Kennedy Space Center ITC-1 Internship Overview

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I. Abstract

As an intern for Priscilla Elfrey in the ITC-1 department, I was involved in many activities that have helped me to develop many new skills. I supported four different projects during my internship, which included the Center for Life Cycle Design (CfLCD), SISO Space Interoperability Smackdown, RTI Teacher Mentor Program, and the Discrete Event Simulation Integrated Visualization Environment Team (DIVE). I provided the CfLCD with web based research on cyber security initiatives involving simulation, education for young children, cloud computing, Otronicon, and Science, Technology, Engineering, and Mathematics (STEM) education initiatives. I also attended STEM meetings regarding simulation courses, and educational course enhancements. To further improve the SISO Simulation event, I provided observation feedback to the technical advisory board. I also helped to set up a chat federation for HLA. The third project involved the RTI Teacher Mentor program, which I helped to organize. Last, but not least, I worked with the DIVE team to develop new software to help visualize discrete event simulations. All of these projects have provided experience on an interdisciplinary level ranging from speech and communication to solving complex problems using math and science.

Acronyms

CfLCD.....Center for Life Cycle Design
HLA.....High Level Architecture
SISO .....Simulation Interoperability Standards Organization
STEM.....Science, Technology, Engineering and Mathematics
DIVE.....Event Simulation Integrated Visualization Environment Team
DES.....Discrete Event Simulation

II. Introduction

A. Center for Life Cycle Design (CfLCD)

The Center for Life Cycle Design was created to increase modeling and simulation influences in the education system and workplace. The organization is gathering information on where it is useful, and why simulation is so important. CfLCD wants to stimulate job growth in modeling and simulation, as well as create as many as 6000 new jobs in the field. Some reasons for promoting CfLCD is that modeling and simulation is a green industry, which is politically attractive while being environmentally friendly. Simulation has also proven to be recession proof with over 10,000 open jobs.[2] New commercial venues can be easily started because the customer does not want to pay for information. Information is almost always free, whether it be online or through a friend. Simulation aims to create an experience that the customer, or student, can see, touch, hear, smell, or even taste. Simulation is also hopeful when the real thing just costs too much money, time, or effort. An engineer would much rather test a new rocket on simulation software, before actually going out and launching the real thing. Modeling and simulation can also train and implant skills into the student without the cost.

Center for Life Cycle Design initiatives include the planning of long-term education development, tracking all of the benefits of modeling and simulation, promoting the success stories, promoting short and long term job creation, sharing resources, promotion of Science, Technology, Engineering, and Mathematics Education (STEM), and develop partnerships through universities. The CfLCD wants to use STEM education to stimulate the interest of simulation engineering in young children. Unfortunately, according to the Organization for Economic Cooperation and Development, in 2003 the United States ranked 25 and 20 in math and science education respectively.[9] The

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STEM education system was actually created to improve the education system in the United States due to this enormous problem. Many high, middle, and elementary schools are adopting new lesson plans to support STEM education.

B. SISO Space Interoperability Smackdown

"The SISO Simulation Smackdown is an effort to promote the concepts of modeling and simulation as a discipline at the university undergraduate and graduate levels and to raise awareness of modeling and simulation down into the K-12 grades."[3] To promote these concepts, Aegis Technologies has supported a participatory program that will get students from universities all over the world to create sub simulations of a whole lunar base space system simulation. High Level Architecture (HLA) will be used to bring all of these components together, a program initially used by the Department of Defense. By using the HLA system along with pitch RTI, the students will connect all of their projects together to create one whole simulation. Their first Smackdown was completed in April of 2011, which included participation from many teams from different universities. These universities included the University of Alabama, Massachusetts Institute of Technology, Bordeaux, Genoa, and a NASA student intern team.[3]

C. RTI Teacher Mentor Program

There is not enough engineering and science influence in the education system, especially for modeling and simulation. To help fight this situation, teachers from all over the U.S. will be brought in to learn how engineering applications can be applied in their lesson plans. NASA will be helping in this development by providing engineering mentors to help the teachers understand how they apply modeling and simulation to the work that they do. Some of the program goals for teachers include:

1. Leave with a better understanding of how to marry modeling and simulation with their lesson plans.
2. Use these simulation tools to actually teach kids through experimentation and simulation.
3. Show how math is used in creating NASA systems and get the students excited about modeling and simulation.
4. Get teachers to implement new lesson plans and disseminating them to other teachers in their school districts.
5. Provide unique hands-on experience at a NASA facility where teachers will get to work with cutting edge technology, investigate aerospace engineering concepts, and create lesson that will motivate their students.

