NADS Engineering Capabilities

Andrew Veit

National Advanced Driving Simulator (NADS)

The University of Iowa

April 2018

Driving Excellence: Transforming the Future

Our Mission:
Improving safety by researching the connection between drivers, motor vehicles, and road users

INNOVATION COLLABORATION EMPOWERMENT INTEGRITY COMMITMENT TO OUTREACH

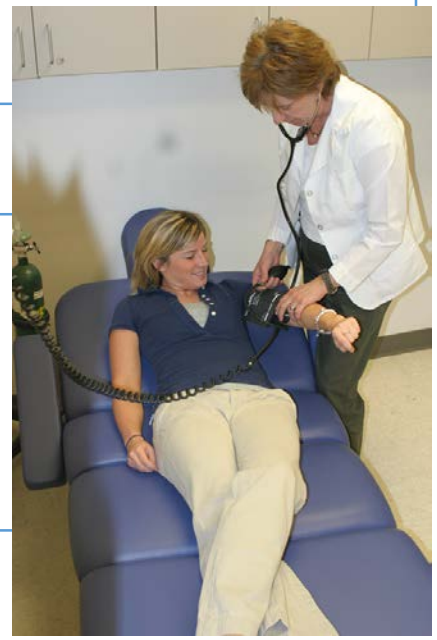
Our Capabilities

Development

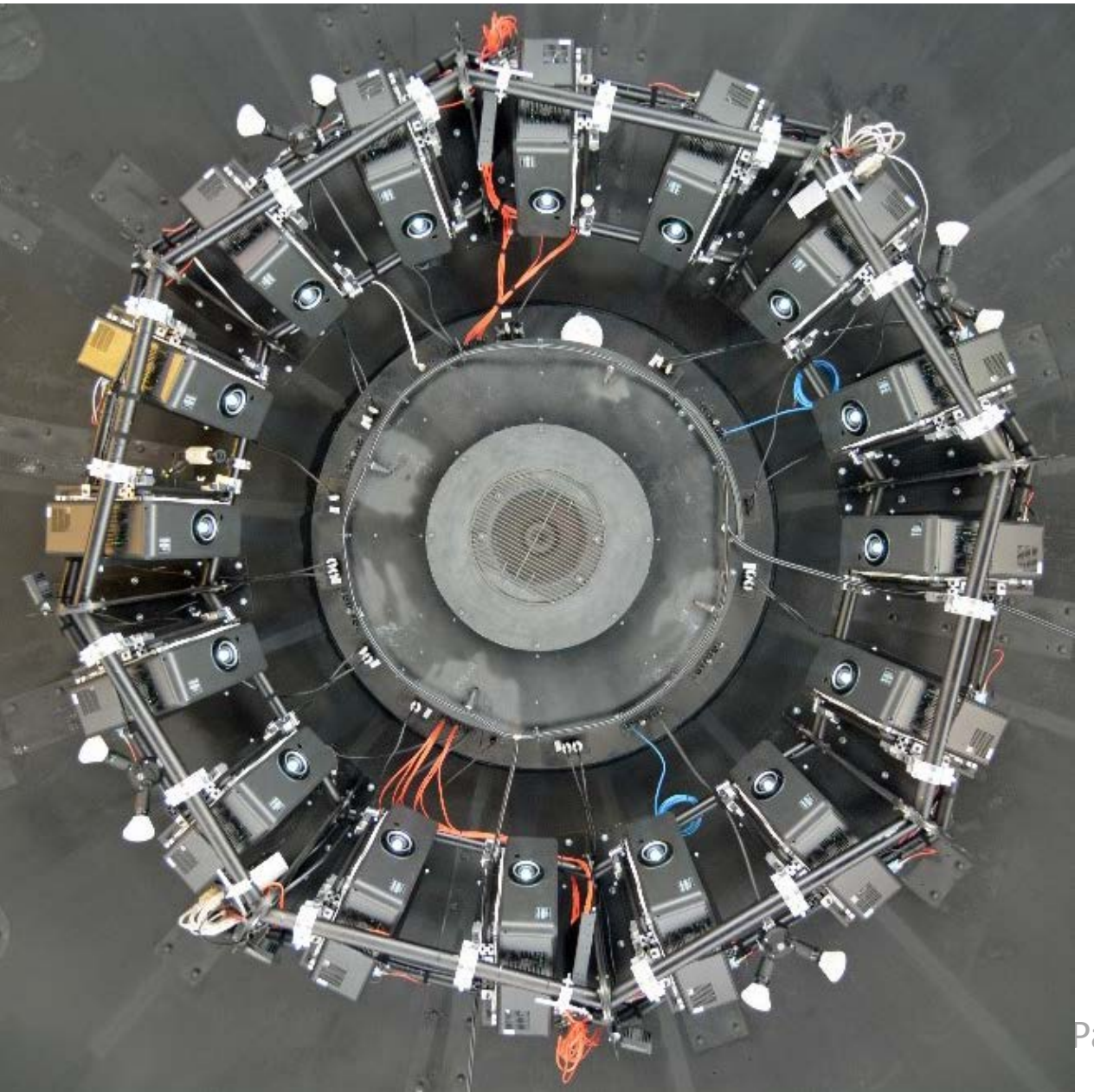
- Hardware Engineering / Instrumentation
- Software Engineering
- Integration with 3rd Party Devices / Software
- Vehicle Dynamics
- Automated Vehicle Models
- Driver Behavior Models

Human Subject Studies

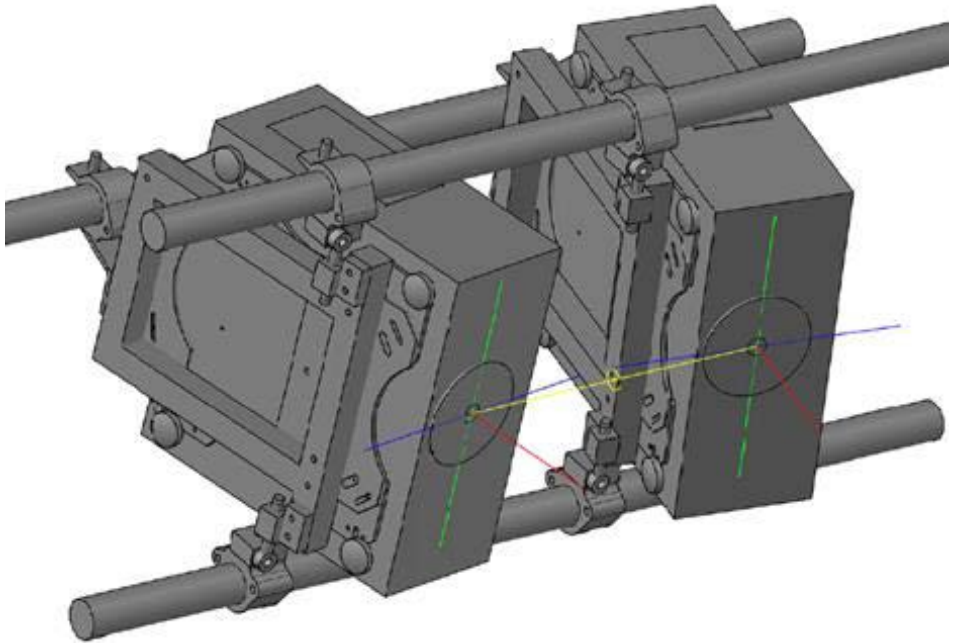
- Experimental Design / Test Plan
- IRB / Subject Recruitment / Handling
- Data Collection using Simulators, Instrumented Vehicles, Naturalistic Data Recorders
- Dosing/Drug Protocols
- Data Reduction / Analysis
- Report Writing



