Tarun Punnoose

Engineering Portfolio

punnoose@stanford.edu

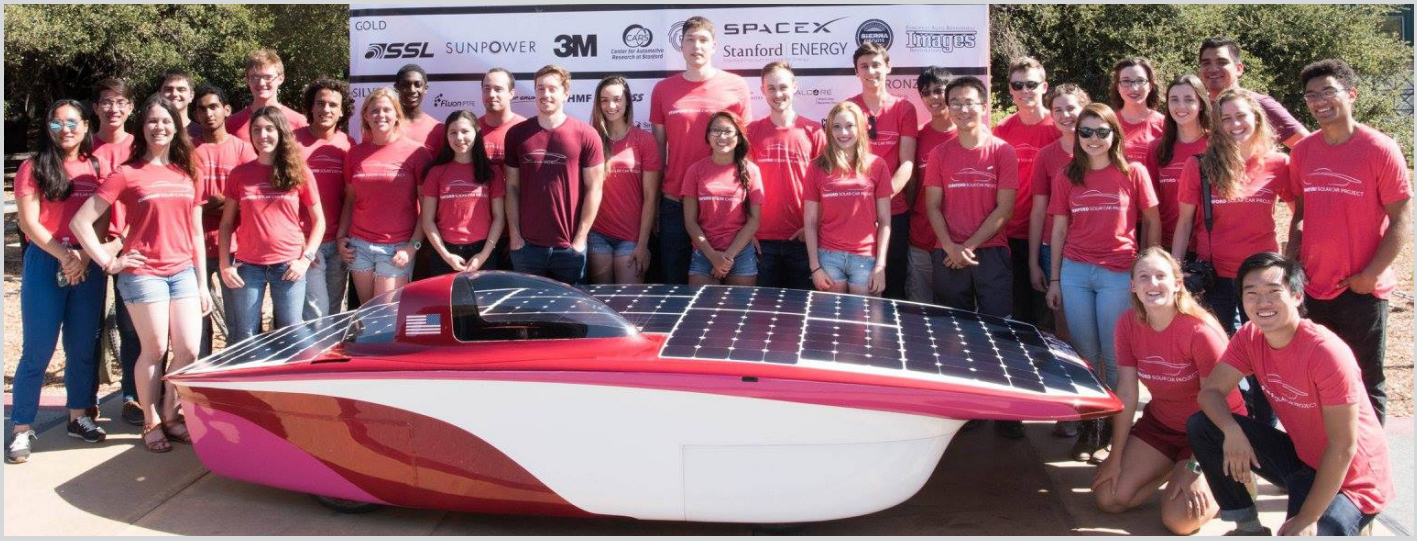
About Me

- I'm a sophmore in Mechanical Engineering at Stanford
- Been fascinated with space since a young age
- I enjoy working with my hands and tinkering with stuff
- Looking for internship opportunities in mechanical system design and manufacture