This is a great opportunity for engineers in the modeling and simulation industry to really show students how all of their knowledge, regarding to math and science, is used in their research.

D. Event Simulation Integrated Visualization Environment Team (DIVE)

As a joint workforce between NASA and QinetiQ NA, a team of software engineers, industrial engineers, computer scientists, and systems analysts have come together to create a program that will help visualize discrete event simulations. Currently, NASA uses Simio to create multiple replications of discrete event simulations over multiple time periods. The problem is that the data coming from Simio must be analyzed by an expert for it to be useful. DIVE aims to create a multi user interface that will encompass Simio simulations. Currently, the DIVE team has created a visual interface, using "Google Earth", which will represent the data with 3-dimensional models. This effort will greatly improve communication between system analysts, engineers, and management.

III. Center for Life Cycle Design Web Research and STEM Initiatives

A. Cyber Security Research

Supporting the Center for Life Cycle Design and STEM education was one of the few responsibilities I held during my internship. To start off, the organization was very interested in cyber security initiatives. In many instances cyber security uses simulation to train their professionals to guard against cyber attacks and the like. One of my research topics included the introduction of cyber security to children. During my research I found that Secure Florida is providing short videos for children on how to stay safe and secure. Secure Florida also offers many classes to introduce the importance of staying safe. The main program introduces cyber risks, counter measures, email safety, and networks. They also offer an online safety course designed for middle school students. Another source of influence comes from the US Cyber Challenge. "The High School Cyber Challenge is designed to find students interested in computer science, and expose them to cyber-security. The competition utilizes quizzes written by the world's foremost cyber-security experts. The quizzes are given to the students, who are allowed to work on them

alone or in teams."[4] Exeter West Greenwich High School, Cranston Career and Technical Center, Warwick Career and Technical Center are the 3 high schools in Rhode Island running the pilot program. The main reason behind these initiatives is that the government is desperate for cyber-security pros, "We probably have only 1,000 of those people in the whole country, and we need between 10,000 and 30,000 in the next couple of years,"[5] said Alan Paller, director of research at the SANS Institute. As you can imagine, the modeling and simulation community would really like to tap into these initiatives to get proper representation.

B. Children Education

The second opportunity I had with the CfLCD was to find ways to get young children excited about the engineering field at a young age. It is important to show children how important and fun math and science can be at a young age. To further improve my understanding of children education I conducted children education research online. To add on to the web research, I interviewed systems engineers, mechanical engineers, industrial engineers, project managers, and computer scientists to find out how they got involved with math and science at a young age. With this information in hand I created a small lesson plan designed to teach 5th graders how to compute probabilities, and how they are used at NASA. Having a relation between math and the workplace really does wonders for getting children to realize just how important the subject is. Some other lesson plan suggestions included Lego building, structural stress testing, and center of gravity testing.

C. Science Technology Engineering and Math Education

Science Technology Engineering and Math (STEM) education is also a very important subject of the CfLCD. STEM has some great values; however, the system is a mess. Many organizations, private and public, want to help by providing their services, but the definition of the initiative gets skewed. It is also very difficult to find out who is doing what, and causes a lot of confusion between the students looking to get STEM education, and the organizations providing it. For instance, NASA runs over 70 STEM initiatives, but there is no complete list. It is a grueling process to find these programs, and sign up for them. To further help improve the program I searched and searched for all of the available STEM programs offered throughout Florida. To my surprise I found that Merritt Island High School just began offering a STEM education program that focuses in on the Aerospace Engineering field called the Da Vince Academy. To get more information on how these programs worked, I set up an interview with the program director, as well as one of the engineering teachers. The Da Vince Academy is a very rigorous program that tests the ability of their students in math, science, and engineering. The students must go through four separate engineering courses, as well as a capstone design class. The graduates are then encouraged to attend a Florida university that will accept their high school engineering accomplishments.[6] Many other Florida high schools are also offering similar programs in the engineering field which include, Crooms AOIT, Edgewater, Hagerty, Lyman, Oak Ridge, Timber Creek, and University High School.[7] The main problem, as stated before, is that these schools are not easy to find. It should be noted that all of the STEM schools should be listed under one reference to help organize this huge initiative.

