

Autonomous Snowplow Competition



**ION North Star Section
Outreach Program**

Autonomous Snowplow Committee



**Competition Kickoff Meeting Presentation
2016 Competition**

12 October 2015

Meeting Agenda

- Welcome to the Sixth Annual Competition!
- Introductions
 - Autonomous Snowplow Competition Committee Members
 - 2016 Sponsors
 - 2016 Teams
- Venues
 - Saint Paul Winter Carnival
 - Student Final Presentations
 - Science Museum of Minnesota
- Rules and Operations
 - Snowfield Surface
- Preliminary Design Review Discussion
- Team Questions



Contact List

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Sponsorship

- Current Sponsors

- ION Satellite Division
- Lockheed Martin, Inc.
- ASTER Labs, Inc.
- Honeywell Inc.
- Orbital ATK Inc.
- The Toro Company
- Deere and Company
- UTC Aerospace Systems
- Space Exploration Technologies Corp.
- U.S. Bancorp
- Nuts & Volts, Servo Magazine
- Proto Labs, Inc.
- Achievement Rewards For College Scientist Foundation



UTC Aerospace Systems



JOHN DEERE



www.toro.com

- Always looking for additional sponsors & funding!!



Real Parts. Really Fast.™



2015-2016 Competitors



<u>School Name</u>	<u>Team Name</u>
Bemidji State University	"Beaver Bot"
Case Western Reserve University	"Herr Auto von Snowmower 2.0"
Case Western Reserve University	"Snow Joke"
Dunwoody College of Technology	"Snow Devils 0110 ₂ "
North Dakota State University	"Snow Blight"
North Dakota State University	"THUNDAR 2.0"

2015-2016 Competitors



<u>School Name</u>	<u>Team Name</u>
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University of
British Columbia

“Snowflake”

University of Michigan
- Dearborn

“Zenith 2.1”

University of Michigan
- Dearborn

“Yeti 6.0”

University of
Minnesota

“GOFIRST –
Ground Squirrel”

University of
Saint Thomas

“John Snow”

Competition Venue

- The Saint Paul Winter Carnival
 - Rice Park, Downtown Saint Paul
 - Gain lots of media attention
 - 350,000 visitors per year
 - 28-31 January 2016
 - 2016 is the 130th year anniversary of Carnival
 - Rosanne Bump
 - CEO & President, Saint Paul Festival and Heritage Foundation
 - Expect all Competition operations to remain the same and go smoothly
 - This is a great venue to have our Competition – very lively during the events
 - Enthusiastic, inquisitive crowds



Student Presentation Venue

- The Student Final Presentations will be held at:
 - Science Museum of Minnesota
 - 120 W. Kellogg Blvd.
Saint Paul, MN 55102



**Science
Museum**
of Minnesota®



- Students are encouraged to visit the Science Museum as an attraction
 - Museum is very close (few blocks) to the Competition site

Competition Time Line

- Sep 2015 – Application Forms Due
(ION National office requests outstanding items to be provided soon)
- Oct 2015 – Kickoff Meeting
(Please ask questions!)
- Nov 2015 – Competition Preliminary Design Review
(Saturday, 7 November 2015 planned date)
- Jan 2016 – Review status with teams
(trip planning, etc.)
- Jan 2016 – Sixth Year of Competition
Final Presentations, Vehicle Qualifications, &
Snowplow Competitions



Competition Rules

- Rulebook being updated, and will be available to teams very soon!

