Co-op Work Assignment

During this tour I was part of the Automation, Robotics, and Simulation division of the Engineering Directorate at the NASA Johnson Space Center. Within that division, I was part of the Dynamic Systems Test Branch. The project I was assigned to was the Active Response Gravity Offload System (ARGOS), which is a project that is prototyping the next-generation system to dynamically offload a fraction of a person’s weight in order to better train astronauts for walking on the Moon or Mars. The project is still in its fairly early stages, and much of the work involved is related to prototyping.

I worked on a wide range of projects to assist with the overall development of the ARGOS system. For many of the tasks, I was working closely in a team setting with another co-op and with the other three people who are working on ARGOS. We worked on two motor test stands – one for testing our motor on the bench and one for hooking it up to a single-axis test bed (SAT) in order to test it under inertial loading. We also designed a coupler to connect the motor to the SAT. The motor is extremely powerful so the test stands needed to be properly designed and assembled. I also helped run, monitor, and evaluate the SAT testing. I spent a lot of time working on a full electrical rack to house all of the electrical components of our system with the other co-op. This required the machining of about 40 different plates and panels, as well as assembling them all together. Another project that I worked on was determining the transfer of forces into a test subject in case the system was stopped in an emergency. These forces ended up being at a dangerous level, so we initiated a trade study looking into alternatives. I also served as a point of contact for machine shops that we were using to fabricate some prototype parts. We also did a lot of smaller, miscellaneous tasks and projects that were essential to keeping the overall project moving along on its deadlines – I was always busy.

Since I was part of a small (five person) project, it was very easy to get help whenever I needed an answer to a question. My mentor, the project lead, and our electrical engineer were always more than willing to help out. Everyone else in our branch and division was also very helpful and easy to talk to.

Assessment of Learning and Development

The tasks I was working on while at the Johnson Space Center were very much related to my studies at school. There was a lot of emphasis on the design process, for which MAE 225 prepared me very well. I was also able to make use of my statics and dynamics courses throughout the tour.

During the tour, I really got to experience how NASA operates. It was very interesting to both experience and observe how everything is done, since it’s not quite like a normal business. I think that being placed in a professional setting where I was working 40 hour weeks also helped me grow professionally and understand a lot more of how engineering is done in the real world.
Life Outside of Co-op

The Johnson Space Center provided a great housing guide to assist us in finding housing, so it ended up being very easy. Two other co-ops (one from Cornell who was co-oping with USA and one from the University of Texas) and I ended up renting out the upper floor in the house of a NASA employee. This made things very easy for us (and cheap!). Unfortunately, the Houston area is set up so that a car is really necessary, so it's a bit of a long drive getting all the way down here. However, since everything is so spread out, there is really no way to get around without one so it's worth it.

Since there were a lot of other co-ops working at the Johnson Space Center (40+ civil servants and another 50 contractors), there was always something to do socially. We went to Galveston beach (before Hurricane Ike hit), played volleyball, went rock climbing, played disc golf, went skydiving, had BBQ's and pool parties, and hung out a lot on the weekends. There were also numerous tours that we were able to go on of various facilities at the Johnson Space Center, as well as lectures given by historical figures such as Gene Kranz (the flight director for Apollo 13) and Chris Kraft (the first flight director). I also took a roadtrip with three others all the way to Cape Canaveral, FL to watch the STS-126 Shuttle launch. Since we were all NASA civil servants, we were able to get on-site at the Kennedy Space Center and watch the launch from the closest location that they allow people.

Evaluation

Overall, this was a great co-op tour that I really enjoyed. The work was interesting and kept me busy, while the people I worked with were extremely nice and fun. Coming through the main gates and working around some of the really cool stuff here was an awe-inspiring experience every single day of the tour.
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Job Summary

For my tour this summer, I was in the Propulsion and Fluid Systems Branch (EP4) within the Energy Systems Division in the Engineering Directorate at NASA’s Johnson Space Center (JSC), in Houston, TX. This branch is responsible for a wide range of propulsion duties for manned spaceflight, including the Space Shuttle’s main propulsion system and reaction control system (RCS). In addition, EP4 is also working on propulsion systems for NASA’s next generation of spacecraft in the Constellation program, such as the RCS for the Crew Exploration Vehicle (CEV) and propulsion concepts for the next lunar lander.