D. Mentor Representation and Shadowing

I was also held responsible for representing and accompanying my mentor at CfLCD meetings on several occasions. One of my first trips was to the Orlando Science Center to meet with the education director Kellen Nixon. The Orlando Science Center has shown great interest in providing a venue for the Modeling and Simulation community to represent them self in an educational manner. During the meeting we discussed how the Center could help with exposing children to simulation in cyber security, and how important simulation is to the advancement of technology. I also attended the National Center for Simulation (NCS) committee meeting. NCS is looking to incorporate a new course in high schools that will teach students the basics of creating, running, and analyzing a simulation. During the committee meeting, I voiced my opinion on the importance of communication between organizations working on STEM projects. I was also a part of the advisory meeting held for the Da Vinci Academy at Merritt Island High School. I have taken a lot of experience from these meetings in many different forms. It has helped with my understanding of how programs are created and supported, as well as speech and communications skills.

IV. SISO Simulation Smackdown Observer

A. Technical Meeting Attendee

During the Simulation Smackdown planning, I became a part of the technical committee. I attended telecom conferences every week with, simulation analyst, Martin Steele and, Industrial Engineer, David Miranda to see how all of the teams were performing, learn how the simulations interact, run simulation tests, and HLA programming. David and I also did testing to figure out how the computers would connect to each other over the virtual private network. To accomplish this task, we created a chat federate with the main purpose of talking to other chat federates. Martin then connected his chat federate to the simulation, and we were able to communicate using the HLA system. Of course, this becomes much more complicated when the federate is a space vehicle that is communicating with the surface of the moon, or any other vehicle federate.

B. High Level Architecture Research

It was important for me to understand the basics of HLA programming. As mentioned before in the introduction, HLA stands for High Level Architecture, and is used to combine simulations from different locations. To begin, HLA is an object oriented programming language that runs in sync with pitch RTI. This RTI console connects all of the computers running simulations. The federate, mentioned above, is the object of the programming language. The federate has all of its own features, data structures, and initial conditions. To simulate the combination of federates in one single world, these federates are brought together to form a federation. HLA basically creates this federation off of all the input from the individual federates. Some of the federates that were created this year include a satellite, high mobility scouting hopper, fuel resource center, lunar orbit shuttle, lunar transport rover, and supply cargo depot.[3]

V. RTI Teacher-Mentor Program Support

A. Planning Committee

I was the point of contact for the ITC-1 department's involvement with the teacher-mentor program being hosted at the Kennedy Space Center over the summer. As the point of contact, I attended telecom conference meetings every other week to provide progress reports to RTI, the sponsors of the program. I also informed Priscilla Elfrey of all the ongoing developments within the planning committee, and the progress of the overall program schedule.

B. Information Gathering

Since this was the first time that the Kennedy Space Center was going to host this program, there was not a lot of knowledge about how the program worked, or what was expected of the ITC-1 group in this endeavor. To start, I sent a briefing letter to the CTO of ICT-1, Benjamin Bryant, informing him of all the duties expected of the simulation-engineer mentors. Four mentors, simulation engineers, needed to be selected to help get these teacher-interns hands-on work experience in the engineering field. These mentors are required to create a small presentation of the research that will be worked on, and commit 15 hours over a 2 week period.[8] Once the mentors were chosen, I gathered all of the biography information on the mentors, as well as information about the project they will be working on in the future. This information is then going to be used to properly disperse the selected teacher-interns that will be joining us during the summer.

ITC-1 is not the only NASA department involved with the program. The education department is heading the learning lesson development at the education center. The teacher-interns will be spending much of their time learning background information on simulation technology, as well as techniques for bringing these work related experiences into the class room. I met with Lina Rosado to review the location of the class room, as well as all of its features. I also worked with Lisa Valencia to set up meeting times for RTI.