NADS-1 Projector and IG Upgrade



- (16) 1920 x 1200 LED Projectors
- Replaced 8 Barco Sim6 projectors installed in 2005
- Mounting system designed and installed in-house
- Image Generator (IG) software developed in-house
  - Rendering
  - Warping and Blending
  - Projector control/admin
  - IG node control



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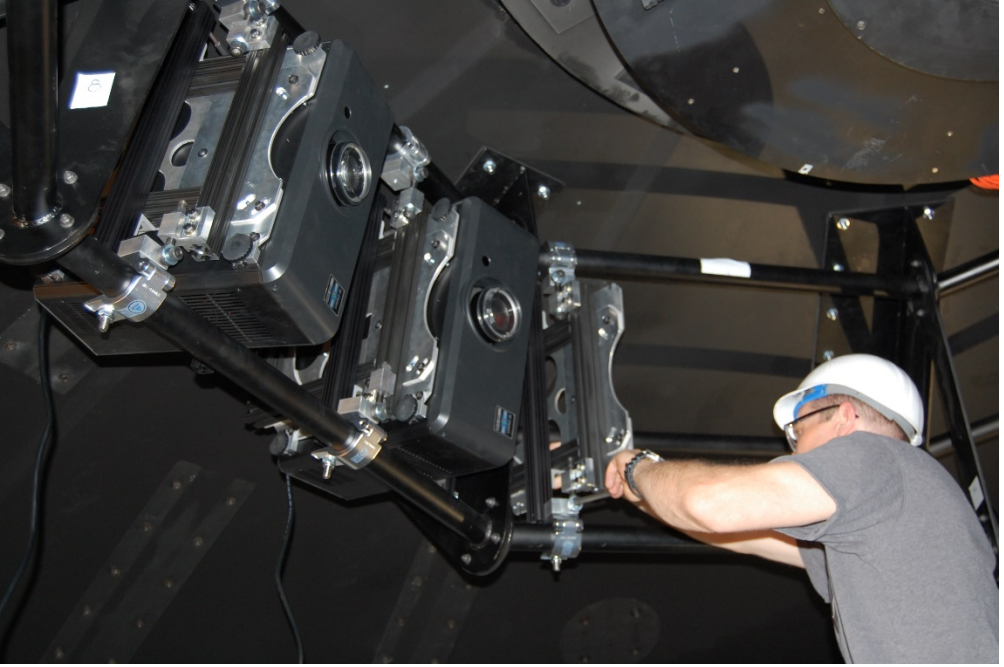
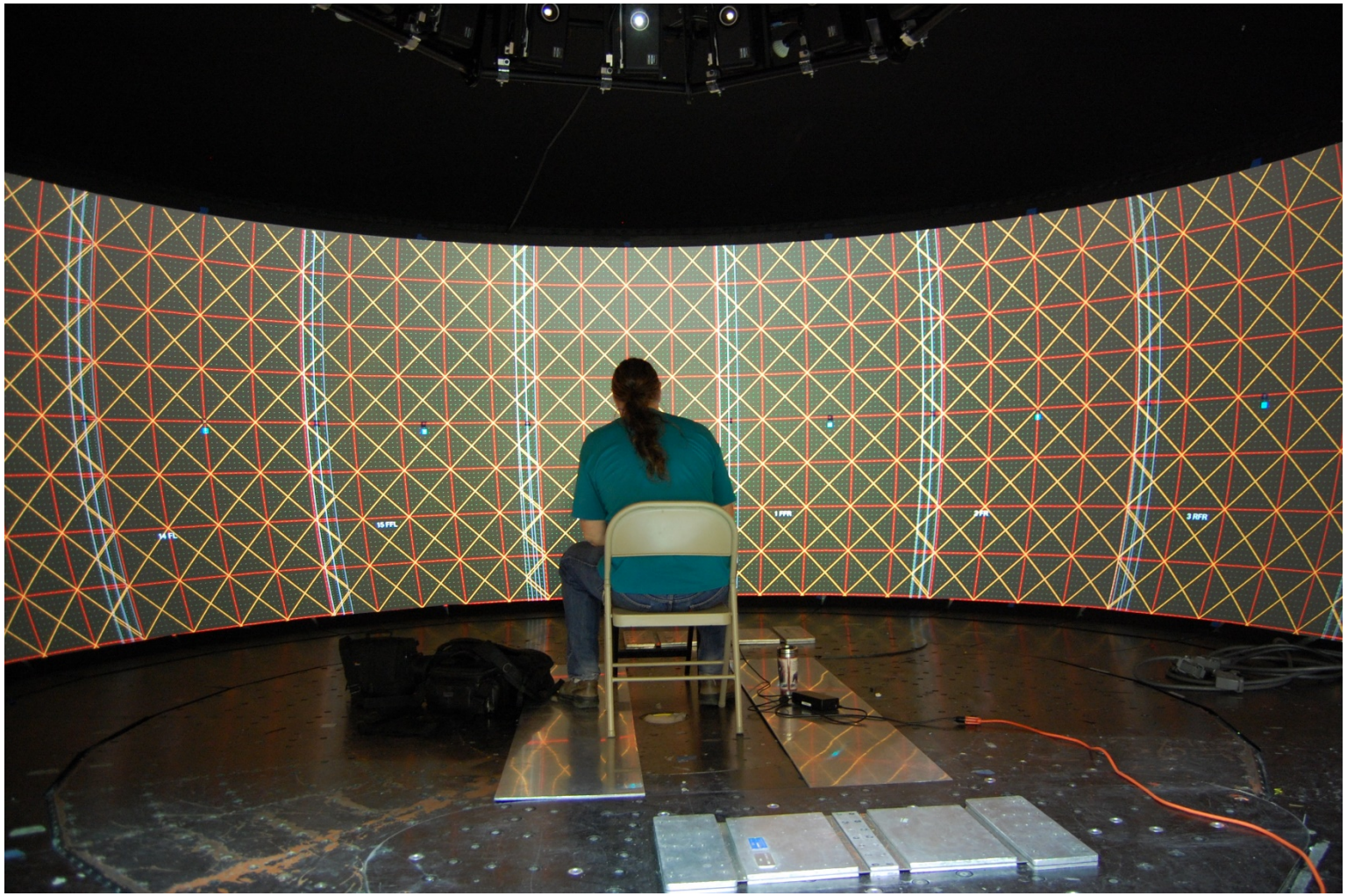
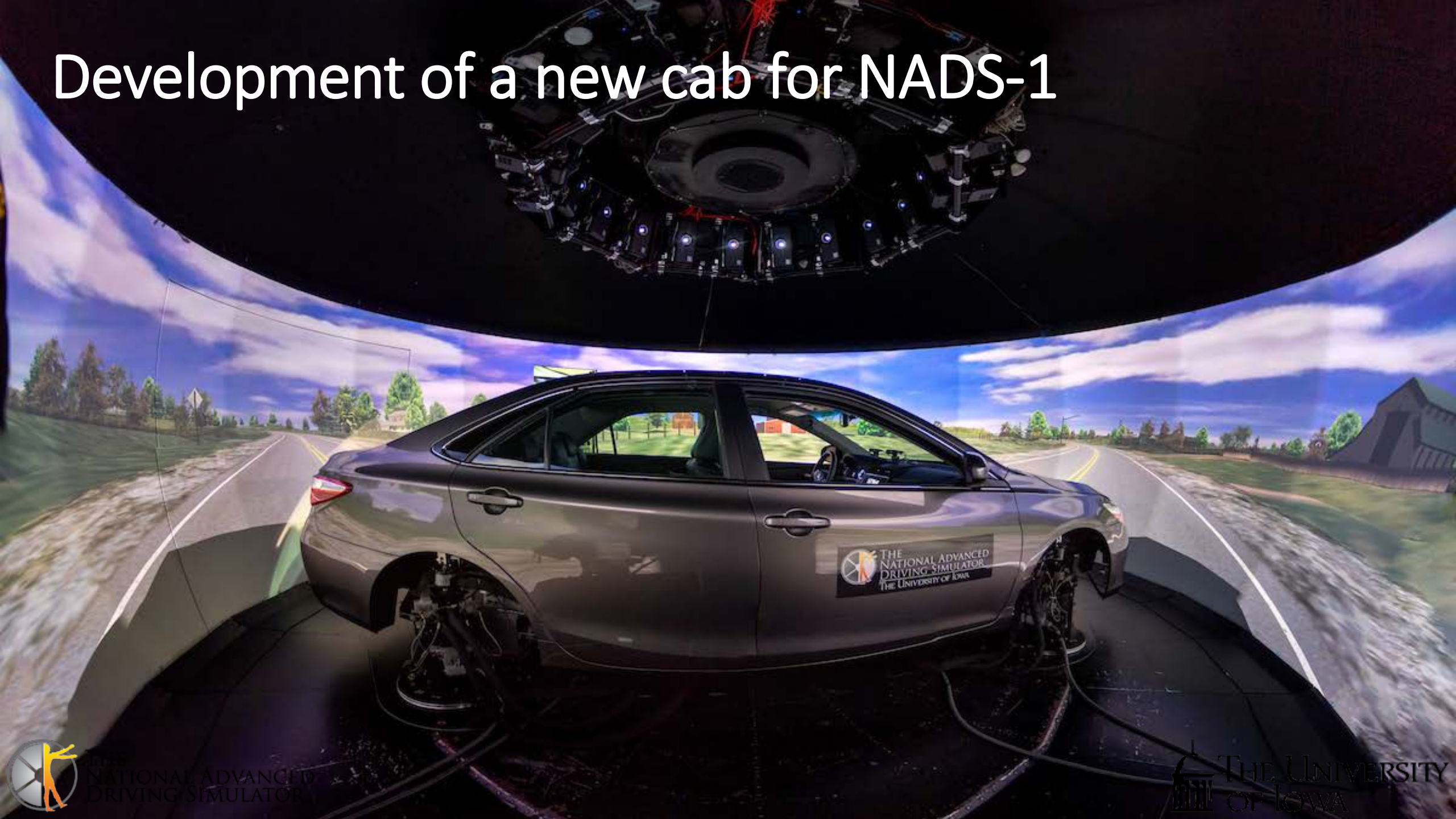




