University of Colorado at Boulder HELIOS V Team October Status Report

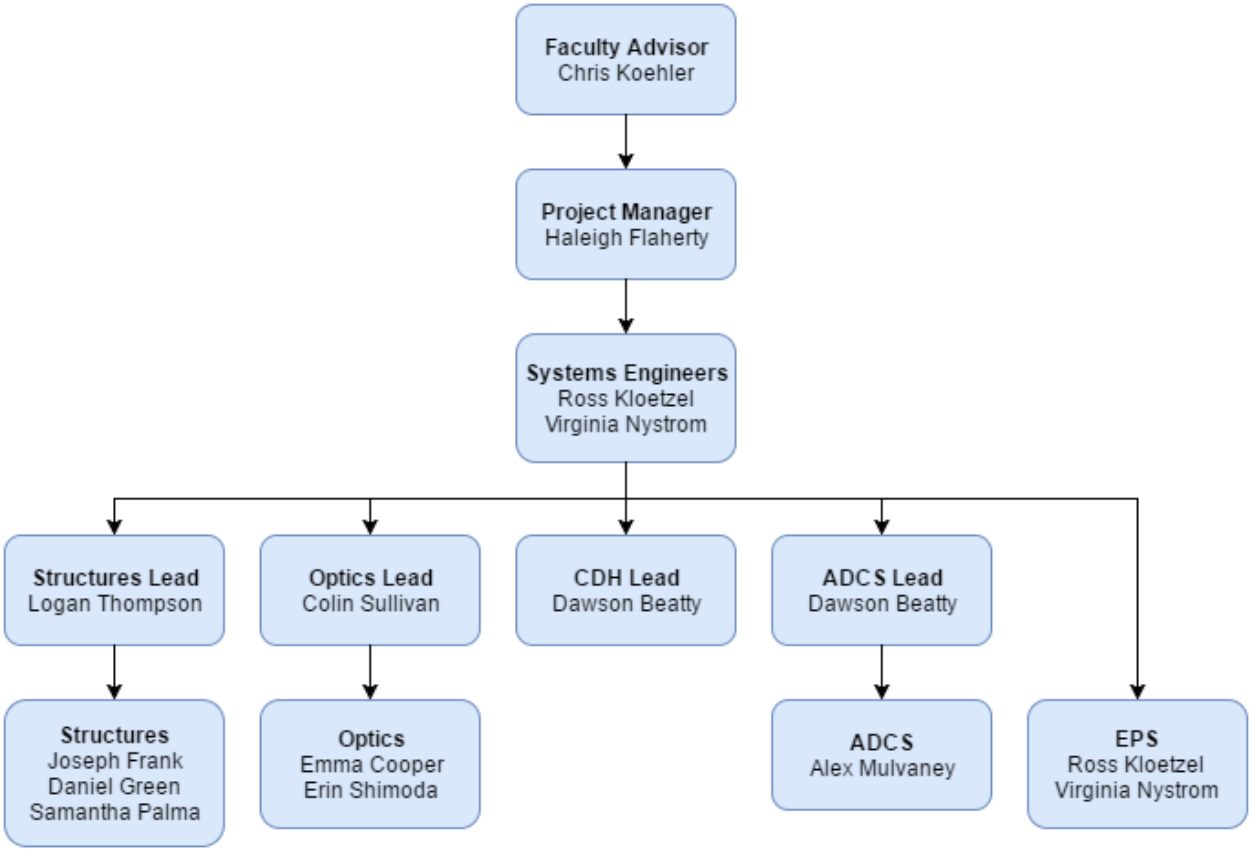
This month the team has been focusing on data analysis. All teams have been working to get their data into a presentable format that clearly illustrates its purpose. The team also began work on their final data presentation and final paper.

