

'Snow Problem Robot Strategy for DESTINATION: DEEP SPACE

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Abstract—We look at the various component subsystems of 'Snow Problem's 2018 robot, Metis, named for the Greek Titan of good advice. These include the drivetrain, intake, transfer, and shooter, as well as some of the "extras" that went into making Metis look good.

1 INTRODUCTION

This document has four sections: we will describe Snow Problems strategic priorities, discuss game tasks, discuss points for the game, and discuss potential strategies.

2 'SNOW PROBLEM'S PRIORITIES

The zeroth step to any strategy discussion is understanding what your teams goals are. For Snow Problem, we are fortunate enough to have a very well dented set of goals for our team. It is worth noting that we are significantly more constrained by goals external to being competitive at a regional or the Championship, which is different from almost all teams.

- 1) Release top quality documentation on our process in order to provide mass mentorship to the FRC
- 2) Build a robot that would be reasonably competitive (rst round of alliance selection or alliance captain) at a Minnesota regional
- 3) Create a robot that is inspiring and cool
- 4) Build a robot that is capable of safe demonstrations year-round These goals are our guiding principles, and any robot we build needs to follow from our goals. We recommend that teams have an honest discussion and clear goals for their robot and team going into the season.

3 GAME TASKS

The rst step of our strategy discussion is to identify all the possible game tasks that may be a part of our robot. What follows are the primary tasks we identified:

3.1 HATCH PANELS

Scoring HATCH PANELS is vital to any strategy in DESTINATION: DEEP SPACE, as gives 2 points, allows CARGO to be scored, and is needed to complete a ROCKET to score a ranking point. As a result, manipulating HATCH PANELS is our second priority after being able to move. Vision Targets and white tape placed on the floor is used for every BAY allowing for a consistent lineup using sensors.

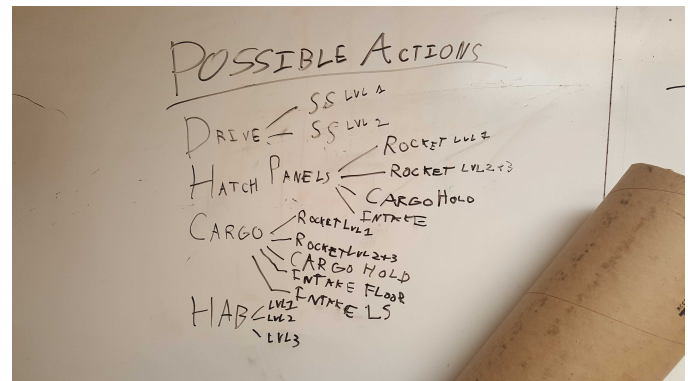


Fig. 1. Game Tasks from whiteboard

3.1.1 Collecting from the LOADING STATION HATCH

The LOADING STATION is the only place to intake HATCH PANELS. It is a necessity to pick up from here as only 6 HATCH PANELS can start on the field with 3 of them being NULL HATCH PANELS and the other 3 starting on robots. It is important to note that the height of the LOADING STATION HATCH is very similar to that of the ROCKET HATCH and the CARGO SHIP HATCH. Vertical movement is not necessary to have a competitive robot. There is also room for the bumper underneath the LOADING STATION HATCH allowing placement of the HATCH PANEL inside a ROBOT FRAME.

3.1.2 Delivery to the CARGO SHIP

Delivering to the CARGO SHIP is one of the most reliable but least important ways to score points. Every BAY is the same height and can be accessed easily. The CARGO SHIP also has the same space for the bumper as the LOADING STATION. Consistency will make this a great option for many teams. This was decided to be one of the main ways we plan to score as it is easy and necessary to score the CARGO.

3.1.3 NULL HATCH PANEL

The NULL HATCH PANEL is an interesting addition as allows for up to 3 HATCHES to start on the field allowing a robot to score cargo immediately. This could be an important

as our baseline for our speed only allowed for 4-5 cycles of both the HATCH PANEL and the CARGO. The negative effect of this is that the NULL HATCH PANEL is not worth any points during the end game.

