

Autonomous Snowplow Competition



ION North Star Section
Outreach Program

Autonomous Snowplow Committee



Competition Kickoff Meeting Presentation
2018 Competition

11 October 2017

Meeting Agenda

- Welcome to the Eighth Annual Competition!
- Introductions
 - Autonomous Snowplow Competition Committee Members
 - 2018 Sponsors
 - 2018 Teams
- Venues
 - Saint Paul Winter Carnival
 - Student Final Presentations
 - Science Museum of Minnesota
 - Hosted by AIAA
- Rules and Operations
 - Snowfield
 - Moving Obstacle
 - Cooperative Navigation Demo
 - Preliminary Design Review Discussion
- Team Questions



Contact List

Committee Contacts

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Sponsorship



Sponsorship

- Sponsors
 - ION Satellite Division
 - Lockheed Martin, Inc.
 - ASTER Labs, Inc.
 - Honeywell Inc.
 - Orbital ATK Inc.
 - UTC Aerospace Systems
 - Space Exploration Technologies Corp.
 - The Toro Company
 - Deere and Company
 - SICK, Inc.
 - U.S. Bancorp
 - Oshkosh Corporation
 - Left Hand Robotics
 - ANSYS
 - Polaris Industries, Inc.
 - Nuts & Volts and Servo Magazines
 - Achievement Rewards For College Scientist Foundation
 - Proto Labs, Inc.
 - Hitching Post Motorsports
- This group has been very generous to the Competition and excellent people to work with
- Please notify them when you meet any of their representatives that we all greatly appreciate their contributions
- New this year are:
 - ANSYS
 - Free Software To All!!
 - Left Hand Robotics
 - Commercial Snow Robot!!
- Always looking for additional sponsors and funding!!
 - Please let us know if you have any groups we should contact



2018 Competitors



<u>Institution Name</u>	<u>Team Name</u>
Case Western Reserve University	"OTTO XL"
Case Western Reserve University	"Snö Jök"
Dunwoody College of Technology	"Snow Devils 1000 ₂ "
Dunwoody College of Technology	"Wendigo 2018"

2018 Competitors



Institution Name

Team Name

Iowa State University
Robotics Club

“Cyplo”

Marquette University

“Arnold”

New Jersey Institute of
Technology

“Snobot”

North Dakota State
University

“THUNDAR 3.0.1”

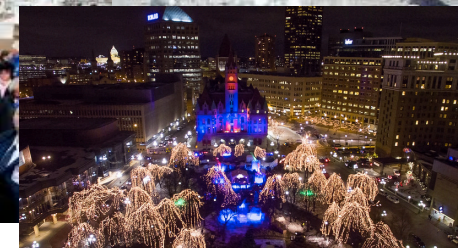
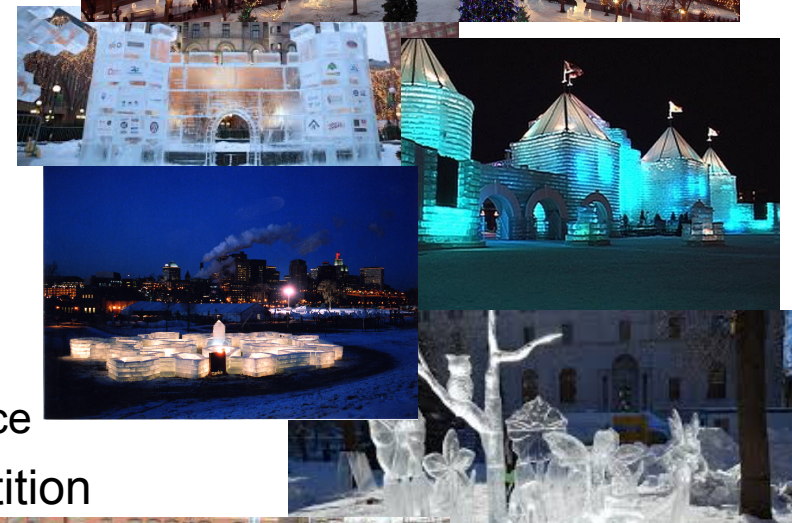
2018 Competitors



<u>Institution Name</u>	<u>Team Name</u>
Samuel O'Blenes	"Plowerwheels"
University of Michigan - Dearborn	"Yeti 8.0"
University of Minnesota	"Snow Squirrel"

