Wearable robot for avalanche rescue

Bachelor project with Biorobotics Laboratory (BioRob)

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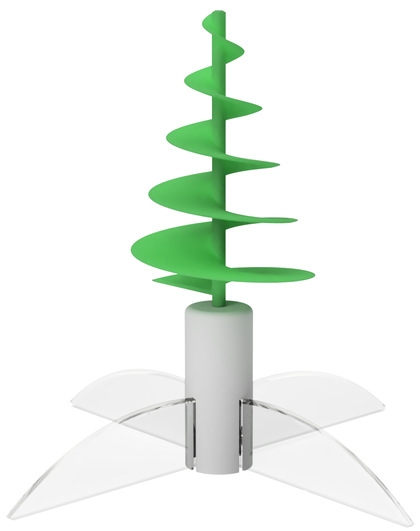
Introduction

Given that increasing numbers of people are participating in extreme sports subject to high avalanche chances, having means for avalanche rescue becomes an important part of the preparation.

Several quite expensive solutions already exist. Our goal in this project is to try to find an alternative method that is easily transportable and low cost.



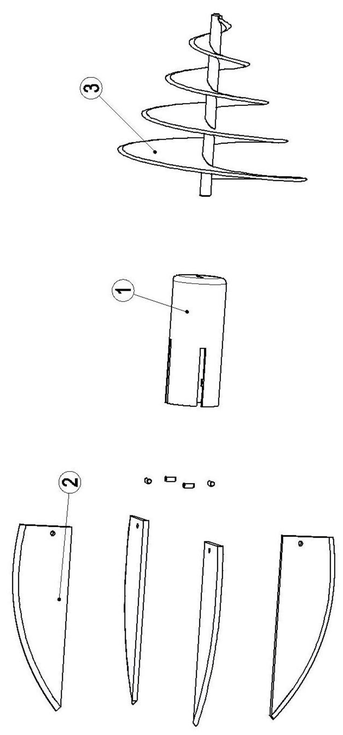
Here is the model that we ended up choosing for our robot. It is to be with the person who is in an avalanche prone area, and the robot would be deployed to dig towards the surface and attract attention thereat.

The Robot

The robot is made out of three main components: the main body, the fins and the helix:

1. The **main body** is the heart of the structure: it contains the motor and accelerometer, and links all the parts of the robot.
2. The **fins** are integrated in our design in order to increase stability and prevent the rotation of the main body while digging.
3. The **helix** is our digging system. We use it to dig through snow and to support the robot's weight during this process.

From the main body, there are wires connecting the motor to the module left behind in the skier's backpack, which contains the battery to power the motor.



Test

We tested our prototype to see if the idea actually worked, and tried out different helices. For these tests, the prototype was slightly modified: the fins are unfoldable and crisscrossed in the middle for more stability.

The tests were done in the following way:

- The testing tube was half-filled with sand and polystyrene pellets.
- The robot was in put in the tube, with only one fin sticking out.
- The generator was activated and configured to provide a tension of 12V DC.
- The prototype was let loose.

Results

Looking at the protruding fin, we were able to track the progress of the robot in our pellet and sand mix. We were able to observe that the motor was powerful enough to make the whole prototype advance at a decent pace.

Testing difficulties

We encountered several problems during our testing. These included:

- Underestimating the quantity of bicarbonate needed to fill the test bench;
- Not having found a way to temporarily fix the helices made the testing harder as we couldn't fix each helix to a different motor for each test;
- Finding a suitable mix to simulate the snow.

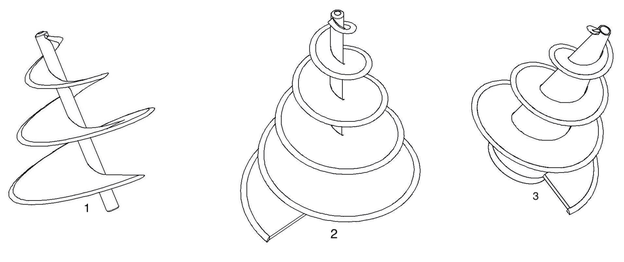
Helices for testing

Here are the three different helices we designed for testing. Here we are presenting the helices and their differences. We maintained a pitch of 40mm for each helix.

Helix	Height[mm]	Surface[m^2]	Max radius[mm]
1	150	0.019	80
2	210	0.028	75
3	157	0.013	64

Helix	Core Profile	Mass[Kg]	Estimated LM [Kg]
1	Cylindrical core	0.062	0.4180
2	Cylindrical core	0.095	0.6160
3	Conic core	0.092	0.2860

Table 1: Helices Characteristics



Conclusions

This project has a long way to go before actually being usable, but it contains a critical idea for the development of extreme sports in snowy regions: a smaller, lower cost solution to help retrieve people caught in avalanches.

Future Improvements

- Adjusting rotation patterns and helix design to be able to turn in every direction;
- Having different helices for different snow conditions;
- Integrating an electronic beacon system;
- Integrating a paint spreading system;
- Building and testing a launching tube.

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