Team Demographics

Student	Ethnicity	Gender	Year	Major	Start Time	End Time	Grad/ Undergrad
Haleigh Flaherty	Caucasian	Female	Junior	Aerospace Engineering	January 2016	Current	Undergrad
Paige Arthur	Caucasian	Female	Senior	Aerospace Engineering	January 2016	May 6th 2016	Undergrad
Ryan Cutter	Caucasian	Male	Senior	Aerospace Engineering	January 2016	May 6th 2016	Undergrad
Erin Shimoda	Caucasian/ Asian	Female	Sophomore	Aerospace Engineering	February 2016	Current	Undergrad
Virginia Nystrom	Caucasian	Female	Sophomore	Aerospace/ Applied Math	February 2016	Current	Undergrad
Joseph Frank	Caucasian	Male	Sophomore	Engineering Physics	February 2016	Current	Undergrad
Severyn Polakiewicz	Caucasian	Male	Junior	Aerospace Engineering	February 2016	May 6th 2016	Undergrad
Rebekah Haysley	Caucasian	Female	Sophomore	Mechanical Engineering	February 2016	June 1st 2016	Undergrad
Colin Sullivan	Caucasian	Male	Sophomore	Aerospace Engineering	February 2016	Current	Undergrad
Samantha Palma	Caucasian/ Asian	Female	Sophomore	Mechanical Engineering	February 2016	Current	Undergrad
Ross Kloetzel	Caucasian	Male	Sophomore	Aerospace Engineering	February 2016	Current	Undergrad
Michael Catchen	Caucasian	Male	Sophomore	Aerospace Engineering	February 2016	May 6th 2016	Undergrad

Alex Mulvaney	Caucasian	Male	Sophomore	Aerospace Engineering	February 2016	Current	Undergrad
Logan Thompson	Caucasian	Male	Sophomore	Aerospace Engineering	February 2016	Current	Undergrad
Dawson Beatty	Caucasian	Male	Sophomore	Aerospace Engineering	February 2016	Current	Undergrad
Gage Froelich	Caucasian	Male	Junior	Mechanical Engineering	February 2016	March 2015	Undergrad
Daniel Green	Caucasian	Male	Junior	Mechanical Engineering	February 2016	Current	Undergrad
Emma Cooper	Caucasian	Female	Sophomore	Aerospace Engineering	March 2016	Current	Undergrad

Team Organization



Accomplishments of October

Structures: The structures team replaced and repaired all critical and noticeable broken components post-flight. Specifically, new washers and a L-bracket were purchased, and the new L-bracket was machined to specifications. Additionally, the structures team performed failure analysis on all post-flight damages, and determined that the major damages to the structure were caused by a single impact, most likely upon landing of the payload. Smaller damages such as loose screws in the shipping container are presumed to have disconnected from constant vibrations during shipping. The team is confident in these conclusions after close inspection of the motor counts plot, which display consistent and full extension of the payload in both the azimuth and elevation direction. This extension demonstrates full structural functionality throughout the duration of flight. The structures team's findings in failure analysis are now documented within a short, comprehensive presentation shared with the entire HELIOS V team.

CDH: Over the past month, the CDH team has been focused on comparing downlink logs to logs from the day-in-the-life tests. Preliminary results show that nothing out of the ordinary happened, and that all subsystems were performing nominally. The upper and lower Raspberry Pi maintained constant communication throughout flight, which sometimes presented an issue during testing.

ADCS: ADCS has completed more image analysis to quantify how the tracking algorithm performed this year compared to last year. The downlink of image analysis from the payloads was used to do this-- the ADCS messages display the degree difference in the azimuth and elevation from the center of the Sun to where the system tracks to.