Contents

Stanford Solar Car Project

Mechanical Team



our newest car Sundae being unveiled

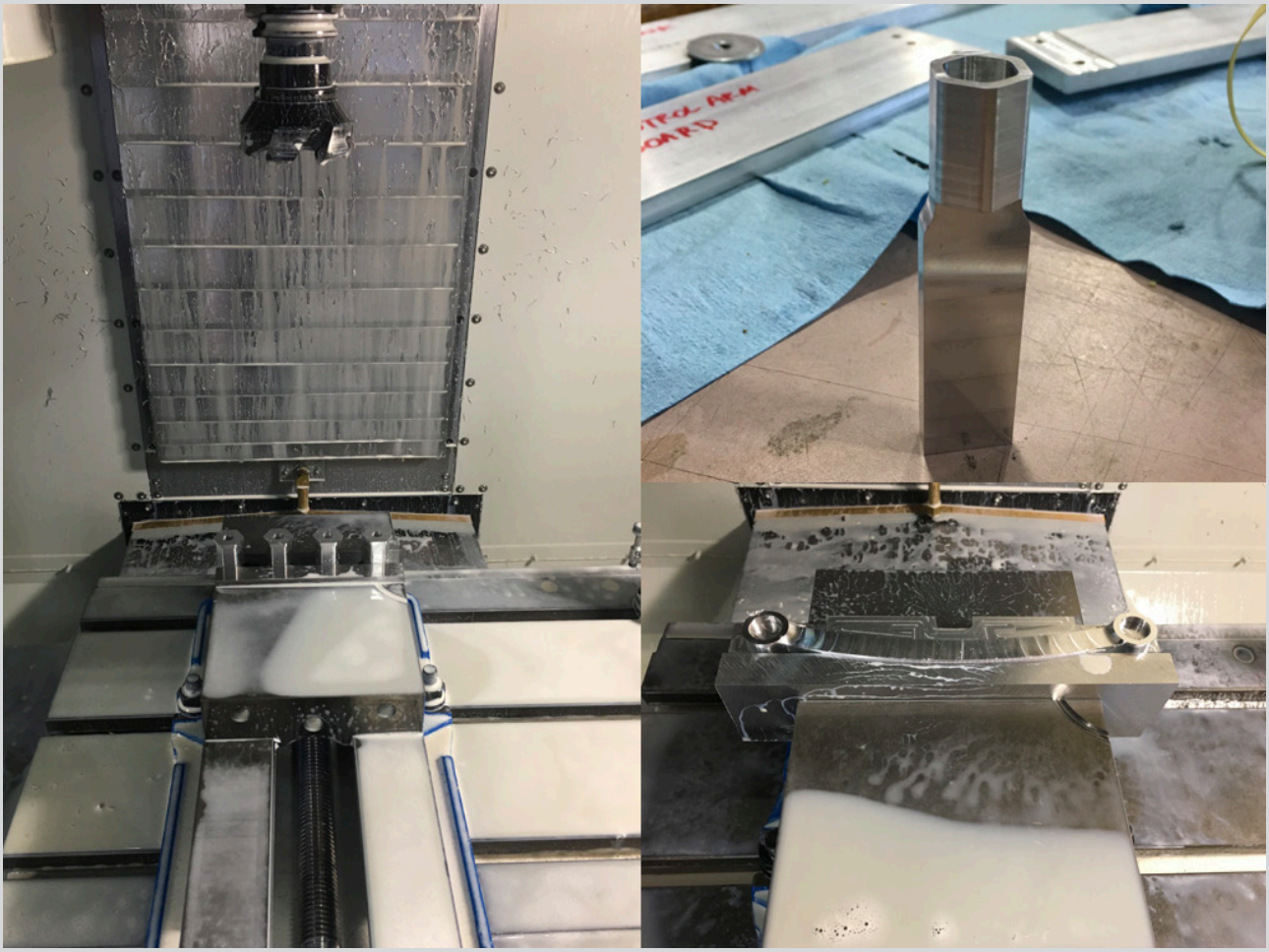
Overview

I joined the Stanford Solar Car Project at the beginning of my freshman year, about halfway through the design cycle. Captivated by the combination of a focus on alternative energy along with complex mechanical challenges, I quickly became a dedicated member of the team. With prior CNC experience, I began to learn to use the Haas VF1 that we have in our shop. Eventually I became the main CNC machinist for the team, machining almost everything that needed to be done in house.

I was in charge of designing the canopy latching mechanism and helped design the canopy hinging system. I CNC machined components for both of these systems and assembled them. I also was in charge of gluing together the topshell chassis so that it fit the aerobody. For this, I had to create a custom, accurate jig. I also helped do many of the carbon fiber layups that make up the aerobody of the car.