Development of a new cab for NADS-1



Development of a new cab for NADS-1

CAN bus integration

Fully programmable infotainment system

Interior representative of modern vehicles

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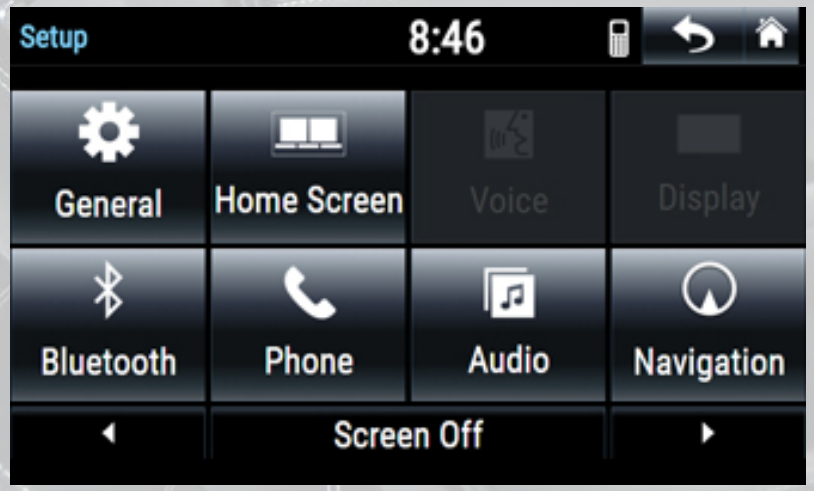
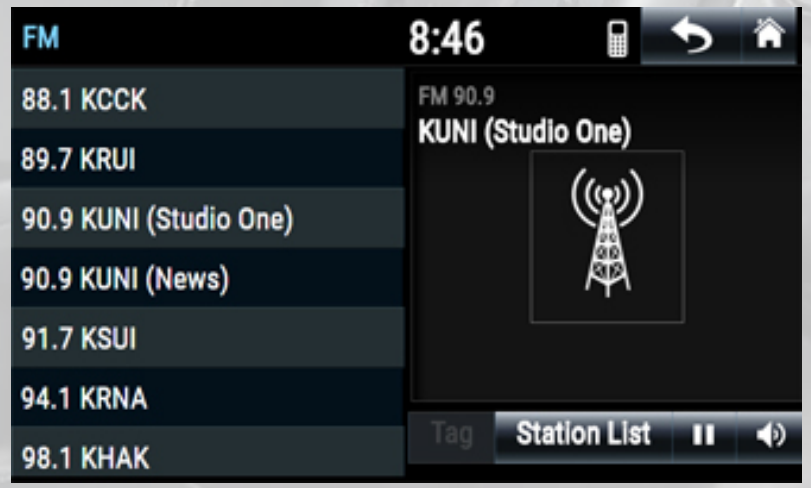
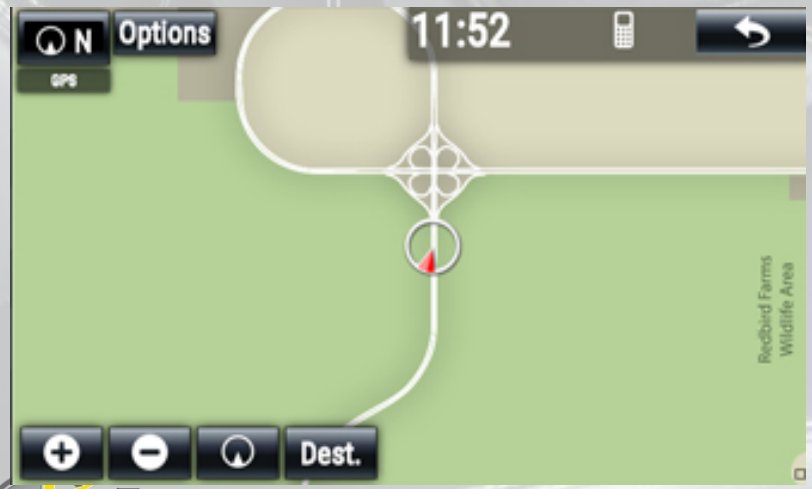
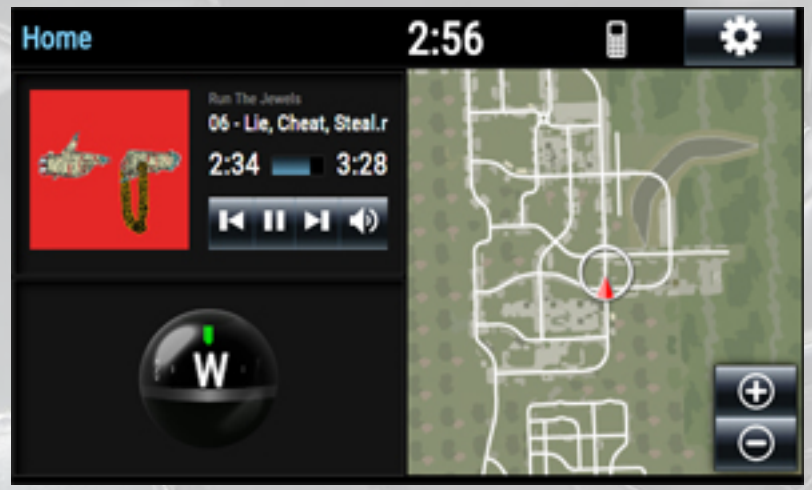
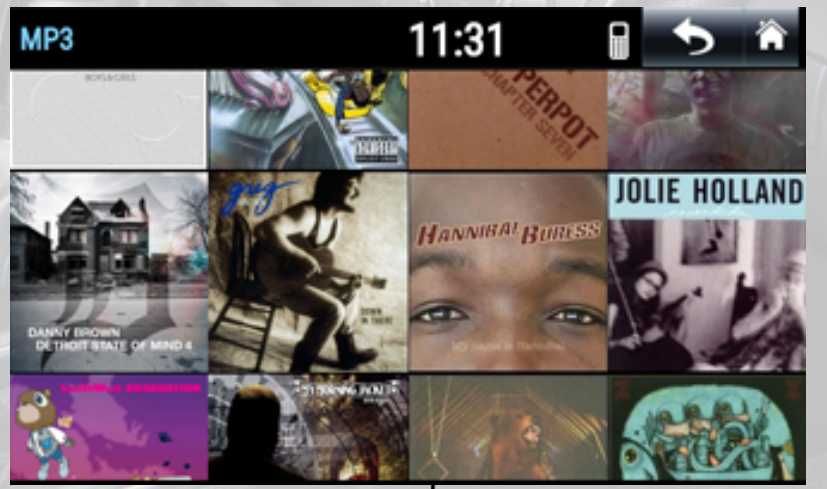
Emulation of OEM Infotainment Systems