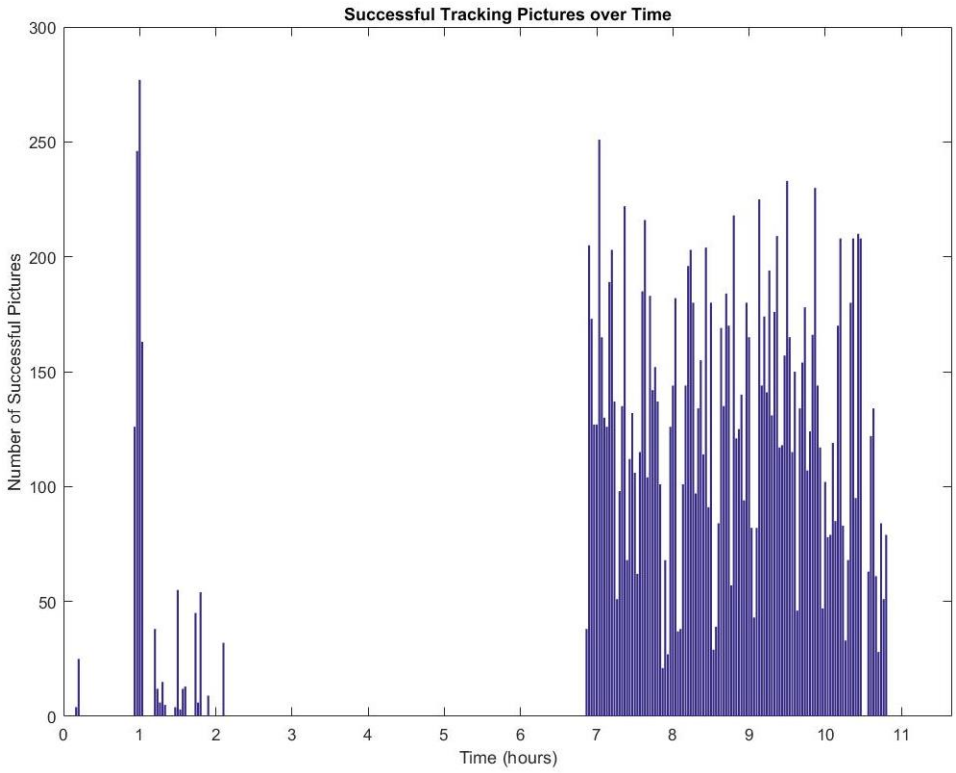
The ADCS team found a 57% increase in tracking ability in HELIOS V compared to HELIOS IV. This number comes from checking which portion of images were within the field of view of the science camera within flight. The team suspects the low tracking ability in the HELIOS IV numbers was due to the counterweight failure, which significantly impacted the payloads movement.

Optics: Over the past month Optics has focused primarily on determining what went wrong with the system and how it may be possible to replicate these circumstances. Given that the payload was not operable both from a structural and electrical standpoint at the beginning of the month, a primary focus was getting the system working again in order to begin failure analysis testing. After the payload was structurally repaired, it was determined that the primary board had a short in it and it was not financially reasonable to repair and as such a new failure analysis plan would have to be constructed. A new plan was drawn and began with constructing a new telescope mount and imaging the sun with the flight configured telescope. As upon further inspection of the telescope the focus was approximately a half turn off and images taken with the new mount closely matched those taken in flight, an initial conclusion was drawn that the focus of the telescope was incorrect for the during of flight.

In addition to this, Optics worked heavily on code development for analyzing and processing flight images. This primarily focused around developing code that found the center of each sun image for easier and more consistent pixel analysis algorithms.

EPS: The EPS subteam has been concerned with repairing the power on HELIOS. It was recently discovered that HELIOS no longer powers on, so the EPS team has been attempting to isolate the power issue in the hopes of repairing HELIOS and making the system usable again. After fixing the power connector, the EPS team has concluded that the issue is not with this component.

Systems: The systems subteam has been focused on data analysis and success criteria analysis. The team has made necessary changes to plots presented in the flight data review and have resolved conflicting numbers on the success rate. The team has also created an animated scatter plot (sample attached to this email) which indicates the position of the sun in the FOV of the ADCS camera in order to visually understand HELIOS's tracking. Plots of the rate of success images over time can be seen below, which will be used to characterize the tracking success over time.



Plans for November

Over the month of November, the CPU usage of both the upper and lower Pi will be characterized to determine how much computation power is realistically needed during future missions. The CDH team will also be plotting temperature, pressure, and accelerometer data with the ADCS team to view the effects of environmental variables on tracking ability.

Over the month of November, the ADCS team will be performing more analysis on the characteristics of the tracking algorithm. For instance, comparing tracking accuracy to accelerometer data to quantify the effects of motion on the payload.

In the next month Optics anticipates finishing all image analysis code and more thoroughly analyzing how focus may have been incorrect.

For November, the EPS team plans to continue methodically following the power lines in the payload to determine the location and cause of failure. From observation, it is believed that the issue is being caused by a short in the main EPS board. This will be the first component which the EPS team will scrutinize in order to determine the failure mode.

For November, the systems subteam will be focusing on the final science report and presentation. Several tasks for November include determining tracking success as a function of time, comparing

HELIOS V and HELIOS IV tracking data, further analyzing the heatmaps and scatterplots of tracking data to determining the reason behind tracking bias, and partnering with ADCS and Optics in comparing tracking images with optical images in order to assess the alignment of the system.