Mars Mission

Yearlong effort to create a proposal for a manned Mars mission under $5 billion

This project spanned 2 semesters in an aerospace focused systems engineering class. The goal, in line with the 2017 AIAA Space Design Competition, was to create a proposal to send humans to Mars with a budget of $5 billion.

I was the team lead and structural engineer. As team lead, it was my duty to schedule team meetings, communicate between my teammates and the professor, act as a unifying voice when writing reports, and resolve team conflicts. As structural engineer, I was in charge of living quarters, radiation and debris shielding, and return capsule.

The core focus of this project was on systems engineering, especially on determining requirements based on stakeholder goals and refining the design using risk analysis. With guidance from Dr. Zachary Putnam and the NASA systems engineering handbook, I lead my team through multiple program reviews and presentations. In the end, we created a strong proposal which earned third place in the national design competition and an A in the class. We even got the chance to present our proposal to an astronaut in person.

UAVs

Studied and practiced design, programming, and deployment of UAVs in both the classroom and the field

I started working with UAVs in my control system class. I learned coordinate frame transforms, state space control methods, and traditional PID control. I applied this knowledge to fly quadrotors in a MATLAB simulation environment. Later, I took a distributed system control class where I learned control works over multiple agents with limited communication, something useful for quadrotor arrays and autonomous driving. In addition, one of my aerospace lab classes included wind tunnel testing of common UAV NACA airfoils for flight characteristics.

Along with a small team, I began working to create the Coffee Coptor, a quadrotor that delivers coffee. A quadrotor was fitted with a cargo box to hold the coffee and a camera to authenticate delivery using QR codes. I wrote a GNC system that plotted an optimal trajectory, accounted for changing mass, avoided obstacles, and provided extra stability during delivery. Before flying a physical quadrotor, the code was tested in a quadrotor simulation so the bugs could be worked out. Finally, the physical quadrotor was programmed and the first flight was successful.

At General Atomics, I helped to fly quadrotors and fixed-wing UAVs during test events. These quadrotors, fitted with RTK GPS, were flown to test and calibrate radar equipment. I learned how to use the ArduPilot software and Emlid Reach GPS modules. After test events, I compared the data from the radar against the GPS data from the quadrotors

Newspaper

Writer and business manager for TechNews, the IIT student newspaper

I started writing for TechNews during my first semester at IIT. I started writing about interesting restaurants and cultural events I visited within Chicago. Exploring the city was made easy using the unlimited ‘L’ pass which was given to all IIT students. One year, I got a press badge to attend the Chicago Auto Show. As press, I attended the show one day early before the crowds showed up. I was able to take some great car photos for the paper and interview staff from the car brands. Overall, I enjoyed exploring Chicago and writing about my discoveries in the newspaper.

Occasionally I would write about student life and my opinions about the IIT administration. Because of this, I was able to interview multiple administrators including the president of the college. I enjoyed writing about the topics which the student body felt passionate about. This also opened up a dialog which encouraged other to share their opinions by writing for the newspaper.

Other than writing, I was also the business manager for TechNews. It was my job to manage ad contracts, ad placement, and payroll. At the end of the year, the newspaper had some budget leftover which I used to throw a celebration for the staff and frequent writers.

SAE

Designed the frame in CAD for the Baja SAE competition

I was a part of the SAE team at IIT. I designed the Baja tube frame using my familiarity with CAD as well as experience working on my go kart. In this task, I needed to account for the competition design restrictions as well as the geometries needed to fit all the components.

I left IIT before the frame was built, but I came back years later to find that my design made it into the completed vehicle.

Ethics

Ethics moderator in high school and member of the ethics bowl club at IIT

At IMSA, my high school, all of the Juniors participated in an ethics class. This class is taught by Dr. Lee Eysturlid with the help of a handful moderators, Seniors who took the class the previous year. I like the class so much that I volunteered as a moderator. To prepare as a moderator, I read multiple books about the different ethical systems and the history of ethics. In addition, the moderators had meetings to discuss what we learned before teaching it to the Juniors.

As a moderator, I did not teach the students, but facilitated their discussion. I was there to answer questions and provide guidance while the students did their own learning and. Especially on a topic like ethics where there is no single answer, the best I could do was provide historical context and share my opinions.

At IIT, I joined the ethics bowl, a club similar to debate club with a focus on ethics. We would compete against other local colleges on ethics topics. A panel of judges gave each team a stance relating to ethics and were asked to argue for its validity, whether the team members personally believed it or not. The teams would take turns arguing their side of the issue. To whoever made the best ethical reasoning, not the best debating or speaking, the judges would crown the winner.

Eagle Scout

My Eagle Scout project was creating the delivering gift baskets to troops deploying overseas

I was heavily involved in Boy Scouts. I sold popcorn, sold chocolate, went camping, attended Jamboree, and earned the rank of Eagle Scout. To this day, I still enjoy any outdoor activity especially camping and hiking.