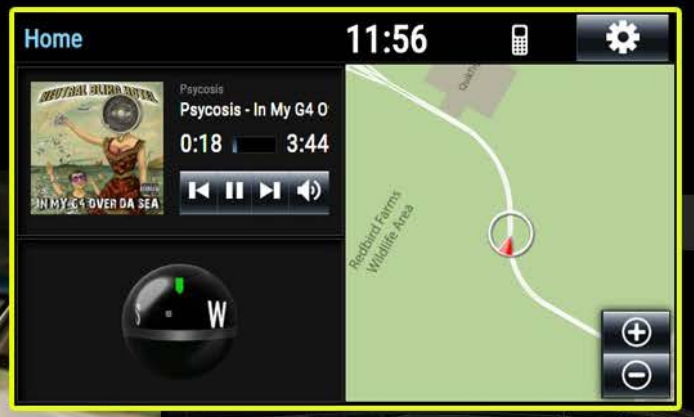






THE NATIONAL ADVANCED DRIVING SIMULATOR

THE UNIVERSITY OF IOWA



Home Screen

The National Advanced Driving Simulator

Vehicle infotainment system

- Touchscreen interface to replace (but mimic) OEM Toyota Entune (2015) system. Fully-integrated OEM physical keys (steering wheel buttons, etc)
  - Built entirely in HTML/Javascript (Node JS)
  - Beyond being controlled by the driver, also controllable by simulator operators, researchers, and/or programmatic triggers
    - GPS positioning/mapping created leveraging overhead map infrastructure
    - All interactions (touch + physical) logged and broadcast in real time to researchers

(ABOVE) : Customizable menu system, SMS functions
(BELOW) : GPS / mapping system

Full audio suite (AM / FM / MP3)

Touch target (researcher view)

graphic design multimedia web design + programming

The National Advanced Driving Simulator

1

Interaction telemetry is collected in real time. Touch events and positions are recorded and relayed to the onboard infotainment controller.

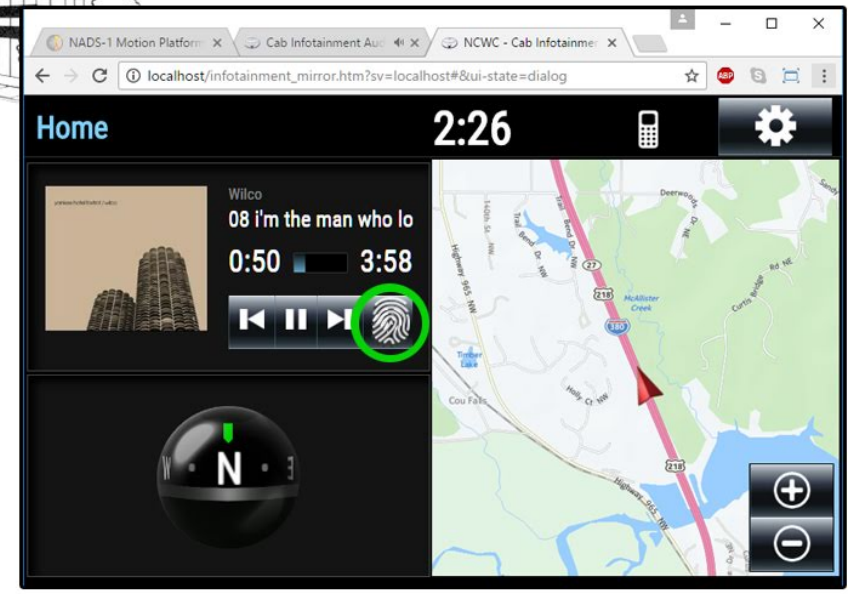
```
VEH_INF_STATUS {
  current_page : 11,
  touch :
    finger_1 : {
      x_coord : 363,
      y_coord : 188
    },
  timestamp : 1415463675
...
```

2

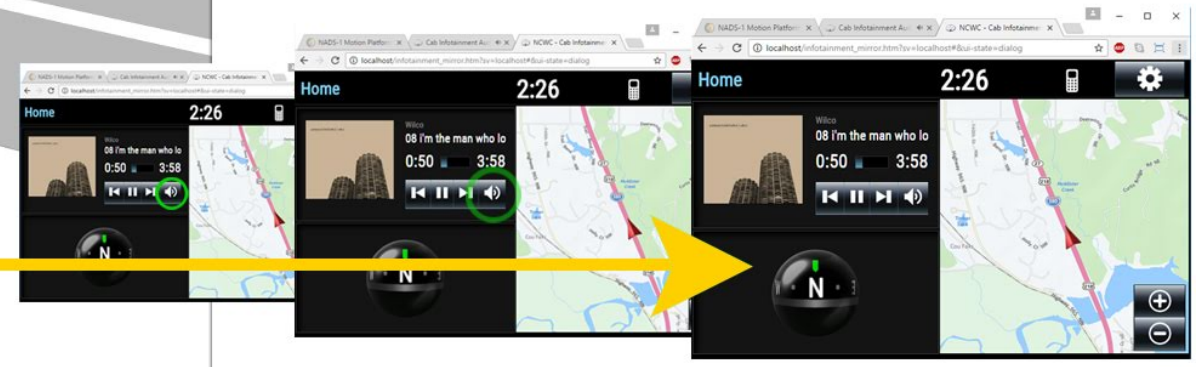
The infotainment controller collates interaction telemetry into a greater system state context, which is broadcast over a cellular link.