Competition Venue

- The Saint Paul Winter Carnival
 - Rice Park, Downtown Saint Paul
 - Gain lots of media attention
 - 350,000 visitors per year
 - 25-28 January 2018
 - 2018 is the 132nd year anniversary of Carnival
 - Deb Schaber
 - CEO & President, Saint Paul Festival and Heritage Foundation
 - Expect all Competition operations to remain the same and go smoothly
 - Rosanne Bump
 - Past CEO, and now in charge of Ice Palace
 - This is a great venue to have our Competition
 - very lively during the events
 - Enthusiastic, inquisitive crowds



Final Presentation Venue

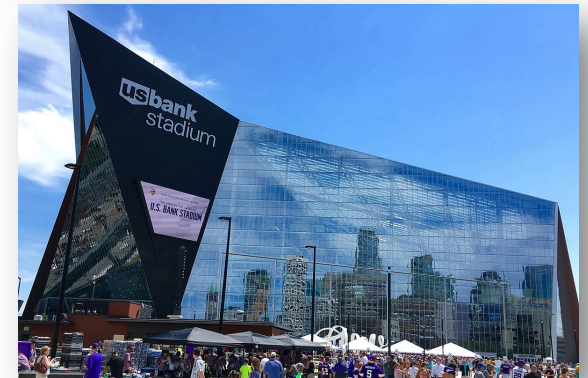
- The Student Final Presentations will be held at:
 - Science Museum of Minnesota
 - 120 W. Kellogg Blvd.
Saint Paul, MN 55102



- Students are encouraged to visit the Science Museum as an attraction
 - Free wristbands for entrance prior to Student Presentations will be provided
 - Museum is very close (few blocks) to the Competition site

Housing Issue

- The 52st NFL Super Bowl
 - US Bank Stadium, Minneapolis, MN
 - 4 February 2018
 - One week after Competition
- Media Weekend
 - Same weekend as Competition !!
- Hotel rooms are extremely limited already
- PLEASE RESERVE YOUR ROOMS NOW
 - Cant stress this enough ...



Competition Time Line

- Sep 2017 – Application Forms Due
(ION National office requests outstanding items to be provided soon)
- Oct 2017 – Kickoff Meeting
(Please ask questions!)
- Nov 2017 – Preliminary Design Review
(Saturday, 4 November 2017 planned date)
- Dec 2017 & Jan 2018 – Review status with teams
(Vehicle status, Trip planning, etc.)
- Jan 2018 – Eighth Year of Competition
Final Presentations, Vehicle Qualifications, &
Snowplow Competitions