helping prep our molds for layups

sanding the aerobody of the car smooth after bondo



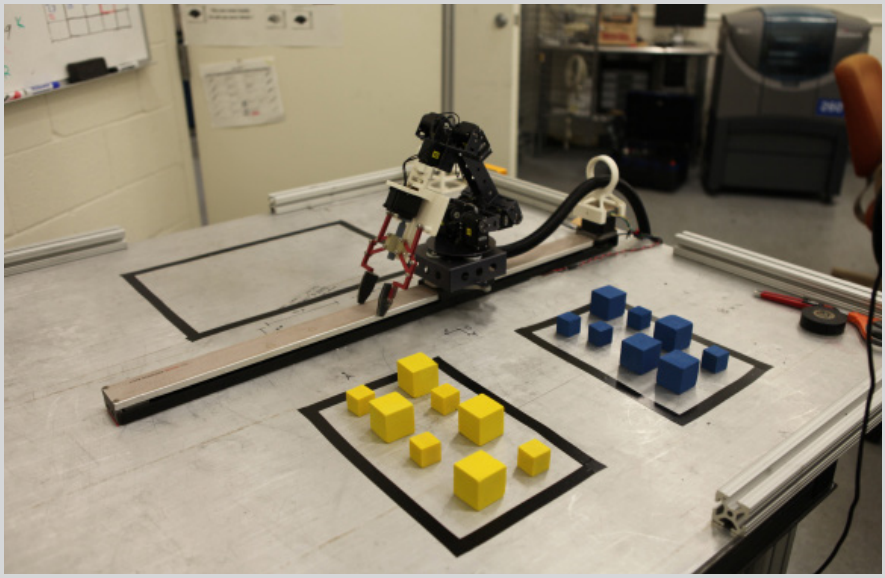
a few of the parts I machined: (left) hexagonal carbon fiber tube inserts, (top right) tube insert test for steering, (bottom right) canopy linkage inside my soft jaws fixture

car with the canopy and topshell hinged - both systems which I helped manufacture and assemble

out on a Central Valley test drive

NASA Goddard

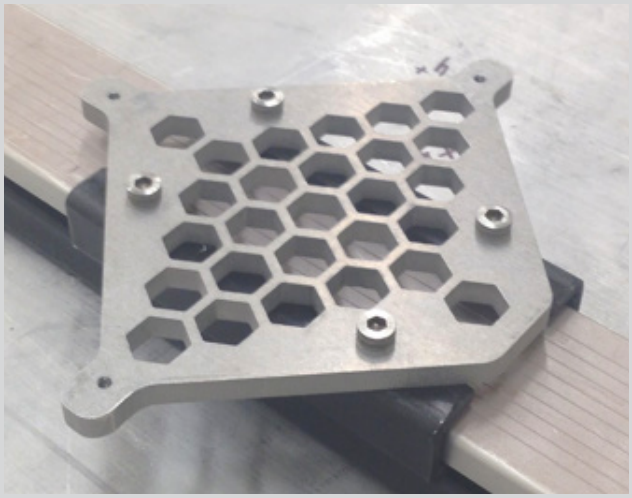
Innovation Lab Intern



final robotic system

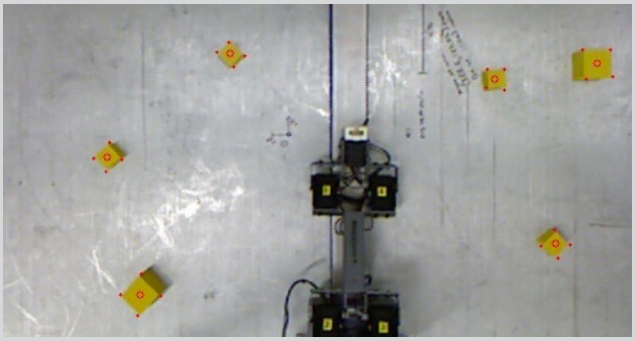
Overview

The Innovation Lab team was part of Goddard's Advanced Manufacturing Branch, which was considering getting a robotic arm to automate machining processes. I was part of a team of interns tasked with demonstrating the utility of a robotic arm using a low cost commercial robotic arm. We decided putting the robotic arm on a linear track system and having it identify, manipulate, and sort a set of colored blocks would be the best demonstration. The arm was also outfitted with a interchangeable head design so it could be used in different applications in the future.



waterjet cut aluminum interface

I designed a lightweight aluminum interface between the arm and the linear track. I also gained familiarity with many manufacturing techniques, like high resolution 3D printers and CNC machining which the Advanced Manufacturing Branch provided. I was also heavily involved in the software and created the OpenCV program that used an XBox Kinect to detect where the blocks were and got an approximate position from that. I also helped design and program the low level electronics system that interfaced with the arm and central computer.



