Michigan Connected and Automated Vehicle Working Group

June 3, 2016
Intelligent Ground Vehicle Competition
Oakland University
Rochester, MI 48309-4401

Meeting Agenda

11:30 AM    Lunch and Networking

11:45 AM    Welcome and Introductions
Adela Spulber, Transportation Systems Analyst, Center for Automotive Research
Gerald Lane, Co-Chairman & Co-Founder, IGVC

12:30 PM    Connected Vehicle Virtual Trade Show
Linda Daichendt, Executive President/Director, Mobile Technology Association of Michigan

12:50 PM    Overview of the American Center for Mobility (i.e., Willow Run test site)
Andrew Smart, CTO, American Center for Mobility

01:10 PM    From Park Assist to Automated Driving
Amine Taleb, Manager - Advanced Projects, Valeo North America Inc.

01:30 PM    Advanced Vehicle Automation and Convoying Programs at TARDEC
Bernard Theisen, Engineer, TARDEC

01:50 PM    Overview of the SAE Battelle CyberAuto Challenge
Karl Heimer, Founder/Partner, AutoImmune (and co-founder of the Challenge)

02:10 PM    Continental – Oakland University Joint Project on ADAS Test & Validation
Irfan Baftiu, Engineering Supervisor, Continental Automotive Systems

02:30 PM    Watch IGVC teams practice and test on the course

03:00 PM    Adjourn
Michigan Connected and Automated Vehicle Working Group

The Michigan Connected and Automated Vehicle Working Group held a special edition meeting on June 3rd 2016, during Intelligent Ground Vehicle Competition (IGVC) at the Oakland University in Rochester, Michigan.

Meeting Notes

Adela Spulber, Transportation Systems Analyst at the Center for Automotive Research (CAR), started the meeting by detailing the agenda of the day and working group mission.

Gerald Lane, Co-Chairman & Co-Founder of the IGVC, welcomed the Working Group to the 24th annual Intelligent Ground Vehicle Competition. Gerald gave an introduction of the IGVC, a competition aimed at university and college students, and focusing on the design, fabrication, and field testing of autonomous intelligent mobile robots. The IGVC started in 1993 and has brought together more than 500 teams from 80 universities and seven countries. Gerald gave details on each step of the competition, as well as information about the 2015 edition. The presentation included in the meeting packet also shows the results of the 2016 race.

Following Gerald Lane’s presentation, Linda Daichendt, Executive President/Director of the Mobile Technology Association of Michigan (MTAM), provided a brief overview of the Connected Vehicle Virtual Trade Show, which is part of the larger connected vehicle environment that the USDOT helps develop. The Virtual Trade Show, set up by MTAM for USDOT, aims at bringing together companies in the connected vehicle sector and helping with the selection of vendors for the Connected Vehicle Safety Pilot Program. Linda showed a demo video that explains the functioning of the Virtual Trade Show. The video is also available on Youtube: [https://youtu.be/l6J01RqU0I4](https://youtu.be/l6J01RqU0I4).

After Linda Daichendt’s presentation, Andrew Smart, CTO of the American Center for Mobility (ACM), gave an update on the development of this new connected and automated vehicle testing environment on the Willow Run site. ACM is structured as a non-profit connected and automated vehicle testing and product development facility, designed to accelerate the development of voluntary standards and technology deployment. ACM will be complementary to MCity. Its bigger scale will allow for high speed testing, by incorporating a part of US 12 highway, as well as testing in residential and commercial environments.

Amine Taleb, Manager of Advanced Projects at Valeo North America Inc., talked about the transition from park assist to automated driving from the perspective of the product development at Valeo. Amine highlighted several evolution steps, including the 1991 Ultrasonic (park assist), the 2007 Park4U (semi-automatic parking), the 2010 Park4U 2.0 (perpendicular parking with active braking), the 2011
FlankGuard (360 degrees park assist), the 2013 Auto Park4U (fully-automatic parking), the 2014 Park4U 3.0 (forward parking), and finally the 2016 Park4U Remote (with sensor fusion and remote command).

Bernard Theisen, Engineer at TARDEC provided an update on the Advanced Vehicle Automation and Convoying Programs at TARDEC. Bernard also talked about the need to create more linkages between the industry of commercial vehicles and the Department of Defense and gave details about the DSRC-enabled platooning test that TARDEC is conducting in June on I-69.