VI. Discrete Event Simulation Integrated Visualization Environment (DIVE) Development

A. DIVE Project DES & Development Collaborative Working Sessions

I was invited to join the DIVE team's working session every Thursday morning. During the work session the team discussed many things, one of which included project progression. Each team member had different tasks,

and updated the team on their task progression. The topics of discussion also included debugging, program enhancements, innovative thinking, and project agenda. For the first five to six sessions, I was simply an observer. Once I had firm understanding of the project and their goals, David Miranda provided me with the opportunity to present an idea I had to solve one of their problems. The problem was, "How do you represent multiple replications of a simulation on one visual interface?" The idea was to represent the data with a progress bar, except this progress bar also has the ability to represent the statics of the data as well.

B. Probability Progress Bar and Box Plot Creation

The first task during my DIVE career was to create a box plot and progress bar to represent the incoming data from Simio. These features needed to be placed on a web page using JavaScript and HTML5. With no previous programming experience, I received direction from Jason Miller on the basics of programming in JavaScript and HTML5. To start, I created a webpage to host these developing models to easily change, and debug the program. Once I did some research on Object Oriented Programming, and the JavaScript nomenclature, I began creating lines and boxes that would change with data input. The next feature was a tooltip that would pop up when hovering the mouse pointer over the plots. The tooltip included information about the data, which included the average, median, maximum, minimum, upper quartile range, and lower quartile range. To compute these values, I created mathematical functions in JavaScript that could be called anywhere on the webpage. See Figure 1 for the JavaScript code to compute the lower quartile range. The last feature of this utility was to display the maximum, minimum, and average values below each plot. To accomplish this, the position of the values had to be matched with the position along the graph. This gave the impression that the values were moving along with the progress bar or box plot. See Figure 2 for the beta version of the box plot and probability progress bar.

```
117 function quart25Calc(a)
118 {
119         sortArray(a)
120         var l = a.length
121         if ((l+1)%4 == 0)
122                 return a[((l+1)/4)-1]
123         else if (((l+1))%4 <= .3)
124                 return a[Math.round((l+1)*(1/4))-2]
125         else if (((l+1))%4 >= .6)
126                 return a[Math.round((l+1)*(1/4))-1]
127         else
128                 var x1 = Math.round((l+1)/4)
129                 return (a[x1]+a[x1-1])/2
130
131 }
```

Figure 1. JavaScript Code for Calculating Lower Quartile

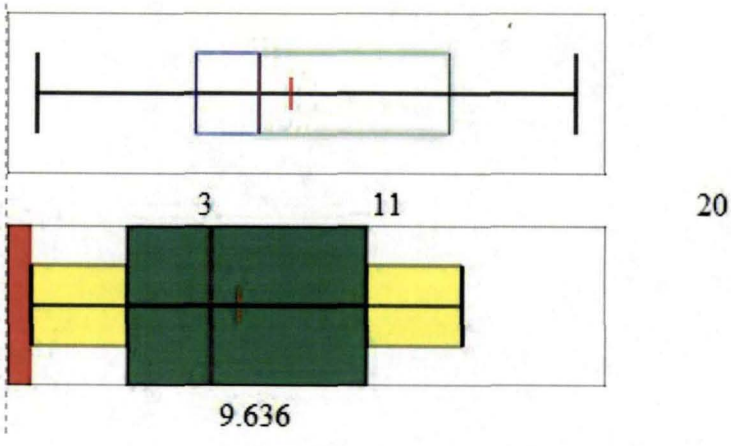

Figure 2. Box Plot (top) and Progress Bar (bottom)

C. Object Movement

The next task is to create a button that will be clickable. Not only will this button be clickable, but once clicked, the user will be able to move 3-dimensional objects from one place to another. This will also be done using JavaScript and the API nomenclature of Google Earth.

VII. Conclusion

Working for the ITC-1 group at KSC has been an incredible experience. I have developed many new skills that will help pave the way for a hopeful career in mechanical engineering. Some of these skills include communication, computer programming, and web research. The internship has also opened my eyes to NASA sponsored initiatives aimed toward STEM and children education. NASA has ensured the success of future generations.

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