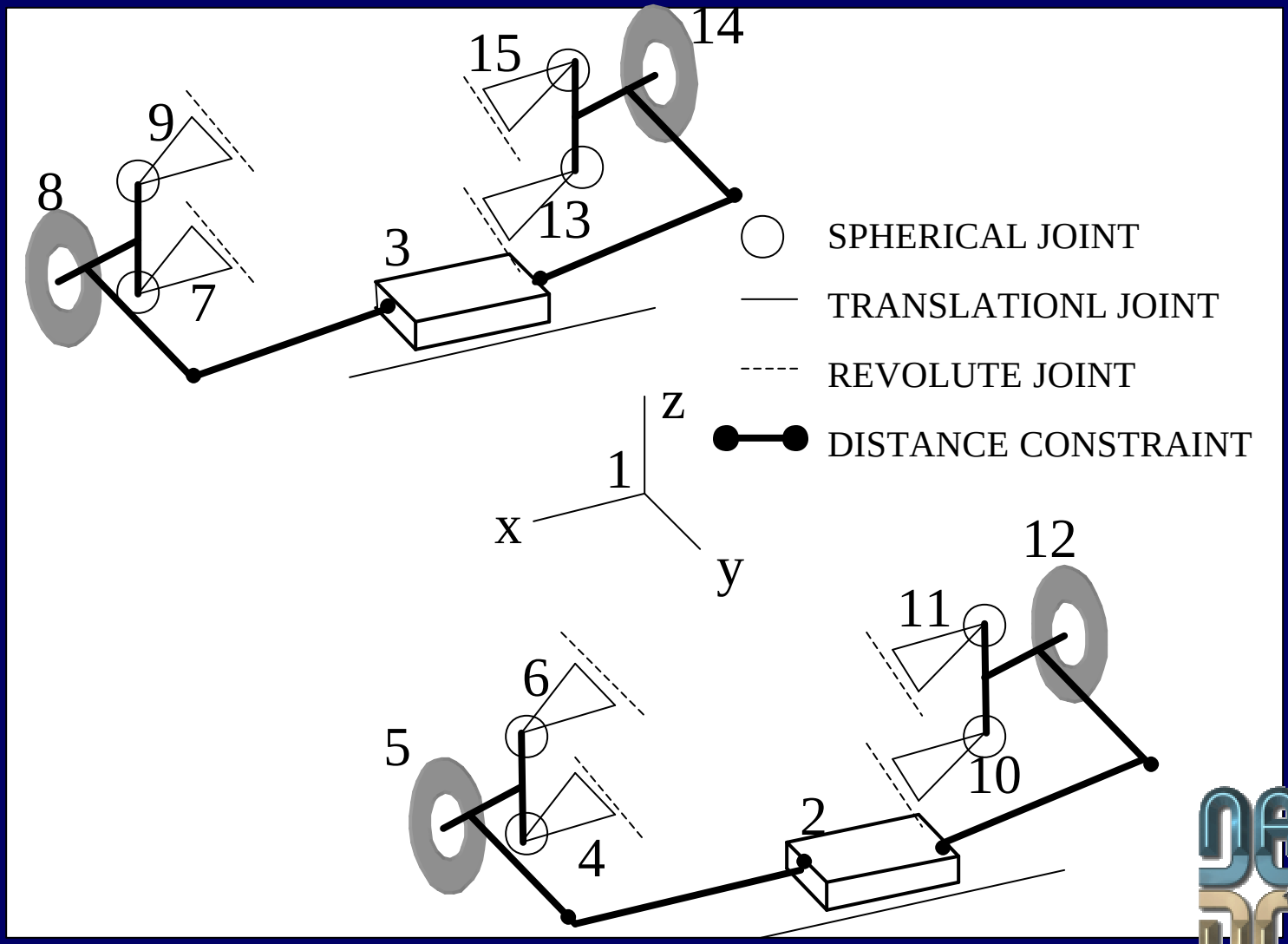
HIGH MOBILITY MULTIPURPOSE WHEELED VEHICLE (HMMWV)