Following Bernard Theisen, Karl Heimer, Founder/Partner of AutoImmune spoke about the SAE Battelle CyberAuto Challenge, that is taking place this year on July 25-29 in Warren, Michigan. The Challenge brings together students, engineers from the automotive industry, white-hat hackers, and government representatives. Its purpose is to develop the future workforce, create mentor-protégé relationships, and help forge the vehicle cybersecurity community.

After the end of the meeting, the members of the CAV Working Group had the chance to watch IGVC teams practice and test on the course.

MDOT maintains a webpage dedicated to its work related to CAV technologies (http://www.michigan.gov/mdot/0,1607,7-151-9621_11041_38217---,00.html). The page includes documents, presentations, and other materials that may be of interest to CAV stakeholders. Meeting packets containing materials (e.g., agenda, meeting notes, attendance, and presentation slides) from past Michigan Connected and Automated Vehicle Working Group meetings can also be found on the page in the bottom right corner under the heading Connected Vehicles Working Group.
### Michigan Connected and Automated Vehicle Working Group

#### Attendance List

<table>
<thead>
<tr>
<th>First name</th>
<th>Last name</th>
<th>Organization</th>
<th>Email</th>
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<tbody>
<tr>
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<td>Abdul-Hak</td>
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Michigan Connected and Automated Vehicle Working Group

Presentations
# Meeting Agenda

<table>
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<td>03:00 PM</td>
<td>Adjourn</td>
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Working Group Mission

Cooperatively pursue projects and other activities that are best accomplished through partnerships between multiple agencies, companies, universities, and other organizations and that ultimately advance Michigan’s leadership position in connected and automated vehicle research, deployment, and operations.

Goals

• Benefit our state and our industry (automotive and more)
• Enhance safety and mobility in Michigan and beyond
Connected & Automated Vehicle Working Group
Welcome to the
The 24th Annual Intelligent Ground Vehicle Competition:

Jerry Lane  GLS&T
KaC Cheok  Oakland Univ.
Bernard Theisen TARDEC
Andrew Kosinski TARDEC
2016 Grand Award Winners

- 1st Place  Lawrence Technological University (LTU)
- 2nd Place  Bluefield State College
- 3rd Place  University of Michigan Dearborn
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<th>Design Group C</th>
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<td>C.L.O.V.E.</td>
<td>Florida Institute of Technology</td>
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<tr>
<td>9:00 AM</td>
<td>The Citadel</td>
<td>PabloBot</td>
<td>Florida RAS</td>
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<td>9:30 AM</td>
<td>Indian Institute of Technology - Kharagi</td>
<td>Eklavya 5.0</td>
<td>The College of New Jersey</td>
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<td>University of Illinois - Chicago</td>
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<td>12:00 PM</td>
<td>University of Central Florida</td>
<td>Metaknight</td>
<td>Old Dominion University</td>
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<td>1:00 PM</td>
<td>Georgia Institute of Technology</td>
<td>Jaymi</td>
<td>Linfield WildCat</td>
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<td>1:30 PM</td>
<td>California State University - Fullerton</td>
<td>Netra</td>
<td>Istanbul Technical University</td>
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<td>2:00 PM</td>
<td>University of West Florida</td>
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<td>3:00 PM</td>
<td>University of Cincinnati</td>
<td>United States Military Academy</td>
<td>Stony Brook University</td>
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<td>3:30 PM</td>
<td>Oakland University</td>
<td>Octagon</td>
<td>Trinity College</td>
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<td>4:00 PM</td>
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<td>Snowstorm</td>
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2016 Sponsors

Platinum Sponsors - Northrop Grumman, Hyundai Mobis & AUVSI Foundation:

Elite Sponsor - Magna:

Gold Sponsors - ClearPath Robotics, Roush, NDIA & Molex:

Sponsor - TORC Robotics:
IGVC Objective

• University & College students to think creatively as a team

• Focus on evolving technologies of vehicle electronic controls, sensors, computer science, robotics, and system integration

• Design, Report Fabrication, and Field Testing

• Autonomous intelligent mobile robots.
IGVC Schedule - 4 Days

- **Friday**
  - Teams Arrive register
  - Setup in tent and practice
  - Qualification Opens

- **Saturday**
  - Qualification
  - Design Competition First Round all day
  - Heat 1 of Auto-Nav- Basic
  - IOP Challenge begins

