

The 23RD Annual Intelligent Ground Vehicle Competition: Building Engineering Students into Robotists



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Competition Purpose



Objective:

The objective of the competition is to challenge students to think creatively as a team about the evolving technologies of vehicle electronic controls, sensors, computer science, robotics, and system integration throughout the design, fabrication, and field testing of autonomous intelligent mobile robots.

Educational Benefits:

This competition has been highly praised by participating faculty advisors as an excellent multi-disciplinary design experience for student teams, and a number of engineering schools give credit in senior design courses for student participation.

Real-world Applications:

To advance and promote intelligent mobility for civilian and military ground vehicle applications. Intelligent mobility will provide the driver aids required for future Automated Highway Systems (AHS) and Intelligent Transportation Systems (ITS). For military systems, autonomous mobility will enable unmanned combat vehicles to perform high risk operations and multiply the force effectiveness of manned systems. IGVC objectives for military applications focus on goals established in the Department of Defense. IGVC promotes core intelligent mobility competencies in perception, planning, actuation and mechatronics.

Competition History



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



23 Years and Running



500+ Teams

80+ Universities

7 Countries



2015 Participating Schools



Bluefield State College	2016 Schools	Universite' de Moncton
California State University-Northridge	Michigan Technological University	University of British Columbia
École de technologie supérieure	Oakland University	University of Central Florida
Embry-Riddle Aeronautical University	Oakland University 2	University of Cincinnati
Georgia Institute of Technology	Southern Illinois University - Edwardsville	University of Detroit Mercy
Hosei University	The Citadel	University of Illinois - Chicago
Indian Institute of Technology-Kharagpur	Trinity College	University of Michigan-Dearborn
Lawrence Technological University	United States Military Academy	University of New South Wales
Lawrence Technological University 2	United States Naval Academy	University of West Florida



Qualification



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.



Auto-Nav Challenge



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**



2015 Auto-Nav Challenge Results

Basic Course



Place	School	Team	Distance	Waypoints	Time
1	University of New South Wales	Pepper	510	6	1:27
2	California State University-Northridge	El Toro	510	6	1:58
3	Oakland University	Mantis	510	6	2:34
4	University of Michigan-Dearborn	OHM 3.0	510	2	3:26
5	United States Naval Academy	Robogoat	510	0	3:33
6	Ecole de Technologie Superieure	CAPRA6	510	0	4:28
7	Lawrence Technological University	Bigfoot	510	0	5:00
8	Embry-Riddle Aeronautical University	Zero2	430		5:00
9	Trinity College	Q	290		5:00
10	Hosei University	Orange2015	284		4:11
11	Université de Moncton	Break Point	157		2:45
12	University of Detroit Mercy	Thor Pro	85		1:36
13	Bluefield State College	Apollo	60		0:19

2015 Auto-Nav Challenge Results

Advanced Course



Place	School	Team	Distance	Waypoints	Time
1	University of New South Wales	Pepper	1032	6	3:52
2	California State University-Northridge	El Toro	1032	6	10:00
3	University of Michigan-Dearborn	OHM 3.0	756	6	6:46
4	United States Naval Academy	Robogoat	633	2	8:55
5	Ecole de Technologie Superieure	CAPRA6	172	0	5:59
6	Oakland University	Mantis	166	0	1:47
7	Lawrence Technological University	Bigfoot	161	0	1:19

Design Competition



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



Design Finalist			
Place	School	Team	Score
1	Embry-Riddle Aeronautical University	Zero2	432.22
2	Oakland University	Mantis	408.11
3	École de technologie supérieure	CAPRA6	402.78
4	University of British Columbia	Snowflake	394.78
5	Bluefield State College	Apollo	393.44
6	Hosei University	Orange2015	388.44

Design results for Group A, Group B and Group C can be found in the paper or on the website.

IOP Challenge



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



2015 IOP Challenge Results



Place	School	Team	Points
1	California State University - Northridge	El Toro	24
2	Lawrence Technological University	Bigfoot	20
3	Trinity College	Q	16
4	University of New South Wales	Pepper	12
5	University of British Columbia	Snowflake	4
6	Hosei University	Orange2015	4

Rookie-of-the-Year



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**



Grand Award



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



Place	School	Team	Total
1	California State University - Northridge	El Toro	64
2	University of New South Wales	Pepper	60
3	École de technologie supérieure	CAPRA6	24
3	Embry-Riddle Aeronautical University	Zero2	24
3	Oakland University	Mantis	24
6	Lawrence Technological University	Bigfoot	20
7	University of Michigan-Dearborn	OHM 3.0	16
7	Trinity College	Q	16
9	United States Naval Academy	RoboGoat	12
10	University of British Columbia	Snowflake	10
11	Bluefield State College	Apollo	8
11	Hosei University	Orange2015	8

2015 Sponsors



Questions?



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