HMMWV MODEL

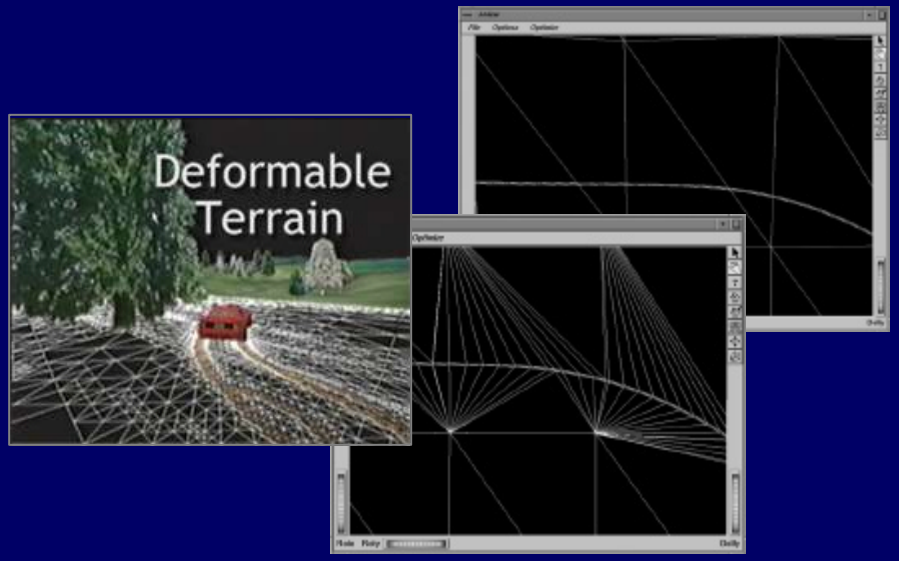

14
15
9
8
13
3
7
SPHERICAL JOINT
TRANSLATIONL JOINT
REVOLUTE JOINT
DISTANCE CONSTRAINT
z
1
x
y
12
11
6
5
10
2
4

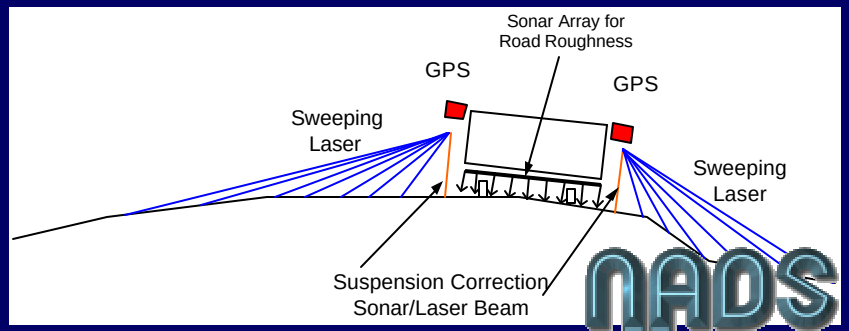
STNTHETIC ENVIRONMENT EXAMPLES

STNTHETIC ENVIRONMENT GENERATION/ACQUISITION

SYNTHETIC ENVIRONMENT ACQUISITION

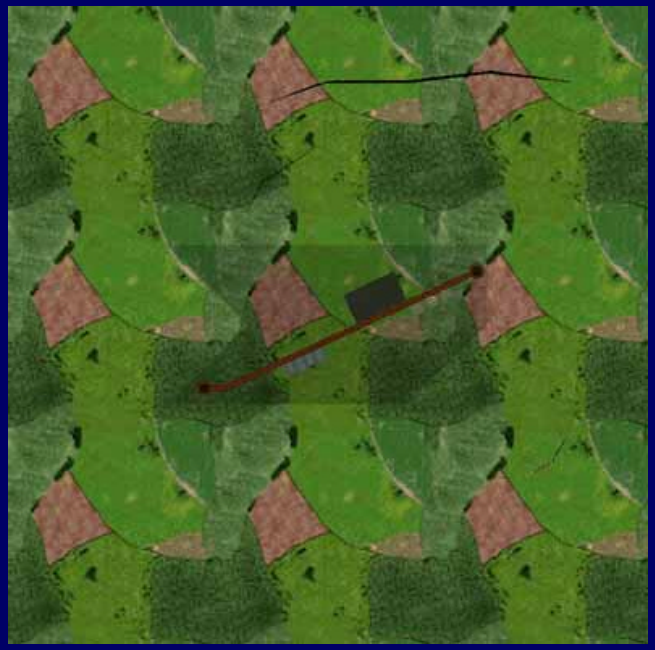
- Software Tools
- Dynamic Terrain Modeling and Simulation
- Geo-specific Database
- Ground Truth Acquisition Tool