- **Sunday**
  - Qualification
  - Heats 2 & 3 of Auto-Nav-Basic
  - Heat 1 Auto-Nav Advanced
  - Design Competition Finals
  - IOP Challenge

- **Monday**
  - Qualification
  - Heats 4 & 5 of Auto-Nav-Basic
  - Heat 2&3 Auto-Nav Adv
  - Awards
IGVC Challenges

• Mandatory Design Competition
  – Design Report
  – Student Presentation
  – Vehicle Inspection

• Autonomous Driving & Navigation
  – Fully Autonomous
  – Must Qualify Autonomous Driving & Navigation
  – Basic Course
  – Advanced Course

• Interoperbility IOP Architecture
1993 - 2012 Autonomous Challenge
1995 Design Competition
1999 – 2000 Road Debris Course
1999 – 2001, 2003 Follower The Leader
2001 – 2012 Navigation Challenge
2006 – 2013 JAUS Challenge
2013 Auto-Nav Challenge
2014 IOP Challenge
24 Years and Running

500+ Teams
80+ Universities
7 Countries
## 2015 Participating Schools

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<tr>
<th>Bluefield State College</th>
<th>2015 Schools</th>
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<td>Michigan Technological University</td>
<td>University of British Columbia</td>
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<td>École de technologie supérieure</td>
<td>Oakland University</td>
<td>University of Central Florida</td>
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<td>Embry-Riddle Aeronautical University</td>
<td>Oakland University 2</td>
<td>University of Cincinnati</td>
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<td>Southern Illinois University - Edwardsville</td>
<td>University of Detroit Mercy</td>
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<td>Hosei University</td>
<td>The Citadel</td>
<td>University of Illinois - Chicago</td>
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<td>University of Michigan-Dearborn</td>
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</table>
Safety is a top priority at IGVC. Before the vehicles can compete in any of the performance events, all vehicles must pass Qualification. To complete Qualification the vehicle must be put in autonomous mode to verify the mechanical and wireless E-stops and to verify minimum speed, lane following, obstacle avoidance and waypoint navigation.

The vehicle software cannot be reconfigured after Qualification. Teams may fine tune their vehicles and resubmit for Qualification. There is no penalty for not qualifying the first time. Vehicles that are judged to be unsafe will not be allowed to compete. In the event of any conflict, the judges’ decision will be final.
A fully autonomous unmanned ground robotic vehicle must negotiate around an outdoor obstacle course under a prescribed time while maintaining a minimum of speed of one mph over a section and a maximum speed limit of ten mph, remaining within the lane, negotiating flags and avoiding the obstacles on the course.

Judges will rank the entries that complete the course based on shortest adjusted time taken. In the event that a vehicle does not finish the course, the judges will rank the entry based on longest adjusted distance traveled. Adjusted time and distance are the net scores given by judges after taking penalties, incurred from obstacle collisions and boundary crossings, into consideration.

**AWARD MONEY:**

$ 25,000
Basic Auto Nav Course
Advanced Auto Nav Course
# 2015 Auto-Nav Challenge Results
## Basic Course

<table>
<thead>
<tr>
<th>Place</th>
<th>School</th>
<th>Team</th>
<th>Distance</th>
<th>Waypoints</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>University of New South Wales</td>
<td>Pepper</td>
<td>510</td>
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</tr>
<tr>
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<tr>
<td>3</td>
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<td>2:34</td>
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<tr>
<td>4</td>
<td>University of Michigan-Dearborn</td>
<td>OHM 3.0</td>
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<td>2</td>
<td>3:26</td>
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<tr>
<td>5</td>
<td>United States Naval Academy</td>
<td>Robogoat</td>
<td>510</td>
<td>0</td>
<td>3:33</td>
</tr>
<tr>
<td>6</td>
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<td>CAPRA6</td>
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<tr>
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<td>Bigfoot</td>
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<tr>
<td>8</td>
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<tr>
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<td>5:00</td>
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<tr>
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<tr>
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<tr>
<td>12</td>
<td>University of Detroit Mercy</td>
<td>Thor Pro</td>
<td>85</td>
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<tr>
<td>13</td>
<td>Bluefield State College</td>
<td>Apollo</td>
<td>60</td>
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<td></td>
</tr>
</tbody>
</table>
## 2015 Auto-Nav Challenge Results
### Advanced Course

