Flight Planning Branch NASA Co-op Tour

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July 22, 2013

Mechanical and Aerospace Engineering

NASA Johnson Space Center

Third Work Term – Summer 2013

ABSTRACT

This semester I worked with the Flight Planning Branch at the NASA Johnson Space Center. I learned about the different aspects of flight planning for the International Space Station as well as the software that is used internally and ISSLive! which is used to help educate the public on the space program. I had the opportunity to do on the job training in the Mission Control Center with the planning team. I transferred old timeline records from the planning team's old software to the new software in order to preserve the data for the future when the software is retired.

I learned about the operations of the International Space Station, the importance of good communication between the different parts of the planning team, and enrolled in professional development classes as well as technical classes to learn about the space station. Many of the projects were proprietary and some details in this report may be vague.

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INTRODUCTION

This summer I worked at the National Aeronautics and Space Administration's Johnson Space Center in Houston, Texas. My experiences here over the last year and a half have been incredible. I have learned more than I could have every imagined about the intricacies of sending and maintaining objects in space. This place has taught me many new skills and the experience has shaped my career in engineering in ways I never would have imagined.

Over the past few months I have been working in the Flight Planning Branch. The Flight Planning Branch is involved in many different aspects of spaceflight. The major task that they are charged with is the day-to-day planning of the International Space Station. There are many different Mission Control Center consoles that are manned by the Flight Planning Branch.

The Flight Planning Branch does integrated planning for other NASA missions such as NASA's Extreme Environment Mission Operations where they study human survival conditions underwater and NASA's Orion, which is a Multi-Purpose Crew Vehicle that will begin flying next year. The Flight Planning Branch is involved with commercial space travel and will be providing planning support on future commercial missions.

The Mission Control Center and planning team require many different tools to efficiently do their jobs. The flight planning branch is in charge of developing and maintaining the wide array of tools that are used to maintain objects in space. I used many of these tools for my projects and helped with developing ISSLive!.

CONSOLE TRAINING

On The Job Training

Figure 1: Mission Control Center

Much of the work that is done in the Flight Planning Branch is on-console work in the Mission Control Center in Houston, shown in Figure 1. I had the opportunity to sit with the Operations Planner (Ops Plan) and many other different positions on the team throughout my training term. Ops Plan is the front room mission control operator and takes around five years of training. I learned what each position does and how they interact with other positions and the rest of the flight control team. Each step that they take is a very integrated process and involves a majority of the flight control team because of the many constraints on each activity that is being performed.

Long Range Planning Support Training

This semester I began the training certification for Long Range Planning Support. The Long Range Planning Support puts together the space station plan a few weeks before it is to be executed. After this week-long plan is finished it is transformed by the other planners into an executable plan that will eventually be sent to the space station. The training for Long Range Planning Support includes learning a wide array of information about all of the different systems on the space station. The planning team has to coordinate activities for each different system and isn't limited to knowledge of a certain area. I took online classes that taught me about the

thermal, electrical, life-support, medical, payloads, motion control, stowage, structures, and data management areas of the space station.

The certification for Long Range Planning Support also requires learning the many different tools that the planning team uses. I participated in classes and went through training manuals and workbooks to learn these systems. I am scheduled to complete this certification before the end of summer.

TIMELINES

My major project this semester was to convert timelines from the planning team's old software to new software that they will begin using later this year. Timelines are the list of activities laid out in time sequence of what occurred or is going to occur on the space station. This project is very important because the old software will be retired and it will be impossible to get the timelines back once this happens and they are a detailed history of what has happened through the International Space Station Program. A sample timeline from ISSLive! is shown in Figure 2. This timeline shows a short amount of time and only one crewmember and is much less complicated than the ones the planning team work with but gives a general idea of how a timeline looks.

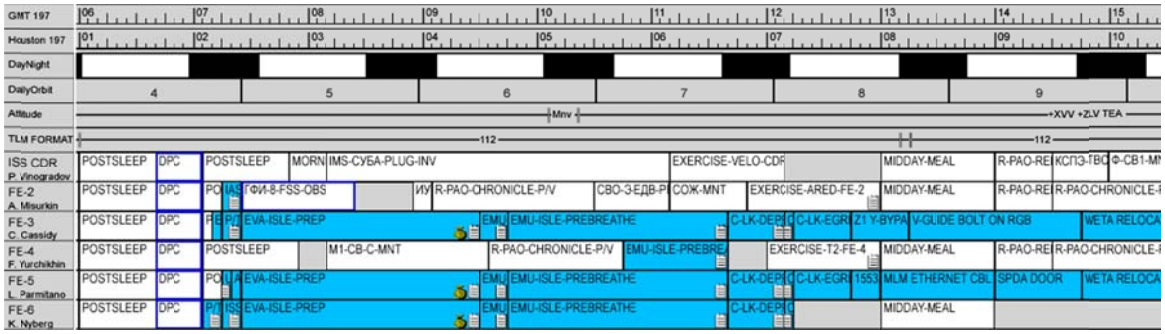

Figure 2: Timeline Example

To complete this project I had to use many of the planning tools that I learned about in my Long Range Planning Support training. The timelines are up to thirteen years old and have been through many software updates. The first step was to check the oldest timelines to see if they were compatible with the new system. I pulled timelines from the archive that coordinated with each update of the system and then attempted to open them. Many of the older timelines had to be imported from another program before they could be opened in the new program. The next step was to check the timelines against a known history to ensure that they were correctly moved to the new program. The timelines with a large amount of error or that had trouble opening were noted. After the timelines were checked and corrected they were sent to the new planning software's database. The timelines with errors or that couldn't be opened were tested with different processes and then I recorded which one works for that version of the software. Once this testing is complete there will be a list of what processes work for each version and it will be easier to move all of the timelines over to the new system.