3

Remote obeservers see a live “mirror” of the system state through a standard web browser.



Touch points are expressed visually as fingerprint target icons, which ripple and dissipate as the driver removes their finger.



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Instrument Cluster + Infotainment System

TESLA MODEL 3

- Approximation of pre-production Tesla OEM system, built to operate with NADS simulators, and instrumented vehicles
- miniSim-compatible

Day & Night operation modes

NADS-1 Cab Scope

- New 2015 Camry purchased ‘off the lot’
- Disassembly and fabrication
  - Flex-plate/airbag assemblies for dome interface
  - Structural Reinforcements for Vibration Actuators
  - Power Entry and Equipment Rackspace
- Instrumentation
  - UEI Ethernet DAQ (www.**uei**daq.com)
  - CANbus
  - Active Steering and Brake loaders (E2M, www.e2mtechnologies.eu)
  - Audio PC, amplifiers, speakers, tactile transducers
  - Chiller for cab air conditioning (dome is air-conditioned)
  - Custom Infotainment Interface
  - OLED diplay in gage cluster replaces OEM display
  - Cab controls work normally (ignition, gage cluster, climate control, driver controls, etc)

Cab Test Fit in Dome

Front Equipment Bay

Cab Ride Height Set
During Fabrication

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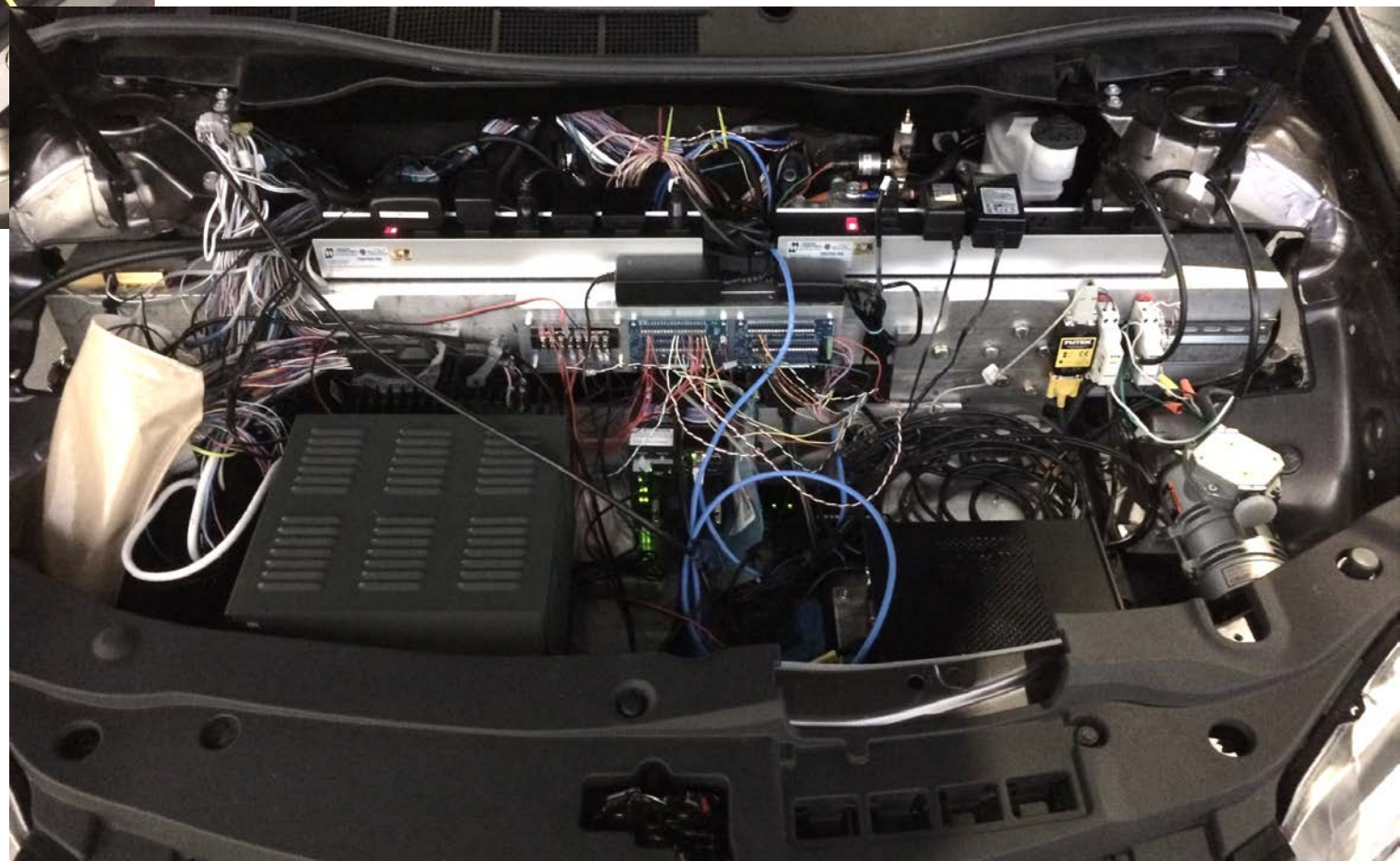
Rear Equipment Bay

Front Equipment Bay



THE NATIONAL ADVANCED DRIVING SIMULATOR

NADS miniSim™

- Portable, small footprint
- Off-the shelf parts. Single PC.
- Cost Effective, Reliable
- Multiple configurations
  - Quarter Cab
  - Simplified Cab
  - Desktop
- Tool for collaboration across institutions/industry/agencies
- Scenarios/softare compatible with NADS-1, NADS-2 simulators
- Growing network of users
- Software actively being improved
  - Distributed simulation
  - Automated vehicle models
  - Multi-site studies

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miniSim™

Georgia Tech

Sonification
Laboratory,
School of Psychology

© College of Computing, Georgia Tech Sonification Lab

The National Advanced Driving Simulator

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miniSim™

NHTSA
www.nhtsa.gov

U.S. Department of Transportation
Federal Highway Administration

leidos

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NADS miniSim™ Partners

Overseas Partners

- GM — Israel
- universiteit hasselt — Knowledge in Action — Belgium
- Black Sesame Technologies — China