OpenCV program output

TJ Excelsior Aerospace

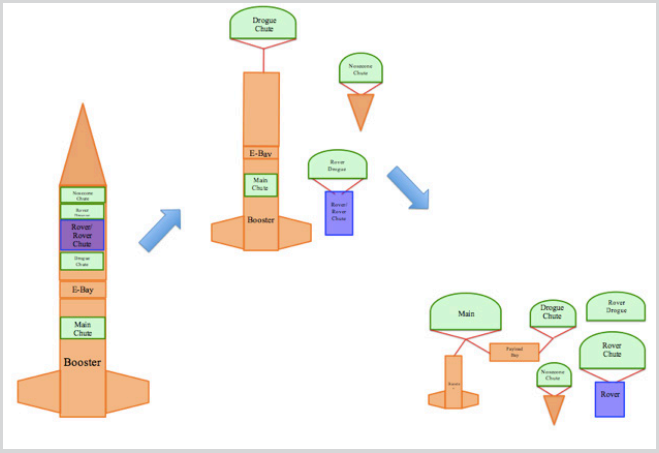
Co-President

our rocket Freedom ready to launch at Battle of the Rockets

Overview

I was a Co-President of the TJ Excelsior Aerospace Club my junior and senior year of high school. The main competition we participated in was the Battle of the Rockets, a high power rocketry competition meant largely for universities. We competed in the Mars Rover Challenge, where we had to launch a rocket containing a rover inside it to above 1000 ft, deploy the rover, safely land the rover, and have the rover drive an the ground along a specified track.

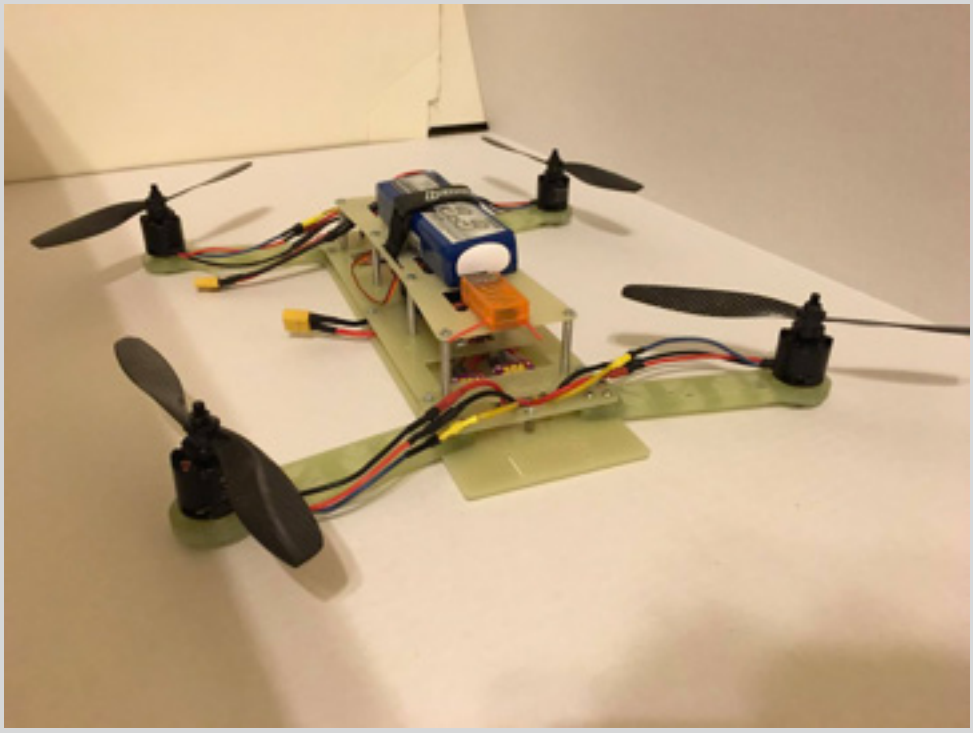
I was the rover design lead my senior year. We decided to go for a simple but robust rover design that would work in the tough terrain on the ground. We had a custom electronics board as our vehicle computer with a CNC machined aluminum body and laser cut wheels. I learned a lot from being in charge of an integrated system of hardware, software, and electronics. Although we had a few hiccups during the actual competition, we were very proud of the rover and rocket that we had built.