Competition Rules

- Rulebook will be available to teams, and may be updated throughout competition

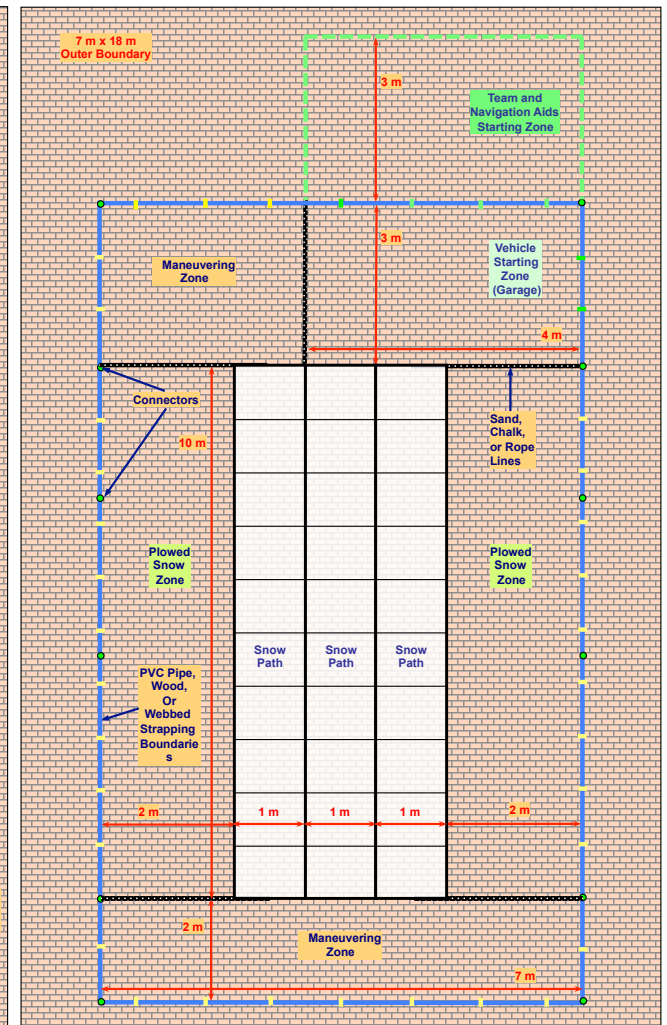
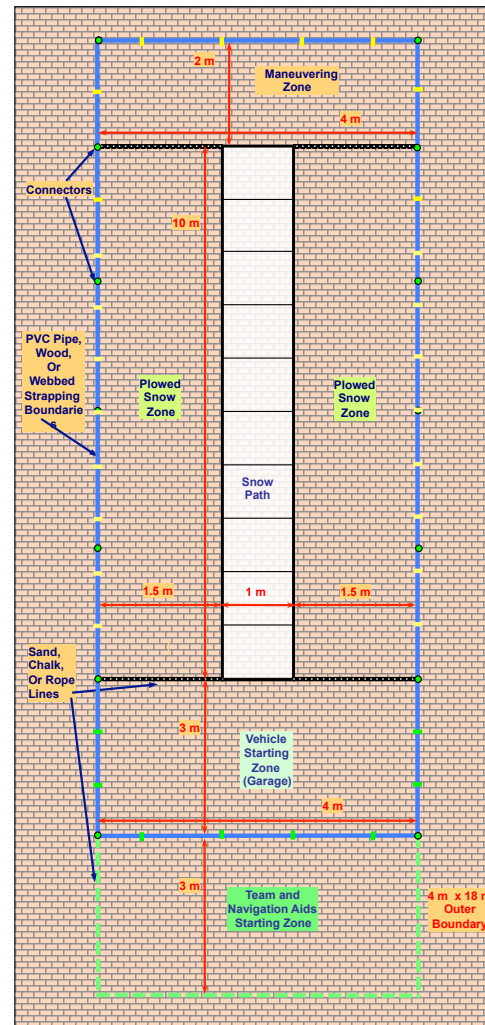
www.autosnowplow.com

- Challenging competition

- Vehicle Garage
- Team Starting Zone
- Snow Path Depth: 5-15 cm
- Post within Snow Path
- Post next to Snow Path
- Moving Obstacle