miniSim™

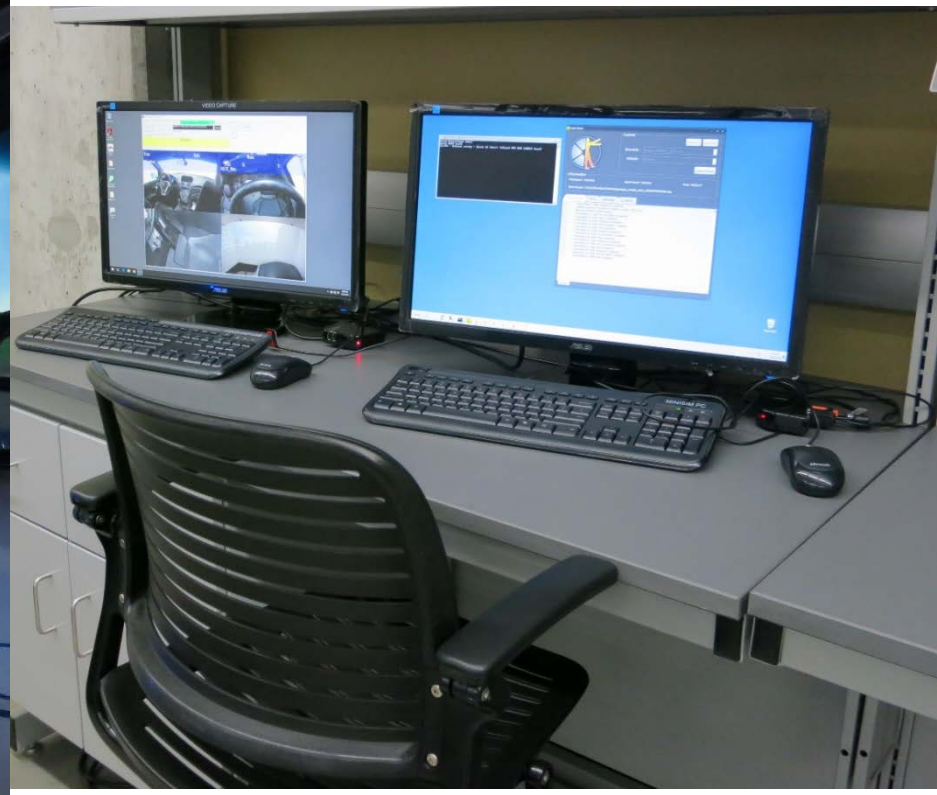
Simulator for Transportation Research

KU
THE UNIVERSITY OF KANSAS

University of Kansas miniSim™

- Cab donated by OEM
  - Used simulator buck, all instrumentation removed
- Section cab to fit doorways
- Instrumentation
  - Commercial USB A/D and DIO boards
  - No CANbus interface
  - Active Steering (www.simxperience.com), Passive Brake
  - LCD Gage Cluster
  - Cab Controls: fan, windows, mirrors, ignition, lights, turn signals, horn, gear select
  - Audio PC, amplifiers, speakers, tactile transducers

University of Kansas miniSim™



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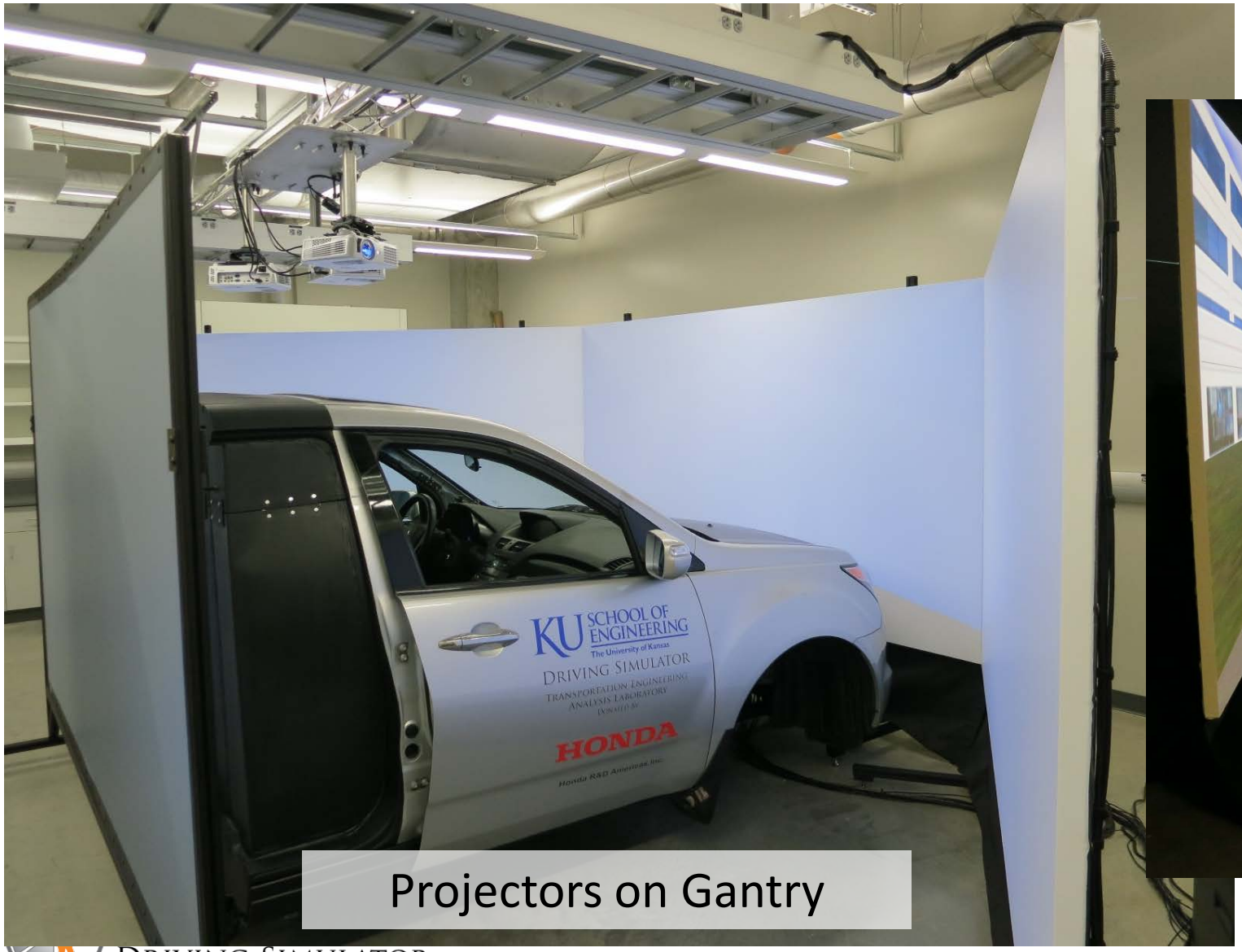
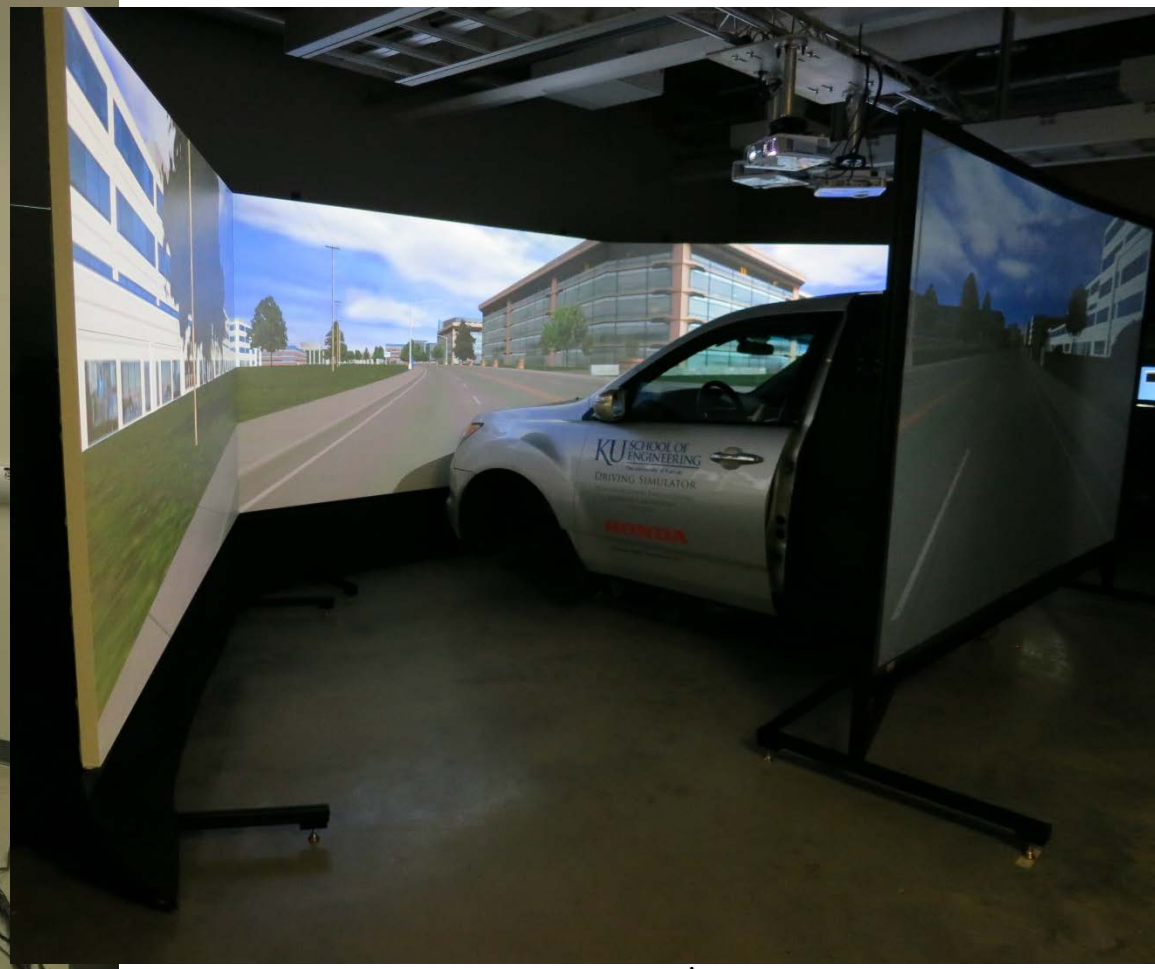
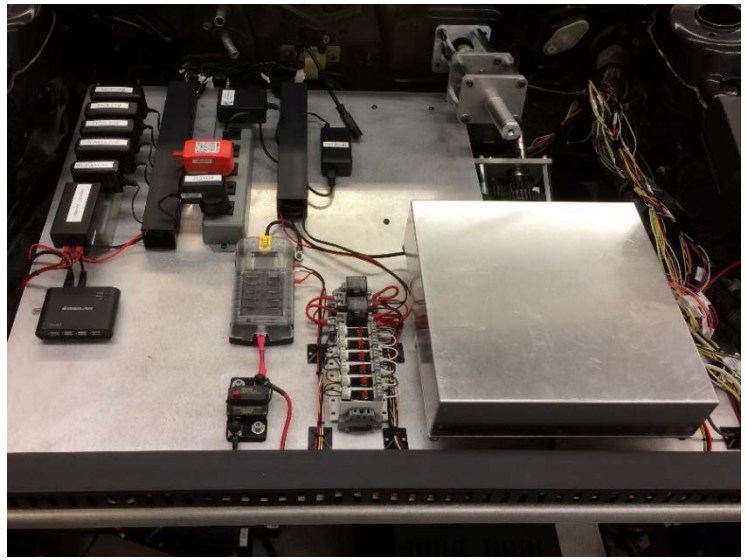