our CONOPs diagram for rocket

working on the rover before launch

Custom Quadcopter

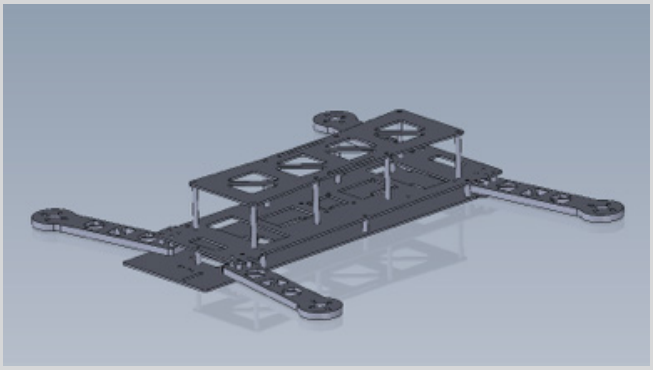


completed quadcopter

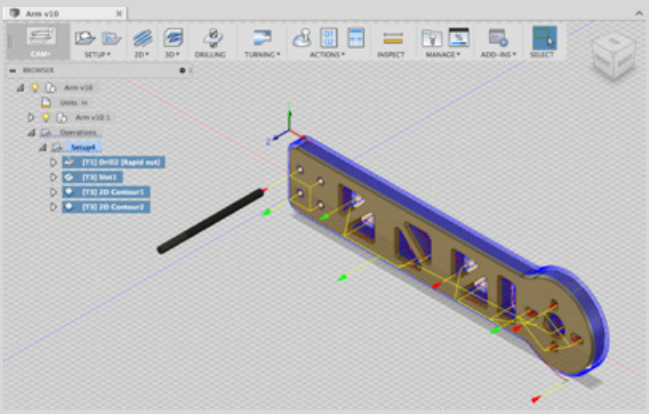
Overview

The purpose of this project was to create a custom quadcopter frame that could serve as an FPV system as well as a vessel for future research projects, such as using a computer vision system and a pose estimation algorithm to autonomously land the quadcopter (planned). The frame was made out of G10 sheets and bars, custom aluminum spacers, and purchased aluminum standoffs.

I designed the whole frame in AutoCAD and CNC machined it out of G10 fiberglass on my high school's Tormach PCNC 1100. I chose, sourced, and assembled all the electronic components myself before conducting a lot of flight testing of the vehicle.



SolidWorks assembly of quadcopter



Fusion 360 CAM of the arms

US Naval Observatory

Astronomical Applications Intern

U.S. Naval Observatory
Astronomical Applications Department

Dates of Moon Phases

Date and Time (Universal Time)			
New Moon	First Quarter	Full Moon	Last Quarter
2014 Jan 01 11:14	2014 Jan 08 03:39	2014 Jan 16 04:52	2014 Jan 24 05:19
2014 Jan 30 21:39	2014 Feb 06 19:22	2014 Feb 14 23:53	2014 Feb 22 17:15
2014 Mar 01 08:00	2014 Mar 08 13:27	2014 Mar 16 17:08	2014 Mar 24 01:46
2014 Mar 30 18:45	2014 Apr 07 08:31	2014 Apr 15 07:42	2014 Apr 22 07:52
2014 Apr 29 06:14	2014 May 07 03:15	2014 May 14 19:16	2014 May 21 12:59
2014 May 28 18:40	2014 Jun 05 20:39	2014 Jun 13 04:11	2014 Jun 19 18:39
2014 Jun 27 08:08	2014 Jul 05 11:59	2014 Jul 12 11:25	2014 Jul 19 02:08
2014 Jul 26 22:42	2014 Aug 04 00:50	2014 Aug 10 18:09	2014 Aug 17 12:26
2014 Aug 25 14:13	2014 Sep 02 11:11	2014 Sep 09 01:38	2014 Sep 16 02:05
2014 Sep 24 06:14	2014 Oct 01 19:33	2014 Oct 08 10:51	2014 Oct 15 19:12
2014 Oct 23 21:57	2014 Oct 31 02:48	2014 Nov 06 22:23	2014 Nov 14 15:16
2014 Nov 22 12:32	2014 Nov 29 10:06	2014 Dec 06 12:27	2014 Dec 14 12:51