- 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

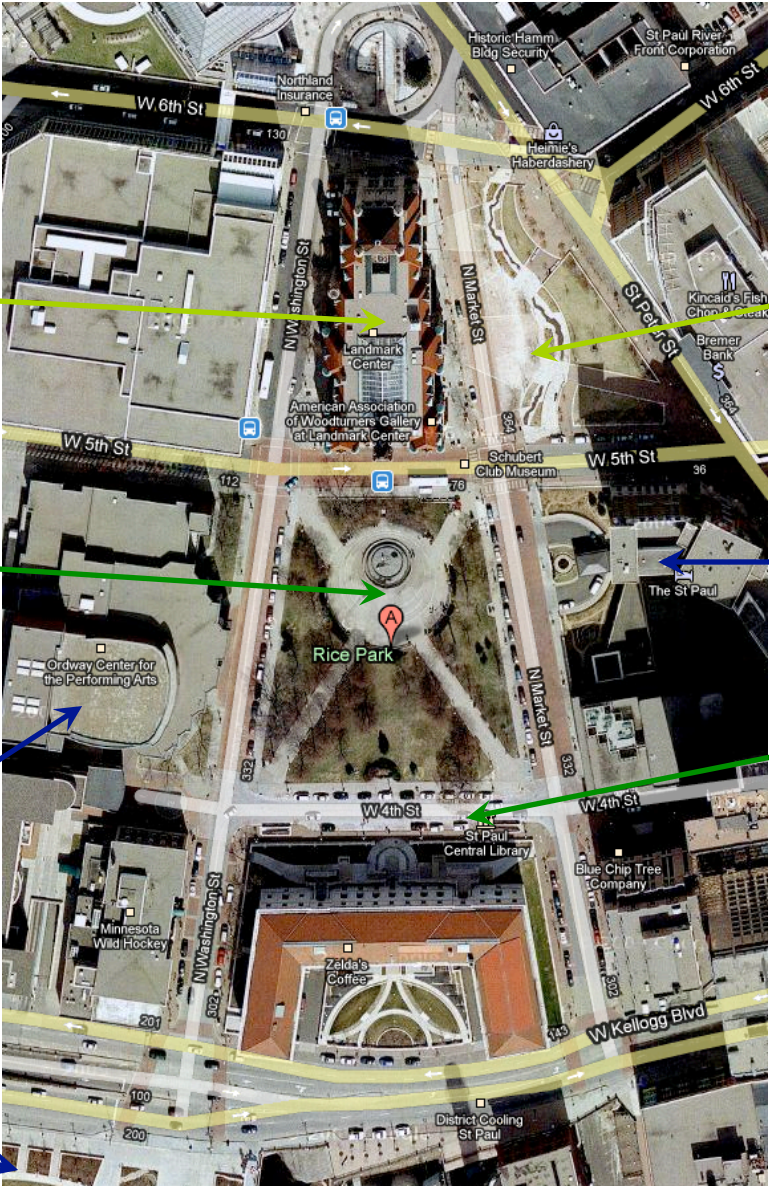
Rice Park

The Saint Paul Hotel

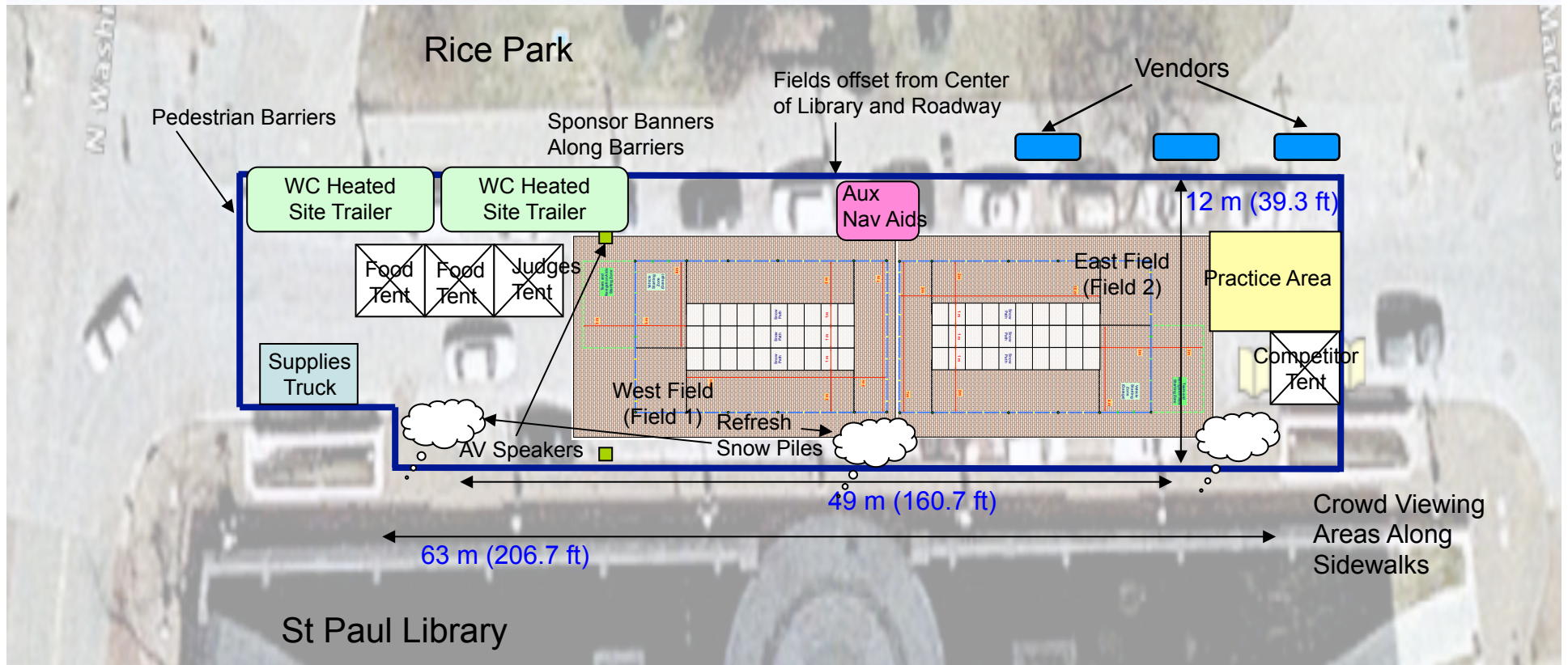
Ordway Center

W 4th Street

Science Museum



Competition Site: Layout



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

Competition Procedures

- Competition Run and Set up Time
 - Single 20-minute run for each team
 - Teams may set up their navigation aiding sources systems as needed, but aiding source set up time is included as part of the 20-minute run
 - Secondary navigation aiding zone (e.g. DGPS stations) can be set up and be running prior to 20-minute run
- Variable Snow Depth
 - Snow depth can vary between 5 and 15 cm along the snow path for either snowfield
 - Snowplow vehicle may experience areas with deeper snow this year
- No After-Hours Operations within the Competition Area
 - Due to insurance and safety, as well as snowfield protection

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



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 Zones
 - Areas for maneuvering vehicle and snow
 - Plowed Snow Zones
 - Areas where all snow must be placed



Competition Procedures

- Fast Completion
 - Extra points for clearing snow from the snow paths in under 20 minutes
 - 50% of the Snow Path must be plowed to earn these bonus points
- No items can be dropped/expelled from vehicle in any direction
 - No sand, water, fire, etc.
 - Keeps snowfield road surface the same for all teams



Presentations for 2018

- **Preliminary Design Review**
 - Important to fully describe vehicle
 - Should address all recommended technical items in template provided
- **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
- **ION GNSS+ Presentation**
 - First Place team is awarded a presentation slot at the ION GNSS+
 - September 2018
 - *A report and presentation are strongly encouraged for that event*



Planned Changes for 2018

- **Simulated Posts**

- Two POINTS Posts this year (similar to last year)
- Simulates a tree or parking meter near or on the snow path
 - A competition fixed “obstacle”
- One post randomly placed outside of Snow Path but within the snowfield boundaries
- One post randomly placed in a 1-m² square of snow path