Projectors on Gantry



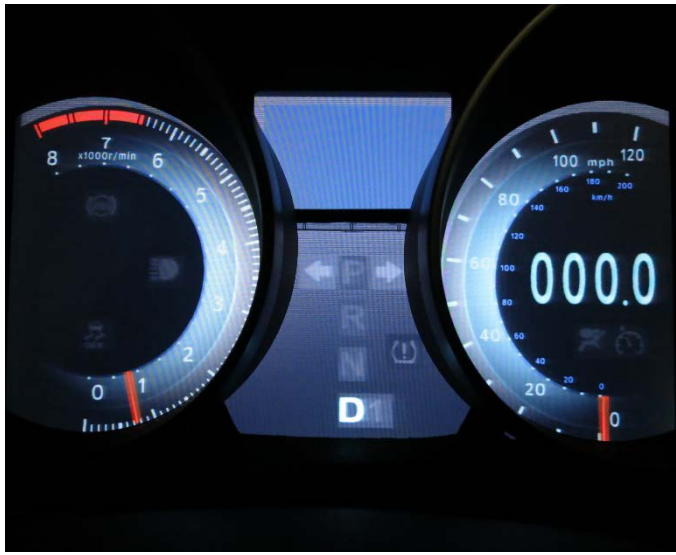
University of Kansas miniSim™

Cab Modified to Fit Doorways



Cab Instrumentation

Rack Mount Equipment

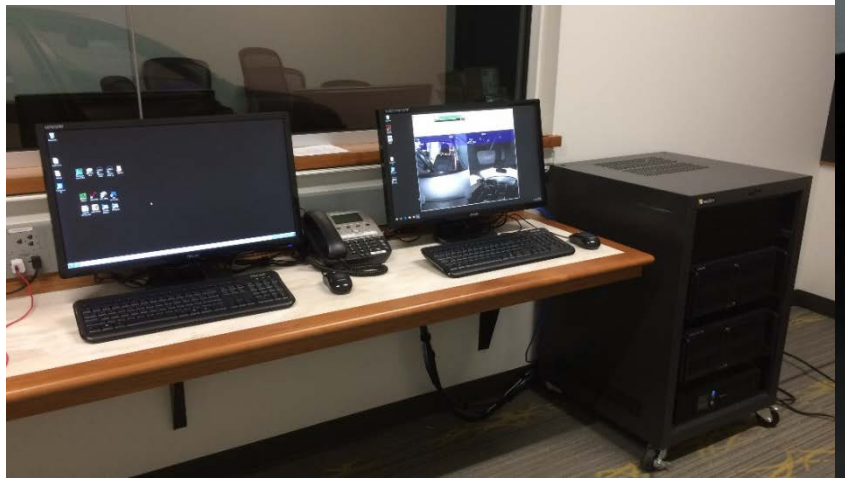


Custom Instrument Model

miniSim™

Simulator for Neurology Research

Yale



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Yale miniSim™

- 2008 Mazda 6 Donor
- Fits through 36in [900mm] doorway
- 166° Horizontal Field of View
- 3 DLP Projectors
- 3rd party warping and blending
- Rear screen with 3 viewports for mirrors

