



# Antenna Tracking Ground Station

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## Abstract:

The aim of this project was to create an automated antenna tracking ground station that would provide a robust frame capable of accommodating the future needs of the BOREALIS program. This goal was accomplished through the incorporation of: stepper motors, increased rigidity, increased accuracy, built in solar sight, 360° rotation capability, and improved tracking software.



Advisor Randy Larimer standing next to V2 station (Left) and V3 station (Right)



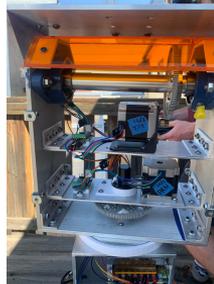
V3 Station up close

## Mechanical Improvements:

360° rotation capability was achieved by implementing a 6' PTFE thrust bearing and an orbiting gearing system. Structural rigidity was greatly increased through the use of 6061 aluminum framing, steel hardware, and robust gearing. This gearing system increased both the available torque from the motors and the overall resolution of the system. The integration of a solar alignment sight has decreased set up time and improved accuracy as compared to the previous version of the system. Additional improvements include an emergency off switch and acrylic dust covers.



Tilt gear



Internal workings of ground station

## Stepper Drivers and Motors:

One of the reasons for beginning this project was to increase the accuracy of the tracker through improved motors. This was done by the use of Tic 36v4 stepper drivers with stepper motors. Our previous iteration of the ground station using servo motors was able to get within one degree of accuracy when attempting to aim at the balloon. The improved system using the steppers was able to get within 0.001 of a degree of accuracy. These drivers use I2C from an arduino which plugs into the Ground Station Laptop.



New Stepper Motors

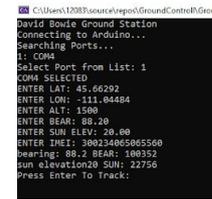


NewTic 36v4 Stepper Motor Driver

	V2 Station	V3 New Station
Steps per rotation	360	406400
Degree of Resolution	1°	0.000885°

## Graphical User Interface and Aiming Math:

This new version was prototyped in C# as a starting point and uses a simple terminal interface. This allowed us to focus on the tracking issues first to determine how to fully utilize the increased accuracy of the stepper motors. The primary issue we have discovered is that the equations that we were using to track need to be refined to get more accurate aiming. In the future, the software will be set up to communicate with a variety of controllers over UART.



Screenshot of ground station GUI



Screenshot of the code for the ground station software