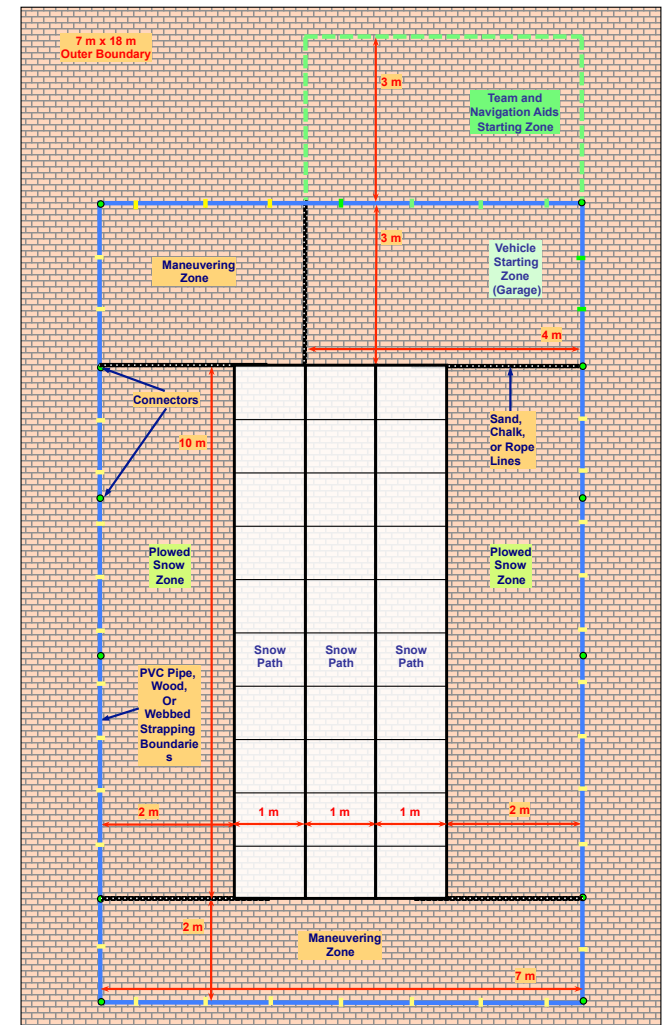
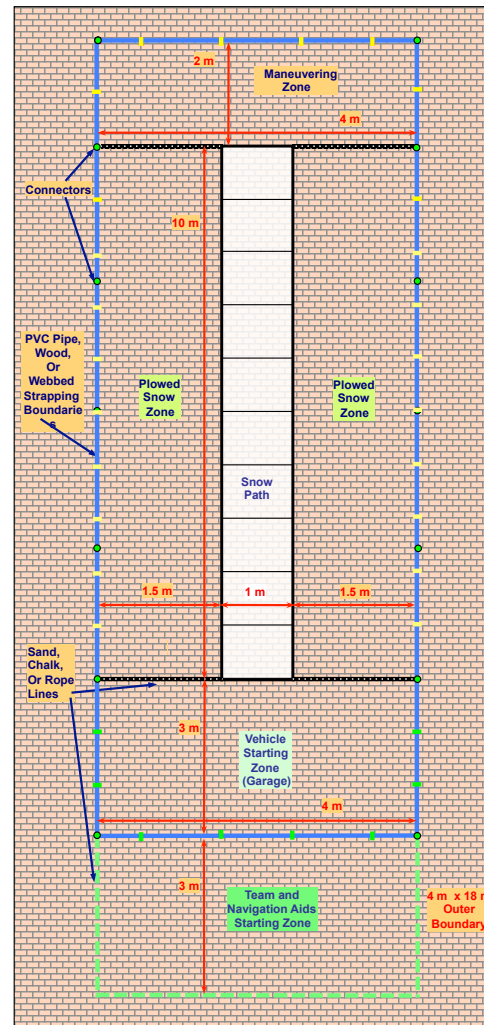
- www.autosnowplow.com

- Challenging competition

- Vehicle Garage
 - Team Starting Zone
 - Post within Field

- Two competition snowfields

- Single Straight "I"
 - 1-m width path
 - Triple Straight "I"
 - Three 1-m width paths