<table>
<thead>
<tr>
<th>Place</th>
<th>School</th>
<th>Team</th>
<th>Distance</th>
<th>Waypoints</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>University of New South Wales</td>
<td>Pepper</td>
<td>1032</td>
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<td>3:52</td>
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<tr>
<td>2</td>
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<td>El Toro</td>
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<tr>
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<td>Robogoat</td>
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<tr>
<td>6</td>
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<td>Mantis</td>
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<td>7</td>
<td>Lawrence Technological University</td>
<td>Bigfoot</td>
<td>161</td>
<td>0</td>
<td>1:19</td>
</tr>
</tbody>
</table>
Although the ability of the vehicles to negotiate the competition courses is the ultimate measure of product quality, the officials are also interested in the design strategy and process that engineering teams follow to produce their vehicles. Design judging will be by a panel of expert judges and will be conducted separate from and without regard to vehicle performance on the test course. Judging will be based on a written report, an oral presentation and examination of the vehicle.

Design innovation is a primary objective of this competition. Two forms of innovation will be judged: First will be a technology (hardware or software) that is new to this competition; and Second will be a substantial subsystem or software upgrade to a vehicle previously entered in the competition. In both cases the innovation needs to be documented, as an innovation, clearly in the written report and emphasized in the oral presentation. Either, or both, forms of innovation will be included in the judges’ consideration.

AWARD MONEY: $ 3,000
2015 Design Competition Results

<table>
<thead>
<tr>
<th>Place</th>
<th>School</th>
<th>Team</th>
<th>Score</th>
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<tr>
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<td>University of British Columbia</td>
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<tr>
<td>6</td>
<td>Hosei University</td>
<td>Orange2015</td>
<td>388.44</td>
</tr>
</tbody>
</table>

Design results for Group A, Group B and Group C can be found in the paper or on the website.
The Interoperability Profile (IOP) Challenge verifies that teams are using a standardized message suitable for controlling all types of unmanned systems, and is the SAE-AS4 unmanned systems standard, commonly known as JAUS. Teams that completed the challenge will send a request for identification to the Common Operating Picture (COP) once every 5 seconds. The COP will respond with the appropriate informative message and request identification in return from the team’s JAUS interface. After the identification report from the COP, the team entry will stop repeating the request. This transaction will serve as the discovery between the OCU via an RF data link and the vehicle. The vehicle that travels the farthest on the course, or completes the course in the shortest time wins.

**AWARD MONEY:**

$ 3,000
<table>
<thead>
<tr>
<th>Place</th>
<th>School</th>
<th>Team</th>
<th>Points</th>
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<tbody>
<tr>
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<td>El Toro</td>
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<tr>
<td>3</td>
<td>Trinity College</td>
<td>Q</td>
<td>16</td>
</tr>
<tr>
<td>4</td>
<td>University of New South Wales</td>
<td>Pepper</td>
<td>12</td>
</tr>
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<td>5</td>
<td>University of British Columbia</td>
<td>Snowflake</td>
<td>4</td>
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<tr>
<td>6</td>
<td>Hosei University</td>
<td>Orange2015</td>
<td>4</td>
</tr>
</tbody>
</table>
The Rookie-of-the-Year Award will be given out to a team from a new school competing for the first time ever or a school that has not participated in the last five competitions. To win the Rookie-of-the-Year Award the team must be the best of the eligible teams competing and perform to the minimum standards of the following events. In the Design Competition you must pass Qualification, in the AUTO-NAV Challenge you must pass the Rookie Barrel.

AWARD MONEY:

$1,000
The Grand Award is given to the team with the best overall performance in all three events. The Grand Award trophies will be presented to the top three teams that perform the best overall (combined scores per below), in all three competitions. For each competition, points will be awarded to each team, below is a breakdown of the points:

**AWARDS:**
- Lescoe Cup
- Lescoe Trophy
- Lescoe Award
### 2015 Grand Award Results

<table>
<thead>
<tr>
<th>Place</th>
<th>School</th>
<th>Team</th>
<th>Total</th>
</tr>
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<td>3</td>
<td>Oakland University</td>
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<td>6</td>
<td>Lawrence Technological University</td>
<td>Bigfoot</td>
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<tr>
<td>7</td>
<td>University of Michigan-Dearborn</td>
<td>OHM 3.0</td>
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<td>7</td>
<td>Trinity College</td>
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<td>RoboGoat</td>
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<td>University of British Columbia</td>
<td>Snowflake</td>
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<td>Bluefield State College</td>
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<tr>
<td>11</td>
<td>Hosei University</td>
<td>Orange2015</td>
<td>8</td>
</tr>
</tbody>
</table>
Questions?

