NASA JSC Summer 2016 Internship Abstract
28th July, 2016

Submitted to: Missy Matthias & Melissa Corning, USRA/JSC Intern Coordinator
Submitted by: Nicholas Mercury Carlstrom, JSC Intern
Reviewed by: Meghan Daley, NASA Mentor - ER7 Simulation and Graphics Branch

Title: Simulation of Mission Phases

This position with the Simulation and Graphics Branch (ER7) at Johnson Space Center (JSC) provided an introduction to vehicle hardware, mission planning, and simulation design. ER7 supports engineering analysis and flight crew training by providing high-fidelity, real-time graphical simulations in the Systems Engineering Simulator (SES) lab. The primary project assigned by NASA mentor and SES lab manager, Meghan Daley, was to develop a graphical simulation of the rendezvous, proximity operations, and docking (RPOD) phases of flight. The simulation is to include a generic crew/cargo transportation vehicle and a target object in low-Earth orbit (LEO). Various capsule, winged, and lifting body vehicles as well as historical RPOD methods were evaluated during the project analysis phase. JSC core mission to support the International Space Station (ISS), Commercial Crew Program (CCP), and Human Space Flight (HSF) influenced the project specifications.

The simulation is characterized as a 30 meter +V Bar and/or -R Bar approach to the target object's docking station. The ISS was selected as the target object and the international Low Impact Docking System (iLIDS) was selected as the docking mechanism. The location of the target object's docking station corresponds with the RPOD methods identified. The simulation design focuses on Guidance, Navigation, and Control (GNC) system architecture models with station keeping and telemetry data processing capabilities. The optical and inertial sensors, reaction control system thrusters, and the docking mechanism selected were based on CCP vehicle manufacturer's current and proposed technologies.

A significant amount of independent study and tutorial completion was required for this project. Multiple primary source materials were accessed using the NASA Technical Report Server (NTRS) and reference textbooks were borrowed from the JSC Main Library and International Space Station Library. The Trick Simulation Environment and User Training Materials version 2013.0 release was used to complete the Trick tutorial. Multiple network privilege and repository permission requests were required in order to access previous simulation models.

The project was also an introduction to computer programming and the Linux operating system. Basic C++ and Python syntax was used during the completion of the Trick tutorial. Trick's engineering analysis and Monte Carlo simulation capabilities were observed and basic space mission planning procedures were applied in the conceptual design phase.

Multiple professional development opportunities were completed in addition to project duties during this internship through the System for Administration, Training, and Education Resources for NASA (SATERN). Topics include: JSC Risk Management Workshop, CCP Risk Management, Basic Radiation Safety Training, X-Ray Radiation Safety, Basic Laser Safety, JSC Export Control, ISS RISE Ambassador, Basic SharePoint 2013, Space Nutrition and Biochemistry, and JSC Personal Protective Equipment. Additionally, this internship afforded the opportunity for formal project presentation and public speaking practice.

This was my first experience at a NASA center. After completing this internship I have a much clearer understanding of certain aspects of the agency's processes and procedures, as well as a deeper appreciation from spaceflight simulation design and testing. I will continue to improve my technical skills so that I may have another opportunity to return to NASA and Johnson Space Center.