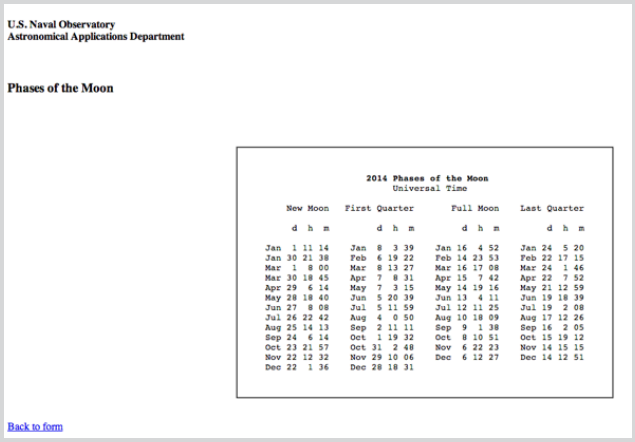
Back to form

new HTML output for Phases of the Moon Calculator

Overview

I was tasked with modernizing two of the data web services the Astronomical Applications deparment puts out: the “Phases of the Moon Calculator“ and the “Complete Sun and Moon Data for One Day.“ Previously these programs were only accessible by a web form and ran on outdated Fortran exectuables. I updated both services to output modern HTML pages with an API for direct access to data.

I used a library created by the Astronomical Applications department to create a C executable that calculated the needed dates and times. Then I wrote a Perl script that calls this executable to generate JSON for the web API. Another Perl script uses the JSON to generate an HTML webpage for users of the web form. The flowchart to the right shows the final structure of the service.



U.S. Naval Observatory
Astronomical Applications Department

Phases of the Moon

2014 Phases of the Moon
Universal Time

New Moon	First Quarter	Full Moon	Last Quarter
d h m	d h m	d h m	d h m
Jan 1 11 14	Jan 8 3 39	Jan 16 4 52	Jan 24 5 20
Jan 30 21 38	Feb 6 19 22	Feb 14 23 53	Feb 22 17 15
Mar 1 8 00	Mar 8 13 27	Mar 16 17 08	Mar 24 1 46
Mar 30 18 45	Apr 7 8 31	Apr 15 7 42	Apr 22 7 52
Apr 29 6 14	May 7 3 15	May 14 19 16	May 21 12 59
May 28 18 40	Jun 5 20 39	Jun 13 4 11	Jun 19 18 39
Jun 27 8 08	Jul 5 11 59	Jul 12 11 25	Jul 19 2 08
Jul 26 22 42	Aug 4 0 50	Aug 10 18 09	Aug 17 12 26
Aug 25 14 13	Sep 2 11 11	Sep 9 1 38	Sep 16 2 05
Sep 24 6 14	Oct 1 19 32	Oct 8 10 51	Oct 15 19 12
Oct 23 21 57	Oct 31 2 48	Nov 6 22 23	Nov 14 15 15
Nov 22 12 32	Nov 29 10 06	Dec 6 12 27	Dec 14 12 51
Dec 22 1 36	Dec 28 18 31		

Back to form

old HTML output

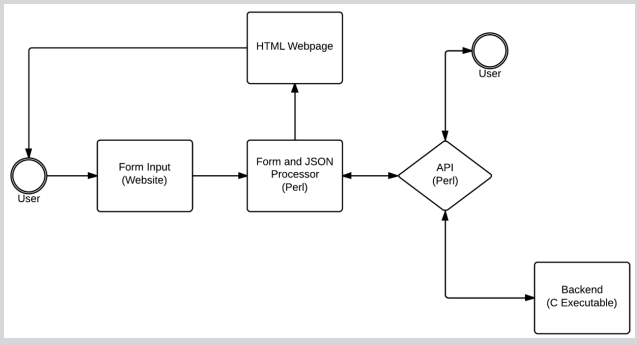


diagram of new service

Smithsonian Air and Space Museum

Volunteer/Explainer

the view inside the McDonnell Space Hangar where I usually worked

Overview

I began my time at the Air and Space Museum as a discovery station volunteer during my sophmore year of high school. I helped teach visitors about aeronautics and space using hands-on demonstrations. For example, one of my favorite stations was the space suit - where I took out a replica EVA suit and explained the different parts of it to visitors. My junior year I was hired as an Explainer, a staff position doing the same volunteering tasks on a more regular basis. I truly enjoyed being able to share my love of space and engineering with others.

showing a rare Pallasite meteorite to a visitor