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Yale miniSim™ cont…

Cab Integration

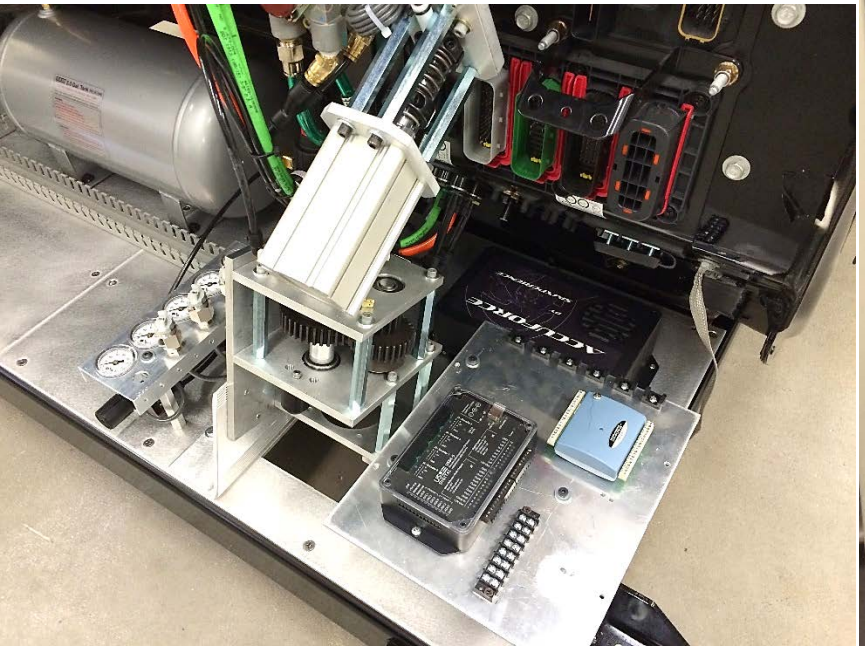
All Connections in Passenger Wheel Well

Clean Projector and Alignment Camera Installation

miniSim™

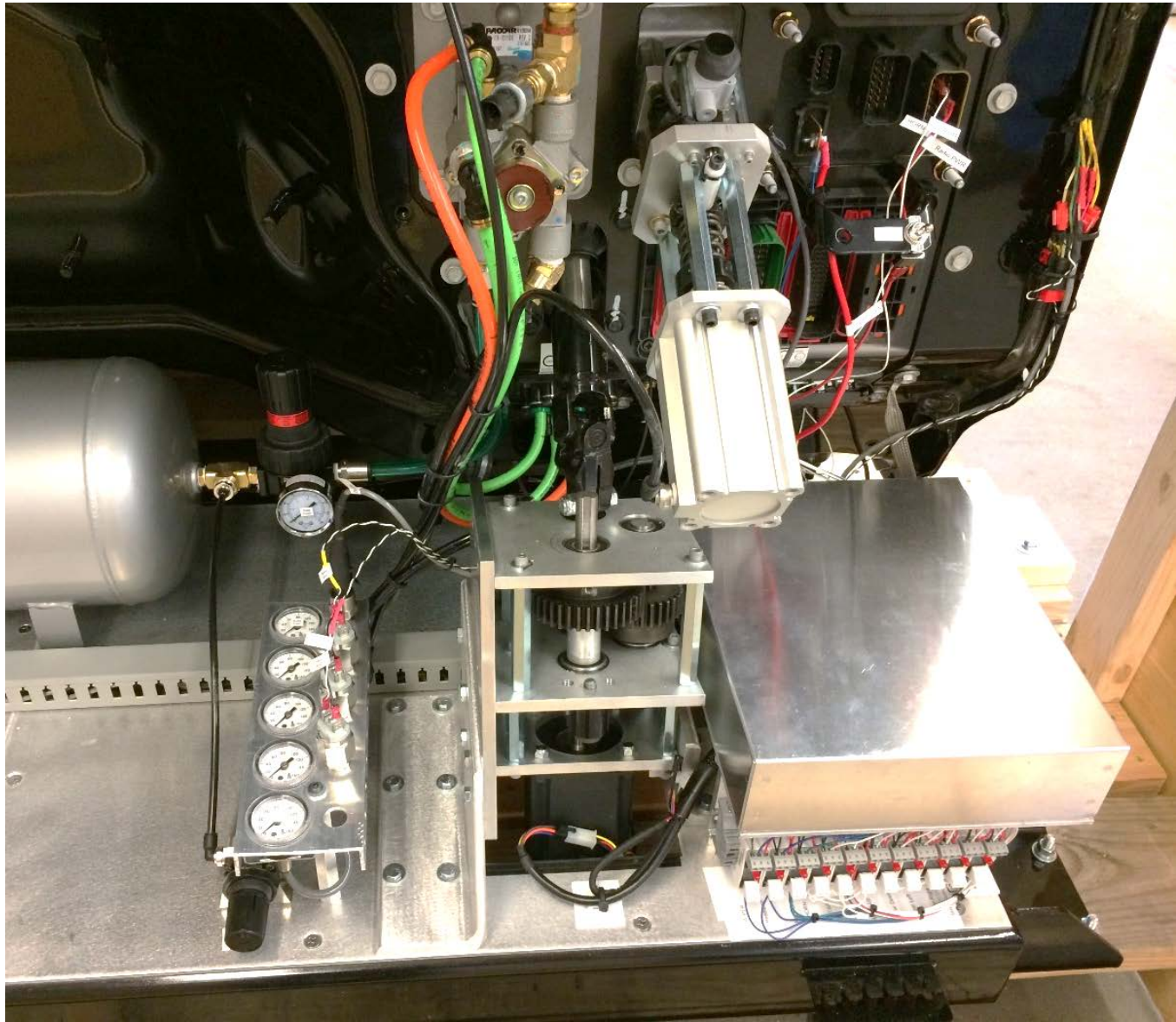
Heavy Truck

Simulator for New Product Development and Demonstration



Truck miniSim™

- New Cab
- Custom Monitor Stand and frame
- Instrumentation
  - Commercial USB A/D and DIO boards
  - No CANbus interface
  - Active Steering (www.simxperience.com)
  - Passive Brake
  - Passive Gear Shift (x/y lever location)
  - OEM Air brakes
  - Custom clutch loader mechanism
  - LCD Gage Cluster
  - Cab Controls: fan, windows, mirrors, ignition, lights, turn signals, horn, gear select, radio
  - Audio PC, amplifiers, speakers, tactile transducers



Truck miniSim™

Metal Fabrication

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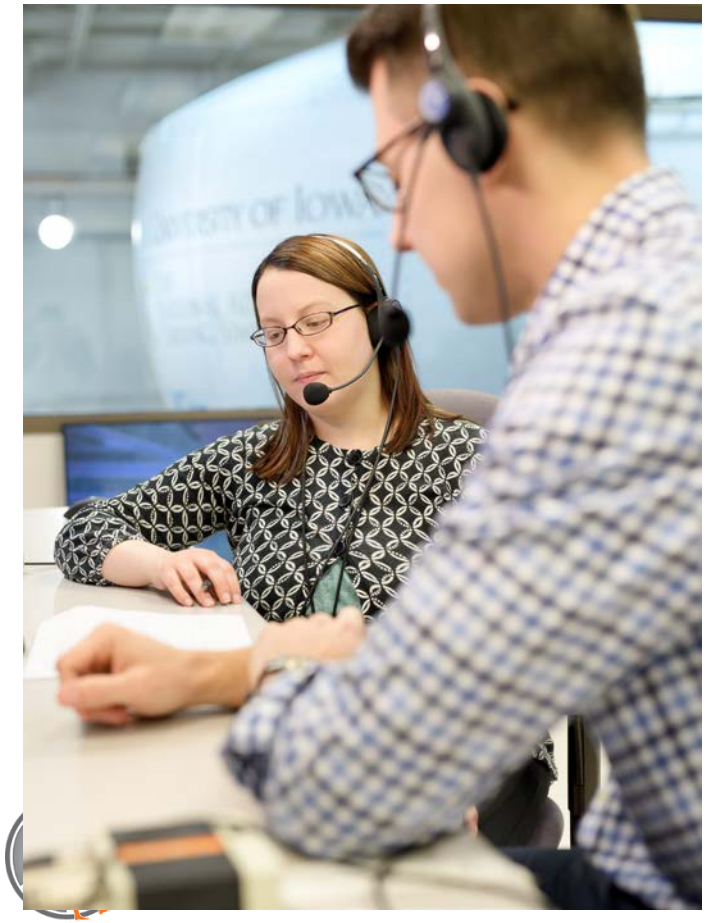

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