WWW.IGVC.ORG
ACM Overview
Andrew Smart CTO

Michigan Connected and Automated Vehicle Working Group

June 3, 2016
Connected & Automated Vehicles

- Connected and Automated Vehicle (CAV) technology will revolutionize transportation
  - can increase safety and mobility, and decrease energy use
- Significant technical and policy challenges remain to be solved
  - including standards, methods for safe testing, validation, and verification
- A combination of simulation, track testing, and on-road testing will be required
CAV Research & Product Development Needs

- Accelerated development of voluntary standards
- Accelerated product development & validation of CAV technology
- Verification and self-certification of CAV technology
- Development, testing, & validation of V2I and I2I applications & standards
- Research, testing & product development for:
  - Crash avoidance & automation technology at high speeds and in urban environments
  - Automated operation on off-road, degraded, and unimproved surfaces
  - V2X communication, including infrastructure and hand-held devices
  - DSRC device communication protocol and interfaces
  - Cybersecurity measures and validation testing
  - Automated freight, trucking and transit of materials
  - Ground truth testing of automated vehicle safety technologies
  - In-use monitoring of vehicles/devices in the field
  - Internationally harmonized standards
ACM - American Center for Mobility

A non-profit connected and automated vehicle testing and product development facility, designed to accelerate the development of voluntary standards and technology deployment.
Other ‘auto’ countries are building facilities

- Sweden – AstaZero
- Spain – IDIADA
- US – ACM
- Japan – JARI
- South Korea – “K-City”
- China – 2-5 locations
Why Michigan?

- Greatest concentration of the auto industry in the world
- Adjacent to university mobility initiatives
- Integrated with a forward-looking state DOT and government
- Unique site with both iconic and tangible qualities
  - Surrounded by connected infrastructure
  - Home of the Arsenal of Democracy
  - Co-located with commercial airport to facilitate travel
- More mobility-related assets than any other region
Why Michigan?
Thank You

Charter Township of Ypsilanti
From Park Assist to Automated Driving

Amine Taleb
Manager – Advanced Projects
Comfort & Driving Assistance Systems
Valeo North America, Inc.
Park Assist Evolution – Birth of Park4U®

1991
Ultrasonic
PARK ASSIST

2007
Park4U®
SEMI-AUTOMATIC PARKING

SYSTEM EVOLUTION
Park Assist Evolution – Enhanced Park4U®

Park4U® 2.0
PERPENDICULAR PARKING
ACTIVE BRAKING

2010

2011 FlankGuard
360° PARK ASSIST
Park Assist Evolution – Automated Parking

Auto Park4U®
FULLY-AUTOMATIC PARKING

2013

2014

Park4U® 3.0
FORWARD PARKING
Garage Park4U®

TRAINED PARKING

Park Assist Evolution – Next Gen Park4U®

2016 Park4U® Remote

SENSOR FUSION
DRIVER OUTSIDE

Valet Park4U®

SPECIFIC PARKING AREAS
Merging Parking and Driving Automation

- Ultrasonic Sensors
- Surroundview cameras
- LiDAR
The Road Towards Automated Driving

- Lane Change Assist
- Adaptive Cruise Control
- Highway Assist
- Highway Chauffeur
- Highway Pilot
- Lane Keeping
- Traffic Jam Assist
- Traffic Jam Chauffeur
- Traffic Jam Pilot
- 360Vue® 3D
- Object Detection
- Park4U®
- Park4U® Remote
- Garage Park4U®
- Valet Park4U®

Automated Parking & Active Safety Converging Towards Automated Driving
The Road Towards Automated Driving

Drive4U

Jun 2016
Valeo
Automotive technology, naturally
2016 SAE BATTELLE CYBERAUTO CHALLENGE

July 25-29, 2016  Warren, Michigan

http://www.sae.org/events/cyberauto/
What is the CyberAuto Challenge

- Practicum-based learning environment
- Immersive
- STEM education program
- Real cars, real tools, real engineers, real hackers
- Intended exemplar for educational programs
- Technical “inn at the crossroads” for the automotive industry
- Unabashedly pro industry (safe zone)
Purpose