Competition Site

Downtown Saint Paul, MN

Landmark Center

Ice Rink

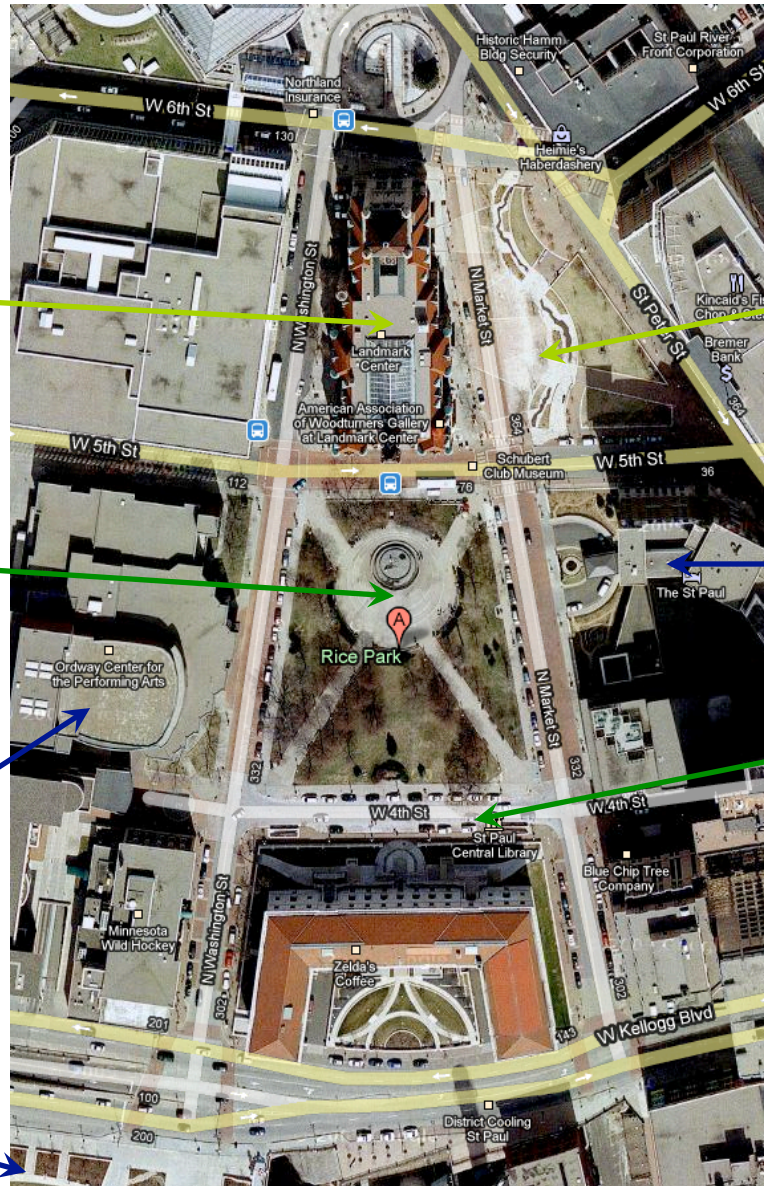
Rice Park

The Saint Paul Hotel

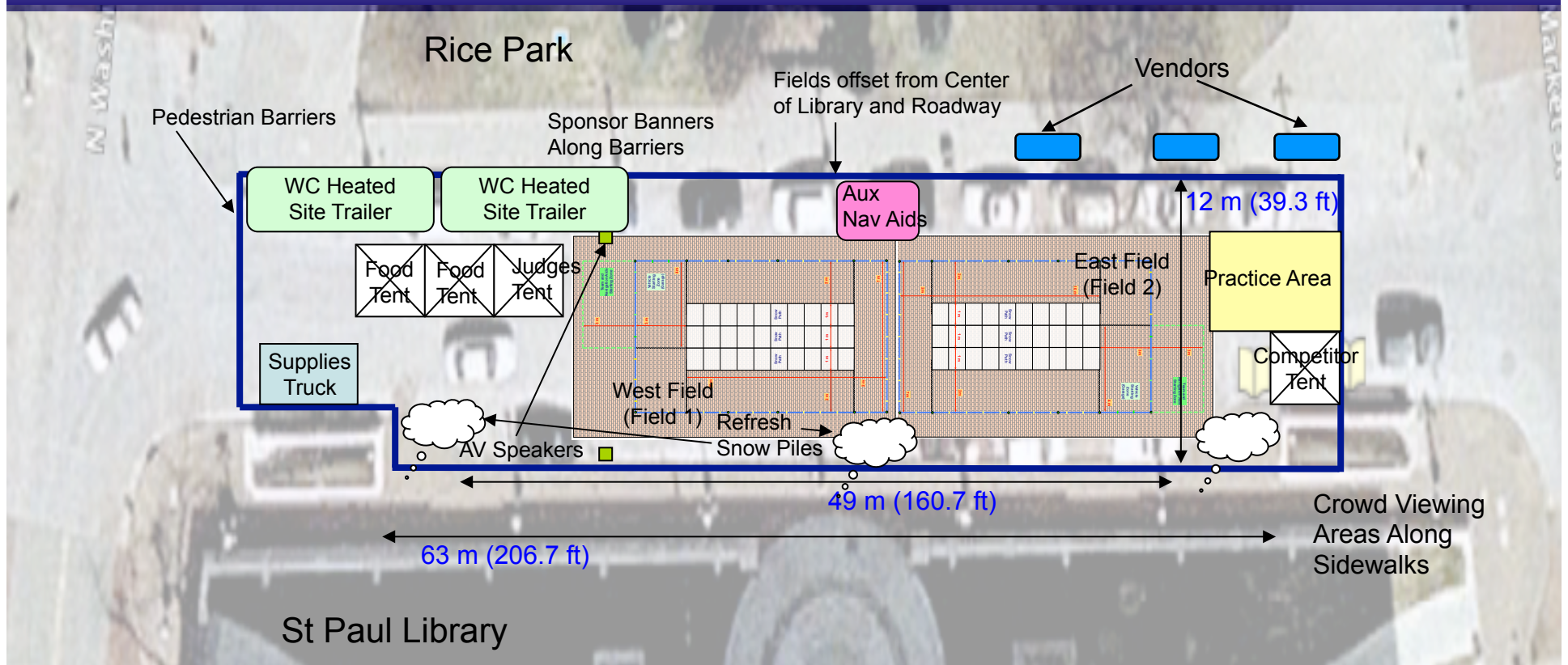
Ordway Center

W 4th Street

Science Museum



Competition Site: Layout



- Competition site: two snowfields set up directly on road, W 4th St, Saint Paul, MN
- Barriers installed to stop crowds from entering competition areas
- Vendors close to draw in viewers
- Viewers can stand and watch all along barriers and steps of Central Library
- Practice area: available for all teams
- Snow filled trucks: for fresh snowfield set up

Fake Snow

- Issue of how to test the vehicles in labs
 - How to test year round and in warm climates?
- Solution: Fake Movie Snow!!
 - Fairly inexpensive and does not melt!
 - Need to compare consistency to real snow
- Real snow used for Competition
- **PLEASE PLEASE PLEASE!!**
 - **TEST AS MUCH AS YOU CAN BEFORE THE EVENT**
 - **Wet, cold outside environment is not the same as your dry, warm lab!**



<http://www.stevespanglerscience.com/product/1262>



<http://www.discoverthis.com/super-snow.html>



<http://www.amazon.com/Be-Amazing-Toys-4100-Blizzard/>

Competition Procedures

- Competition Run and Set up Time
 - Single 20-minute run for each team
 - Teams may set up navigation systems as needed, but set up time is included as part of the 20-minute run
- Variable Snow Depth
 - Snow depth can vary between 5 and 15 cm along the snow path for either snowfield
 - You may experience areas with deeper snow this year
- No After-Hours Operations within Competition Area
 - Due to insurance and safety, as well as snowfield protection



Competition Procedures

- Competition Zones
 - Vehicle Starting Zone (Garage)
 - Starting position for vehicle
 - Vehicle must return to Garage on own power at end of run
 - Lose points if no portion of vehicle enters Garage
 - Team and Navigation Aids Starting Zone
 - All team members must start within this Zone at beginning of run before placing any navigation aids
 - Maximum of 6 team members allowed for setting up navigation aids
 - Maneuvering Zone
 - Areas for maneuvering vehicle and snow
 - Plowed Snow Zone
 - Areas where all snow must be placed
- Fast Completion
 - Extra points for clearing snow from the snow paths in under 20 minutes
- No items can be dropped/expelled from vehicle in any direction
 - No sand, water, fire, etc.
 - Keeps snowfield playing field surface the same for all teams

