

Autonomous Snowplow Competition

Two-Year Competition Concept

2020 – 2022

Summary

The general concept is over the next two years, before the in-person dynamic competition date of February 2022, schools will *coordinate* and *cooperate* together to form a Team of two robots for the overall goal of quickly and efficiently plowing snow off a snow field. The general purpose is to have more than one vehicle simultaneously operating on a competition snow field to increase the complexity of vehicle operation. Multiple vehicle operation will increase the application utility, while reducing clearing time and overall single vehicle workload.

Each set of two robots will form a Team, who will compete together in both the virtual design and the dynamic snowplowing events. The primary objective of the Team is to have the two robots simultaneously plow snow from the same snow field. A secondary objective is to encourage academic groups to interface, learn, and develop working relationships with each other. Diverse groups working remotely during the pandemic is not all that different than real-world large group engineering applications.

Team Composition

Two-Vehicle Team Event: For the primary event, each Team should be composed of two robots each from a different school group. Therefore, two separate robots from school groups must merge and work together for a common snowplowing goal. There are no restrictions on which schools must work together (can be from same school, can be from different schools). There are no limitations on the number of teams a single school robot can enter in the Competition (although we recommend only one robot per team).

Single Vehicle Event: For all school groups, the Competition will host a standard dynamic event where one robot plows snow from a snow field at a time. The standard dynamic event also enable school groups to participate who don't merge with other school groups or who choose to join the Competition in 2021. School groups can opt in/out of this event next year, however, all Teams are welcome to participate in the Single Vehicle Event. Therefore, new schools entering the competition in the second year can join the Competition without participating in the first year.

Competition Timeline (Estimated)

First Year

September 2020:	Applications Available
October 2020:	Team Introductions and Email Information
November 2020:	Kickoff Event with Initial Rules & Concept
December 2020:	Status Review with Teams
January 2021:	Status Review with Teams
February 2021:	Virtual Competition (likely a presentation, with awards)

Second Year

April 2021:	Status Review with Teams
June 2021:	Status Review with Teams
September 2021:	Applications accepted again (allow more teams)
October 2021:	Team Meeting with new Rule updates (if needed)
November/December 2021:	Status Review with Teams
January 2022:	Status Review with Teams
February 2022:	Dynamic Competition held at Dunwoody College of Technology, Minneapolis, MN

Two-Year Competition Concept

First Year

The first year is primarily intended to form Teams, to design the cooperating robots, and to get school groups working together. Competition goals and expectations will be assigned for Teams that are to be met by end of First Year.

There will be a Virtual Competition at the end of First Year.

Second Year

The second year will primarily continue the robot development, but concentrate on physically enabling the snowplow vehicles to work together. This will be as much as Teams can do or are allowed during remote learning/pandemic times.

Teams should demonstrate or show the physical operation of the communication between snowplow vehicles (Nov. 2021).

There will be a Dynamic Competition at the end of Second Year.

Basic Competition Rules

Similar courses as previous years.

Timed event (e.g. 20 mins)

Judged primarily on amount of snow plowed to appropriate zones, while providing bonus points for faster plowing, as well as penalties for infractions.

Each Team will complete two runs during the dynamic event, with a combined score of the two runs to determine the results.

Single Vehicle Event – This will be very similar to previous Competition years. However, this is a separate event with separate awards for these Competitors. It will be recommended that all individual robot school groups participate in this event.

Two-Vehicle Team Event – This event will have two robots per Team. Must form and execute some method of communication or observation between vehicles so that they *actively* cooperate with the snow plowing task.

Modes of Inter-Vehicle Communication: Optical imaging, WiFi, Bluetooth, other RF options, Audio/Sonic, etc. between a Team's vehicles are allowed. This mode must be presented and explained to the Judges during the Competition (cannot be secret). The communication may be *active*, where data is passed between vehicles, or *passive*, through vehicle sensor observations. A solution or mechanism for indicating the communication between vehicles (e.g. flashing light) may be required, in part to help the spectators know what is actually happening. There will be limited restrictions on this concept, to allow for unique and creative concepts for snowplow vehicle operation. So direct wired connected vehicles would be acceptable – although this type of solution may be overly complex during operation.

Penalties:

- Boundary infraction: Cannot hit the edges of the field (navigation goals)
- If only one robot does any plowing (second one fails to touch any snow)
- If a stationary obstacle (post) is struck during the plowing event
- Both snowplows must return the garage (garage area must be expanded)

Although not recommended, Team robots may be allowed to hit or bump into one another for this event, as this may be part of their snow plowing strategy. Teams should consider the implications of large robots striking one another, and should work to avoid this if possible.

Rules are subject to change throughout the event, and may be revised by Competition organizers. Pandemic issues may require further changes. All Competitors will be notified of any changes and Rulebook updates.

Snowfield Layout

Single I: For Single Vehicle Event only

Triple I: For Two-Vehicle Team Event.

Larger garage will be added to make sure both vehicles are accommodated.

Robot Vehicles

Will use the same rules as previous years for required vehicle parameters.

No changes to safety systems. These must be part of robot.

Will expand safety rules to include inter-vehicle communication and robot response during lost-link conditions.

Awards

Expecting to provide monetary awards and trophies at both the First Year and Second Year ending events, with higher value for the Second Year event.