ISSLIVE!

This semester I had the opportunity to work with the ISSLive! team and help continuing development for the website. ISSLive! can be found at: http://spacestationlive.nasa.gov/. It is an educational tool used to allow the public to interact with International Space Station live data that is being streamed through the interface. ISSLive! provides timelines for astronaut activities and science activities, an assembly

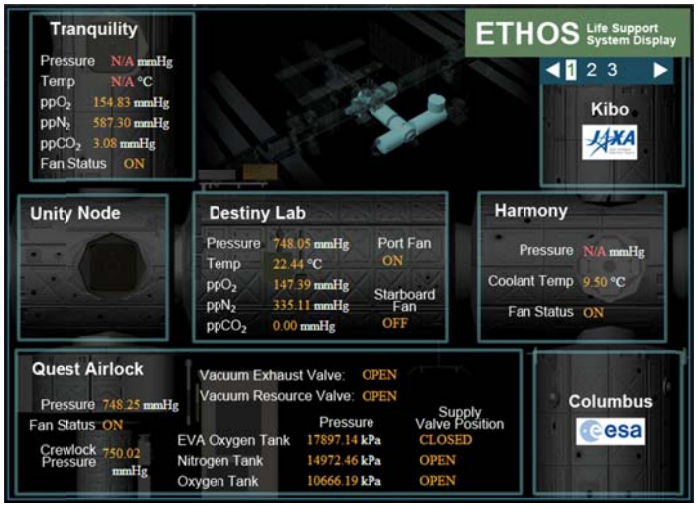

Figure 3: ISSLive! Ethos Console Screen Capture

video, and an interactive space station and mission control center. ISSLive! streams live console data into its interface to allow you to see what is happening on the space station at any moment. A sample of the Ethos Console on ISSLive! is shown in Figure 3 and a sample timeline is shown in Figure 4.

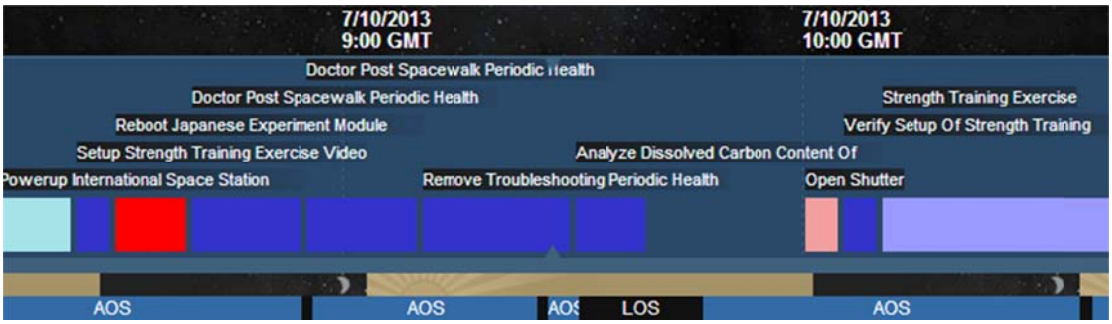

Figure 4: Sample Timeline from ISSLive!

My project with ISSLive! was to help complete the Application Programming Interface (API). An API is used for web-designers to use data from a certain website and integrate it for their own purposes. It is typically used on a webpage or on a mobile application. The ISSLive! API will return values in Extensible Markup Language (XML) or JavaScript Object Notation (JSON). These are languages that are human readable as well as machine readable. They format the data in a way that it can easily be separated and incorporated in a different program that is designed to interact with the file.

My project with ISSLive! was to set up the database that the API would pull data from. This database is everything that is allowed to be seen by the public. It includes things such as the current value, units, minimum value, maximum value, and the number format. I had to learn C++ to convert the number formats to the value that is easiest to incorporate into a program. With the C++ format stored into the database, when a developer is designing software they can have the database automatically format the data even if the data type changes later.

The next challenge was to provide a set of instructions for the API so that developers understand what data they are getting from the files they receive in order to better use them. I spent time learning C++, SQL, and JavaScript as well as understanding JSON and XML to complete this task.

SUMMARY

I have learned a lot this summer about what it takes to plan for such complex operations as sustaining a space station and the people in it. The training in Long Range Planning Support taught me about time management on a scale I never thought possible. Working in the Mission Control Center reminds me how big a role communication plays in our everyday lives and that no matter how much training you have, there is always room to get better at anything you do.

The ISSLive! and timeline projects both taught me about software development and programming. The timeline project gave me a glimpse into the space stations past and the differences between the beginning of the International Space Station Program and the current efforts. I had the opportunity to work with various people throughout the NASA community this tour and learn about aspects of the space program that I had never thought about before this summer.