Planned Changes for 2016

- No Longer Requiring Final Reports
 - Committee has elected to remove this effort from the competition
 - Teams are no longer required to submit a Final Report, and points have been adjusted for the Preliminary Design Review and Final Presentation
 - However, winning team is awarded a presentation slot at next year's ION GNSS
 - *A report and presentation are strongly encouraged for that event*
- **PDR and Final Presentations**
 - Judges would like to see new content each year
 - Please don't recycle last year's presentation,
or Judges will deduct points up to 10% per their discretion
 - Teams will be asked to describe year-over-year changes and their biggest design challenges

Planned Changes for 2016

- **Simulated Posts**

- Two POINTS Posts this year
- Simulates a tree or parking meter near or on the snow path
 - A competition fixed “obstacle”
- One post randomly placed outside of field snow path but within the snowfield boundaries
- One post randomly placed in a 1-m² square of snow path
- Points lost (10%) if vehicle hits, moves, or topples over either post
 - However, snow can “hit” post without losing points
 - Snow “void” surrounding post, so vehicle does not need to plow right against post

- **Parking In Garage**

- No longer can take advantage of “restart” declaration to park in garage at end of run
- Vehicle must return to Garage (Vehicle Starting Zone) using its own power

Competition Scoring

Category	Scoring (%)
PDR Presentation	10
Final Presentation	15
Single "I"-Shaped Snow Path	25
<u>Triple "I"-Shaped Snow Path</u>	<u>50</u>
Total Competition Points	100



PDR Presentation

- PDR presentation day: 7 November 2015 (Saturday)
 - Presentation medium: conference call & screen sharing
- PDR presentation slides held in confidence until the end of competition
 - Recommend these to be as complete and professional as possible, as all team materials may be eventually made public
- PDR presentation slides submission deadline: Final Version
 - 9:00 PM (Central); 5 November 2015 (Thursday)
 - Email submission to Vibhor and Suneel:
vibhor.bageshwar@honeywell.com & sheikh@asterlabs.com
 - Please submit a PDF version of the presentation to minimize file size
 - CD submission (not necessary if you email the presentation slides)

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ION North Star Section Outreach Program

Team Questions

- Any Questions?
- General Discussion



Backup Slides



Introduction

- Goal: Design an Engineering-based Outreach student competition
 - Specific to Guidance, Navigation, and Control (GNC) technology
- Modeled after ION Robotic Lawn Mower Competition
 - Complementary competitions
 - Similar vehicles, sensors, and goals
 - Different seasons
- Take a *winter-approach* to the competition
 - Choose snow-blowing/snow-plowing, instead of lawn-mowing,
 - Winter is a potentially a tougher scenario
 - Less fixed visual cues
 - Covered with snow (pure white)
 - Blowing snow (visibility poor)
 - Changing visual cues
 - Snow drifts change from day to day
 - Harsher environment
 - Cold effects sensors performance
 - Reduced lighting
 - Control challenges
 - Must redirect new snow away from old high snow drifts



Motivation

- Public Outreach
 - Significant publicity and visibility of ION and its members to a new area
 - Promote ION's talents and capabilities to large public audience
- Technology Potential
 - Minnesota Department Of Transportation: Snowplow safety systems
 - Minneapolis Airport Commission and FAA: Automated runway clearing
 - University of Minnesota: Driver-assisted bus and Alaskan highway snowplows
- Encourage growth within ION North Star Section
 - Competition provides a large, local project to which members can immediately contribute towards
- Large public venue
 - St. Paul Winter Carnival (January in MN ... refreshing!)
- Encourage participation in all three ION competitions
 - Mini-Urban Challenge : High School-Level students
 - Robotic Lawn Mower : Spring Event, College-Level students
 - Autonomous Snowplow : Winter Event, College-Level students + public
- Encourage industry sponsorship
 - Mentorship and Judging competition opportunities
 - Meet competent, highly-motivated potential employees

Plowing versus Blowing

- **Snow Plow**

- Move snow from one area to another along the ground



Hand Plow



Wheeled Plows



Yuki-Taro Autonomous Snow Plow Robot



RC Plow

- **Snow Blow**

- Eject snow from one area to another through air



Hand-Wheeled Blowers



Heavy Wheeled Blowers