3.1.4 Delivery to the ROCKET

The ROCKET is a high difficulty-high reward challenge. The first level ROCKET HATCH is the same height as the HATCHES on the CARGO SHIP, however there is no gap for bumpers. The challenge only gets more difficult because completing the ROCKET requires HATCH PANELS to be placed at taller heights. The Level 3 HATCH PANEL is much taller than the starting height limit of the ROBOT. Completing the ROCKET is worth a ranking point, making it one of the most important objectives of the game. We decided to forgo prototyping for level 2 and 3 of the ROCKET in favor of a climbing mechanism due to time.

3.2 CARGO

3.2.1 Collecting from DEPOT/Floor

Picking up from the floor is more versatile than depending on the LOADING STATION as it allows for missed shots and early deposits from the LOADING STATION to be picked up. This is also generally faster as it cuts drive time down compared to driving to the LOADING STATION to pick up the CARGO. Picking up from the DEPOT will be very similar however, a rail is included that can make grabbing CARGO more difficult. We decided not to pick up from the floor as we believe we cannot make the best floor pickup and want to put our resources into something else. Since the floor pickup will probably be the best option, we expect other Ri3D teams to show great designs.

3.2.2 Intake from Loading Station

This is the most reliable method for the intake of CARGO. Teams will be able to consistently intake CARGO from the opening in the LOADING STATION. This makes it a great option for some designs that require a more exact loading.

3.2.3 Scoring in the CARGO Ship

This is the easiest way to score CARGO. The opening is decently large and has a net in it that lessens the change of the CARGO bouncing out. This will become a common way for many teams to score so alliances should be score

3.2.4 Scoring in the Rocket

To score in the ROCKET requires far greater accuracy than the CARGO SHIP however it is needed to get the ROCKET ranking point. There are few great designs to handle this problem. One common way to approach this problem is a typical launcher. However, a lift may be a great option as a team could integrate it with their HATCH PANEL mechanism.

3.3 HAB Climbing

The HAB has three levels of increasing difficulty. The first level will not give many teams trouble as it only requires teams to drive up 15 ramp. This can be challenging for teams with less traction as the material used has proven

to be slippery in the past. The second level is 6 above the first level. The third and final level is 13 above the second level. Approaching this problem has been one of the biggest talking points for our team. We have talked about using stilts, as well as pivoting wheels. We have decided to forgo some of the other challenges to spend more time to create a way to beat this challenge.

4 POINTS ANALYSIS

There are some key numbers with this game when it comes to scoring. Our estimated naive maximum score is:

Award	Value	Total
SANDSTORM Bonus 1	3	9
SANDSTORM Bonus 2	6	12
HATCH PANEL	2	40
CARGO	3	60
HAB Climbing Bonus 1	3	9
HAB Climbing Bonus 2	6	18
HAB Climbing Bonus 3	12	36
HAB Docking	1 RP	-
One (1) Complete Rocket	1 RP	-

Of note is that since only two robots can start on the HABITAT teams can only get 9 and 12 points for driving off the HABITAT. There are twenty BAYS across the CARGO SHIP and both ROCKETS adding up to 100 points that the ALLIANCE can for filling every BAY. It is theoretically possible to have all three members of the ALLIANCE climb up onto each level of the HABITAT but since there is not enough reasonable space for all three ROBOTS the maximum score is lower. We estimate that a realistic perfect score is around 139 points.

5 ROBOT STRATEGIES

From our game tasks that we identified, we created several robot strategies that we could choose from for our robot strategy.

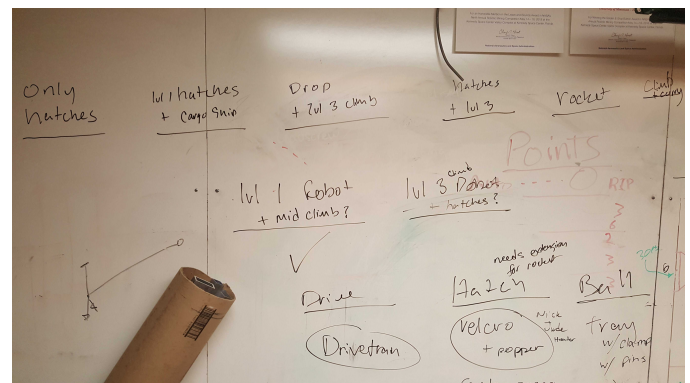


Fig. 2. Robot Strategies from whiteboard

5.1 Moving Van

This strategy would be effective for a lower resource team with the idea of taking the CARGO from the LOADING STATIONS and placing them into the CARGO SHIP BAYS.