- Points lost (**15%**) if vehicle hits, moves, or topples over either post
 - However, snow can “hit” post without losing points
 - Snow “void” surrounding post, so snowplow vehicle does not need to plow right against post

- **Parking In Garage**

- Vehicle must return to Garage (Vehicle Starting Zone) autonomously using its own power
- **20%** penalty if snowplow vehicle fails to park autonomously
 - Can not take advantage of “restart” declaration to park in garage at end of run



Planned Changes for 2018

- **Moving Obstacle**
 - A dynamic event during the competition this year!
 - Simulates a pet, person, car, etc. entering into the snow path
 - Obstacle will enter at a random location along snowfield but within the snowfield boundaries
 - Vehicle must come to a complete stop when obstacle enters Snow Path
 - It does not matter what orientation the snowplow vehicle is in when obstacle enters Snow Path – vehicle must stop
 - Points lost (15%) if snowplow vehicle does not stop or hits obstacle
 - Obstacle will exit snowfield after the snowplow vehicle comes to a complete stop
 - Or after obstacle is hit by snowplow vehicle

Planned Changes for 2018

- Cooperative Navigation Challenge
 - Working to include this again at the competition this year!
 - Two vehicles operating in tandem on same course
 - We are still working on details of the Challenge
 - Willing to accept inputs from teams
 - But Committee will make final decisions
 - Are any teams interested already?



Fake Snow

- Issue of how to test the vehicles in labs
 - How to test year round and in warm climates?
- Solutions:
 - Ice Rink Snow
 - Fake Movie Snow
 - Fairly inexpensive and does not melt!
- 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.amazon.com/Be-Amazing-Toys-4100-Blizzard/>

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

PDR Presentation

- PDR presentation day: 4 November 2017 (Saturday)
 - Presentation medium: conference call & screen sharing
- PDR presentation slides held in confidence throughout the 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); 2 November 2017 (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



2017 Institute of Navigation Autonomous Snowplow Competition

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