For my Eagle Scout project, I decided to create gift baskets for troops deploying overseas. With the help of my troop, I distributed flyers to the local neighborhoods asking for donations. A few weeks later, I collected the donations, filling up 3 vans in total. I took these donations to a sendoff ceremony at a National Guard Armory where I gave them to the troops and their families on the day they left.

Raspberry Pi and Arduino

I’ll tinker with these things all day. I’m always thinking up new projects to use them in.

Some things I’ve made:

Line following robot car

Auto-closing blinds

Media server

Bike wheel LED display

Google home

Wireless speaker

Bluetooth car music adapter

Passive Walker

A project to demonstrate the efficiency of the walking motion, although a bit too heavy

I built a passive walker for my aerospace dynamics class. Based on the computer simulations of the walker, I expected it would walk (at least for a bit) when placed on a slope. However, the actual thing was too heavy and had too much friction to move. Though still a fun thing to build.

EWB

Engineers Without Borders, building a bridge for the people of San Claudio, Nicaragua

I was a part of the Engineers Without Borders organization at IIT. Our goal was to build a bridge for the people of San Claudio, Nicaragua. I looked through site surveys to map where and what resources existed in the surrounding area. The bridge was going to be built using local materials with the assistance of the people living there.

I also attended a national EWB conference where I learned about the projects which other engineers were pursuing.

Tesla Coil

2 foot tall handmade tesla coil that runs off a motorcycle battery

Tesla coils are cool devices. Ever since seeing a tesla coil at the science museum as a kid, I know that I wanted to build my own. I powered the primary coil using a high voltage transformer from an old CRT TV. I hand-wound the secondary coil using magnetic wire and a 2 foot long fiberglass tube.

My goal is to convert this into a musical tesla coil.

Air Cannon

This thing could shoot ice bullets a few hundred yards, all powered by a bike pump

Inspired by MythBusters, a friend and I built an air cannon using 3x 2 liter bottles and some PVC piping. The bottles could easily hold 100 psi, which were pressurized using a bike pump.

Anything could be fired out of the air cannon, but my favorite were ice bullets. I once took the air cannon to an archery range and fired arrows out of it. Even though the arrows were blunt target practice arrows, the arrows buried themselves in the targets up to the fletching.

Model Rockets

Launching everything from Estes kits to handmade rockets with 3D printed nose cones

I started launching model rockets using the Estes kit rockets. Over time, I ran out of larger kits to launch and started building my own. I 3D printed my own nose cones which I designed to exactly fit my body tubes. My altimeter claimed I once got to 2000 feet.

IMSA Engineering

This class taught me basic engineering concepts before I attempted the classic engineering challenges

This was my first formal introduction to engineering. IMSA offered an intro to engineering class that quickly covered the fundamentals before working through a list of engineering challenges including cardboard boat and toothpick bridge.

The final project was a freeform ‘build something useful’ task. I designed a smoke detector for the deaf and blind which sprayed a foul smelling mist and flashed brighter lights. The design could be easily implemented in the home by piggy backing off of conventional smoke detectors. The mist was also refillable, just in case you wanted to use Febreze instead.

Go Kart

Fun and educational. I rode it around and also took it apart to learn how it worked.

My buggy-style go kart was a lot of fun. In the summers I tore up the fields and ran time trials on the streets. But it really came alive in the Illinois winters. After everything iced over, it turned into a drifting machine.

When I wasn’t riding it, I would be working on it. I took apart the entire engine and fixed up the front steering. I added quick remove plexiglas body panels which helped to keep the bugs out of my face and retain some warmth in the winter.

MATLAB

Image processing and analysis

Stereo vision

Thermal management analysis

Control systems

Simulink

CAD

SolidWorks

NX

Solid Edge

Inventor

Linux

Arch and Ubuntu

Media and file servers

Virtualization

Programming

Python

Java

C++

JavaScript

HTML/CSS

Fortran

Photo and Video Editing

Premier pro

Photoshop

Gimp

Languages

German

Chinese

Spanish

Leadership

National Youth Leadership Training (NYLT)

Order of the Arrow

Boy Scouts

Student Government

Fermilab

Lecture series, cleanup, reseeding and control burns

I visited Fermilab multiple time for school, but I also visited on my free time. I enjoyed attending the monthly lecture series talks about current research. In attrition, I helped with their land management efforts including garbage cleanups, control burns, and reseeding.

Cross Country

I started running cross country in middle school and continued it though high school. I was never a fast runner, but I enjoyed running nonetheless. I still try to get in 3 miles every day.

Ultimate Frisbee

At IMSA, the Ultimate Frisbee team had a rough few years. There were no longer any active members. I appointed myself captain and revived the team. I re-wrote the club charter, recruited new members, and ensured that the team would run smoothly for years to come.

(I’ve also done a bit of Frisbee golf)

Biking

I made it through high school and college without a car. A bike was my main form of transportation, only walking or riding a bus in extremely bad weather. One summer, I spent a week biking across northern Illinois on the Grand Illinois Trail. I brought a test with me and camped at local campgrounds. Luckily for me, Illinois is a very flat state which made the trip much easier. California is different story.

Discovery Center

Summer Sleuths