This strategy is very simple to execute because the ROBOT drives across the PLAYING FIELD and barely has to manipulate the CARGO inside the robot to score inside the CARGO SHIP HATCHES. The CARGO travels 5 inches from the height of the LOADING STATIONS into the CARGO SHIP HATCHES. This strategy only requires a basic ramp on the top of the ROBOT and makes it very easy to score CARGO. It is a limiting strategy because the team must rely on its alliance partners to score HATCH PANELS before it has a chance to score any of its CARGO. However, this strategy can take advantage of the NULL HATCH PANELS starting on the field to start scoring immediately. Since this ROBOT does not have much capability and involves a simple mechanism, the team can later add a hatch mechanism to become more independent. We think that this is a decent strategy for low resource teams but limits their scoring ability by relying on their ALLIANCE.

5.2 MVR

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5.3 Rocketeer

This strategy is effective for teams with more resources since the ROBOT is focusing on scoring HATCH PANELS and CARGO in the ROCKET alone. Their goal is to focus on scoring points in the ROCKET so that the rest of their ALLIANCE can focus on scoring points in the other ROCKET and the CARGO SHIP. This strategy is more advanced because teams need the knowledge to build a lifting mechanism and be able to score both HATCH PANELS and CARGO in each level of the ROCKET. Teams who specialize in the ROCKET are a valuable member of their ALLIANCE because they can score 30 points with a complete ROCKET and earn a ranking point for their ALLIANCE. This is one of the specialized robots that has the potential to do everything but focuses on a single aspect of the game.

5.4 Jack-of-all Trades

This strategy is effective for a wide variety of teams because it focuses on all aspects of DESTINATION: DEEP

SPACE. The goal of this strategy is to focus on scoring all the HATCH PANELS and CARGO in the CARGO SHIP HATCHES as well as scoring in the first level of the rocket. This strategy lends itself well to a wide variety of teams since there is plenty of game elements to score and it is unlikely that teams will run out of things to do in a MATCH. Teams who pursue this strategy can also add a mechanism to climb up on the HAB PLATFORM without affecting their main scoring strategy.

5.5 Drive, Panel, Climb

This strategy is good for low resource teams who mainly focus on climbing up onto the HAB PLATFORM and adding capability to their ROBOT by scoring HATCH PANELS. These teams may not be able to climb up onto the third level of the HAB PLATFORM but make up for it by making it up to the second level of the HAB PLATFORM and scoring HATCH PANELS.

5.6 The Climber

This strategy is good for low resource teams who focus all their efforts on climbing up on the HAB PLATFORM and do not have the resources to add any additional scoring capabilities on their ROBOT. The goal of this strategy is to have an extremely reliable climbing mechanism that reliably compliments all alliances.

5.7 The Defensive Climber

This strategy is similar to the HAB Climb Bonus: Level 3 and HAB Line cleared strategy only the team spent all of their time and resources towards a perfect climbing mechanism and they do not have any additional scoring capability. Teams who choose this strategy will assist their ALLIANCE with defense and helping other robots climb on the HAB PLATFORM.

5.8 The 'Snow Problem

We will be pursuing the Level 1 HATCH PANELS and CARGO with a HAB Climb Bonus: Level 2 or 3 strategy and we will determine through prototyping how high up the HAB PLATFORM we can climb. To this end, our priorities are:

- 1) Drive
- 2) Scoring HATCH PLATES
- 3) Scoring CARGO
- 4) Climbing the HAB PLATFORM

6 CONTACTING THE AUTHORS

Team 'Snow Problem may be reached in order to ask questions on our Chief Delphi thread, on Twitter (@SnowProblemz), or via our Twitch stream during the three day build. After the build, we will still be answering questions on the thread and via email (at gofirst@umn.edu). We are doing this for you, the FRC community, and are happy to answer questions and discuss our designs with you.