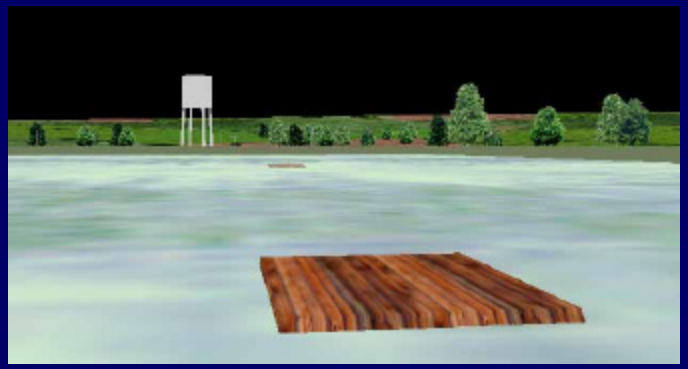




STNTHETIC ENVIRONMENT EXAMPLES

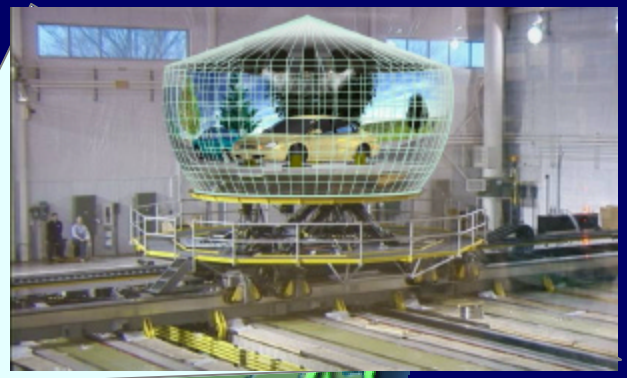
DEERE PROVING GROUND



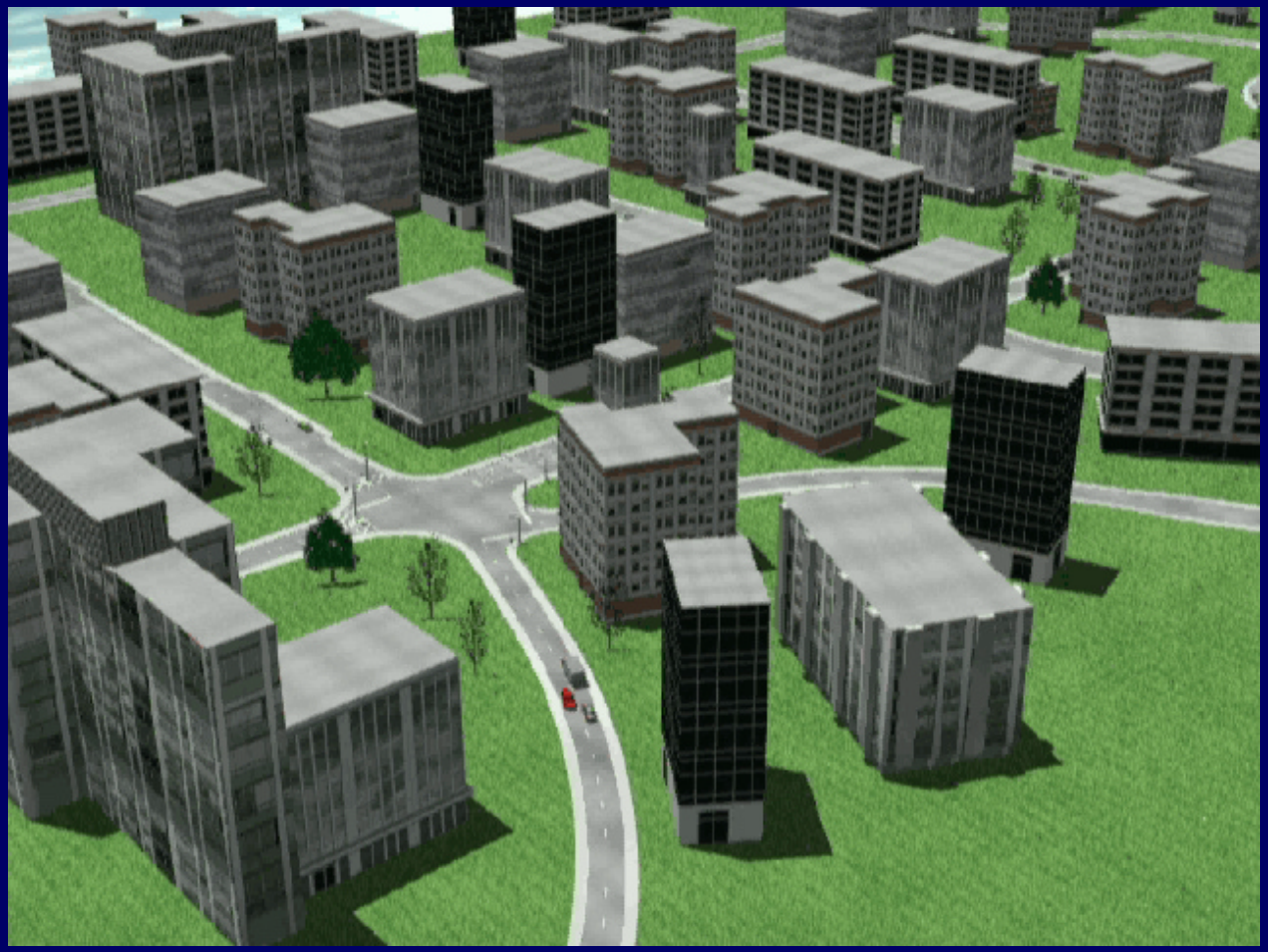


NSF SIMULATOR NETWORKING DATABASE

COLLABORATIVE ENGINEERING ENVIRONMENT



INTELEGENT 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