Mentor — Protégé

Develop Workforce

Forge Community
Cohorts

Students

Professionals
Cohorts

- High School
- College
- Professionals
Preliminary Challenge week schedule

**Immersive in Nature**
- Maximize group interactions
- Focus on collaborative teaching & engagement
- Provide basic instruction with continuous facilitation

- Sunday arrival
- Mon thru Wed series of lessons alternating with hands-on work
- Tuesday off-site tour / networking event
- Thurs 24 hr. Challenge “hackathon”
- Friday graduation
Keynotes and themes

2012 – APG – Len LaPadula - Resiliency

2013 – OSU CAR – Jim Christy – CyberCrime

2014 – Delphi - Bruce Schneier - Privacy

2015 – Delphi – David Strickland – Landscape Changes

2016 – Mccomb CC – Mudge – IoT Cybersecurity
Value Proposition

• Awareness of relevant automotive cybersecurity issues
  – Increased vehicle electrical/electronic system complexity
  – Increased number of interfaces – wireless and wired

• Cooperative relationship building
  – Collaboration among students, industry, gov’t, academia fostering mentor – protégé relationships

• Workforce development
  – Exposing high school and college students to high tech careers in auto industry
  – Improving current auto engineer cybersecurity skills and knowledge
  – Intern / employee recruitment opportunity
Benefits for students

• Develop foundational understanding of security approaches
• Learn about unique automotive cyber issues
• Increase technical skills; particularly in CAN protocols and programming
• Put theory to practical use
• Develop initial project management skills; experiencing time constraints and limited resources
• Team with working engineers and researchers in a professional environment
• Develop relationships with professionals and other students….now they are a part of a “community of interest” – the auto cyber community!
• Participate in a unique event aimed at developing a new discipline for the automotive industry
Benefits for professional team members

• Develop and deepen peer to peer relationships with automotive engineers (OEM and supplier), researchers and government representatives
• Raise awareness among students of the highly technical nature of automotive jobs; igniting interest in automotive careers
• Actively develop the future talent pipeline in cybersecurity, ensuring a well-trained and educated workforce for the automotive industry
• Develop mentor-protégé relationships with students
• Directly assess student capabilities for potential job recruitment
• Developed a germ of cyber auto “community of interest” for the future
History

- Motivated by the progress in embedded technologies in automobiles & increased connections – cellular, WIFI, Bluetooth, OnStar, DSRC, Satellite radio, etc.
- Need for a tailored curriculum to support cybersecurity auto issues; portions of electrical engineering, mechanical engineering and computer science plus other professions
- 2012 created by Battelle and the Founder of Center for Advanced Vehicle Environments (CAVE) Karl Heimer, now co-founder of AutoImmune
- 2015 SAE International leadership and administration

Aug 2012 Aberdeen Proving Grounds (Maryland)
July 2013 Ohio State University Center for Automotive Research (Columbus, Ohio)
July 2014 Delphi Headquarters, Troy MI (Detroit Metropolitan area)
July 2015 Delphi Headquarters, Troy, MI (Detroit Metropolitan area)
- 192 attendees -- 30+ students, 30+ professionals from OEMs, auto suppliers, government agencies (DoD, DoT), 5 “white hat” hackers, 5 STEM educators, plus visits by several automotive management leaders, e.g. Security Directors

July 25-29, 2016: Macomb Community College, Warren MI
Contact Information

Patti Kreh – patti.kreh@sae.org  
Program Executive / sponsorships, student outreach, corporate outreach

Marc LaDuc – marc.laduc@sae.org  
Program owner / Logistics

Karl Heimer – karl.heimer@autoimmune.io  
Content, curriculum, theme professional outreach
2016 SAE BATTelle CYBERAuto CHALLENGE

July 25-29, 2016  Warren, Michigan

http://www.sae.org/events/cyberauto/
Senses for Safety.
Driver assistance systems help save lives.