My main project this summer was working on a project testing a mockup of the CEV Crew Module RCS fluid lines. The objective of the testing was to build a system to simulate the fluid dynamics of the RCS fluid system during normal operations such as system activation and cycling of the thrusters. The main fluid dynamics that we were looking into was the phenomenon known as waterhammer, where sudden changes in velocity of an incompressible fluid (such as a thruster closing) can cause huge pressure transients. In addition, a computer simulation was constructed alongside the test system in order to anchor the model to the system and assess EP4’s current fluid modeling capabilities. My duties with this project included assisting with the testing procedure at our test facility, plotting and analyzing our data quickly and efficiently, and performing data reduction. I mainly used the software Igor Pro to do my work, and became very efficient at writing code to automate the process as much as possible in order to be able to analyze the data very quickly. My mentor was one of the main people working on this project, so I spent a lot of time working with him throughout the summer.

I also worked on many secondary projects throughout the summer that gave me a glimpse into the wide range of what EP4 does. One of these projects was working on testing a redesigned thruster rain cover for the Space Shuttle. When the Shuttle is on the launch pad before launch, the forward RCS thrusters are covered by Tyvek rain covers, which prevent water from getting into them (which would corrode the thrusters and also freeze once the Shuttle was in space, possibly preventing them from operating correctly). These rain covers have a parachute design that inflates upon launch so that they peel away at low velocities when they can’t damage the Shuttle if they impact it. Unfortunately, the current design has shown to be prone to tearing on one thruster, and the remnant that remains can be released at a high, dangerous velocity. My duties with this project included helping to construct a full buildup of over 150 covers throughout the summer, as well as making two trips to Texas A&M’s wind tunnel to conduct testing.

Another secondary project I worked on was creating a CAD model and 3D printer model of a ball valve that’s found on the Shuttle’s main propulsion system. There recently has been a problem with this particular ball valve where a seal was cracking for unknown reasons. In order to help the engineers working on the problem visualize what was going on, I used drawings from 1976 to create a full model of the valve. I also used a 3D printer to print a cross section of the valve for them to use during presentations and discussions so that it’s easy to see how all the internal components fit together.

Finally, I did some work with the Cryo Cart project, which is working on developing a mobile cryogenics system that can provide liquefied oxygen and methane to test articles, giving EP4 much more
flexibility in its testing. I worked on creating a drawing for an electronics shroud as well as getting the shroud manufactured after sending out an RFQ. Another project I did with Cryo Cart was designing a support structure for the liquid line front panel. This support structure had to support a decent amount of weight, be resistant to any forces if something bumped into it, and navigate through a preexisting maze of fluid lines. Finally, I did a trade study comparing various thermal greases for use in the system.

My work activities were related to what I’ve done at Cornell, but I still definitely learned a lot and developed my skills while here. A lot of the CEV waterhammer testing involved things that I learned during MAE 3230, but were much less theoretical. Also, while Cornell classes have helped me hone my engineering judgment a bit, there’s no substitute for actually having to do the work in a real world setting. It’s an invaluable benefit of co-op’ing.

I feel that this tour combined with my previous tour to further help me develop professionally. It’s helped me continue to develop my communication skills in the workplace, as well as learn more as an engineer. It has also given me a nice, different perspective than my last tour, since I was in the Automation and Robotics Division last fall. Both of these tours combined have given me somewhat of an idea of the wide range of the engineering that goes on at JSC.

The Johnson Space Center co-op program really does a great job connecting co-ops. During the summer between civil servant co-ops and interns and contractor co-ops and interns, there are a huge number of college students in the area. JSC provides a social listserv for us to use in order to organize social events, athletic activities, etc. For example, I was playing soccer on Mondays, volleyball or softball on Wednesdays, softball on Thursdays, and would always have something to do over the weekend (even things like trips to Austin for July 4th or trips to the beach, etc). JSC also allows us to organize tours and lectures, so we’re able to see all the cool things that go on here, as well as hear some very historical and knowledgeable people speak. For example, this summer we spoke with Chris Kraft (first flight director), Gene Kranz (famous for being the flight director of Apollo 13), Eileen Collins (first female commander), Mike Coats (former astronaut and current Director of the Johnson Space Center), Walter Cunningham (Apollo 7 astronaut), Duane Ross (head of astronaut selection), and Steve Altemus (Director of Engineering at JSC), among others. We also organized a “Bridging the Gap” picnic, where the civil servant co-ops mingled with most of the upper management at JSC (from branch chiefs all the way up to Mike Coats).

Overall, my tour in EP4 for the summer of 2009 was a great experience, where I had plenty of meaningful projects to work on and really had a good time.