Continental – Oakland University Joint Project

Project Review
June 3, 2016
Agenda

› Project Background
› Current Project Objective
› Future Project Objective
› Team Overview
› Vehicle Build
› Budget & Contributions
Project Background

- Oakland University Hosts the one and only IGVC competition WW
- Some 40+ Universities all over the world compete
- Typically the platforms utilized are not street legal and they are slow

"Spec1" est. 1992

Why?
- Relevance to auto transportation
- Expect broader sponsorship interest
- Large space to create challenges

Vehicle
- FMVSS-500 / EU Quadricycle (street legal)
- Roadway Track Setting, up to 25 mph

When & Where?
- Rochester Hills, Michigan
- During IGVC "Spec1"
- "Third Ring" along with Spec1 "Basic" & "Advanced"
Project Background

*Modeled after IGVC but w/ roadway scenarios & conditions*

**Vehicle Platform:**
- Standard FMVSS 500 Vehicle (Gem e2)
- Drive by-wire
- Sensors (Radar, Camera, GPS, IMU...)
- Connectivity via wi-fi and cellular

**Teams to Develop:**
- Integration by-wire controls
- Integrated motion control
- Integrated Automotive Sensors
- Sensor fusion
- Vision / Detection SW
- Driving control SW (lane keeping, gap keeping...)
- Decision and navigation AI
Projected Scope and Definition for June/2016

Projected Scope

- Environmental Model
- Sensor (Information) Fusion

Implemented Features:
- Create Key Information Database (obtained from fusion)
- Lane Keep & Det.
- Full ACC
- Object Det. & Avoi.
- GPS Mapping
- Road Sign Recog.
- BSD
- Surround View (SRR)
Project Scope and Definition for June/2017

Projected Scope

- Environmental Model
  - Radar (LRR)
  - Radar (SRR)
  - Camera (F/R)
  - Camera (SV)
  - LiDAR
  - Veh. Info
  - GPS
  - Steering & Brake Sys.

Sensor (Information) Fusion

- Implemented Features:
  - Create Key Information Database (obtained from fusion)
  - Lane Keep & Det.
  - Full ACC
  - Object Det. & Avoi.
  - GPS Mapping
  - Road Sign Recog.
  - BSD
  - RCTS

Handling Strategy:
- Safe Environment
- Efficient
- Comfort
- Road Env. Prediction

Execution:
- Self Driving / Autonomous

Vehicle Information:
- Vehicle Speed
- Vehicle Battery Life

On Board GPS:
- Mapping
- Driving Direction

Road ENV:
- Road Surface
- Traffic
- ENV Recognition (AI)

a. Machine Learning
b. Validation Strategy

Sense Plan Act
Team Overview

- Project team is made of Continental Employees from various BU’s that are involved in different levels of education within OU.

- PhD Thesis & Project Lead:
  - Irfan Baftiu (ADAS)

- Project Team Members (Currently):
  - Gentian Godo (AE- ADAS) – Graduate Level
  - Peter LeVasseur (AE- ADAS) – Graduate Level
  - Noah Gedrimas (SNT) – Graduate Level
  - Peter Southerland (T&V – ADAS) – Graduate Level
  - Kyle Carpenter (SNT) – Graduate Level
  - Ganesh Adireddy (SNT) – Graduate Level
  - Nilsi Godo (T&V – ADAS) – Undergrad Level
  - Viljo Wagner (T&V – ADAS) – Undergrad Level
  - Fady Hanna (T&V – ADAS) – Undergrad Level
  - Nashwan Marcos (T&V – ADAS) – Undergrad Level
Sensor Mounting Design – Requirements

› Manufacturability
  › Brackets need to be easy to make and mass producible

› Accuracy for modularity
  › Brackets need to be located accurately using existing holes in frame

› Stiffness
  › Brackets need to be adequately stiff Target of 55Hz natural frequency

› Cost
  › Brackets need to be cheap to manufacture
Sensor Mounting – Design

› All brackets are made from 6061 T6 Aluminum out of ¼” plate and 1” 0.125” wall box tubing

› Brackets were cut using a water jet and welded with a TIG

› Parts were sand blasted and spray painted by a third party

› Brackets bolt to the frame and to the adjustable azimuth angle brackets provided by Continental
Sensor Mounting Design – Long Range Radar (LRR)

› Front LRR bracket was designed to mount to existing chassis bolts, thus eliminating the need to modify the vehicle.

› Rear LRR bracket were similarly designed to mount to existing chassis bolts, thus eliminating the need to modify the vehicle.

› Overall intent was to design brackets which would not drive any body or chassis modification.
Sensor Mounting Design – Short Range Radar (SRR)

› Front SRR bracket was designed to mount to existing chassis bolts, thus eliminating the need to modify the vehicle.

› Rear SRR bracket were similarly designed to mount to existing chassis bolts, thus eliminating the need to modify the vehicle.

› Overall intent was to design brackets which would not drive any body or chassis modification.