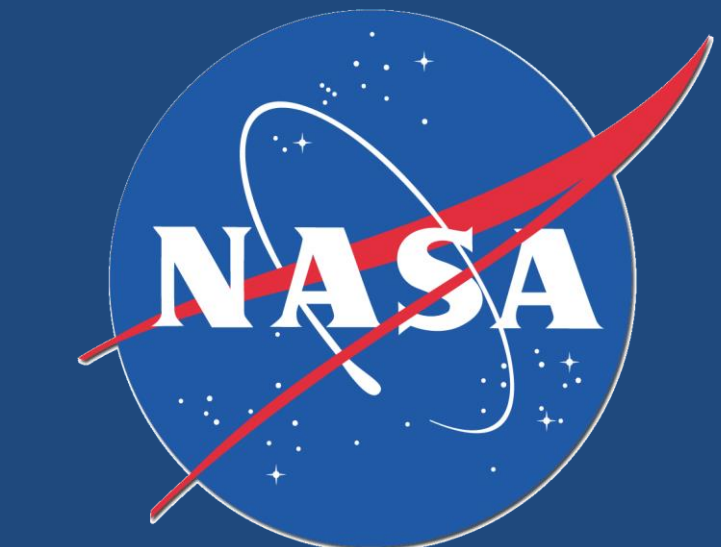


Hybrid Propulsion Systems Studies For RVLT



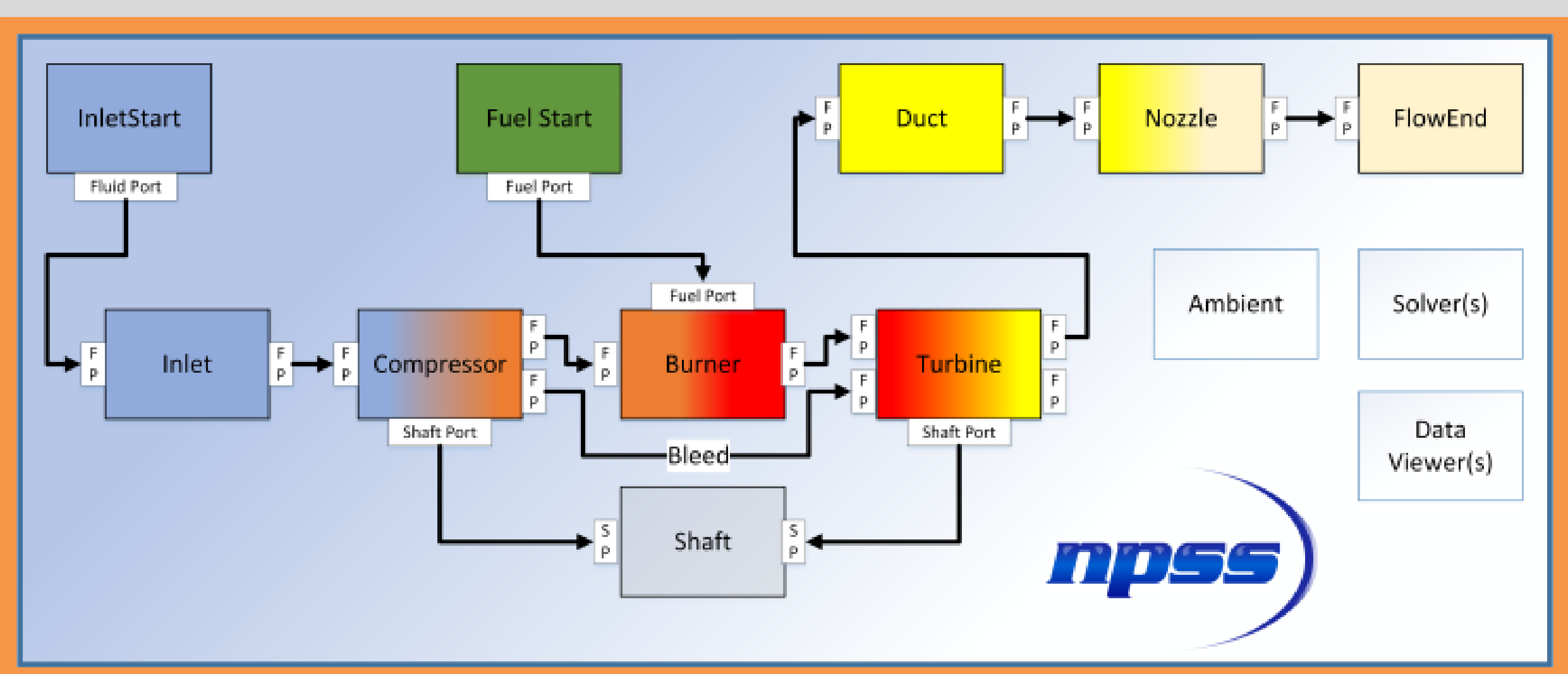
Task

During this internship my role was to perform hybrid propulsion system studies for RVLT and AATT efforts. This included working with NPSS (Numerical Propulsion System Simulation), an object oriented Simulation software for turboshaft and turboprop designs. Using MATLAB Simulink's S-function block as a bridge, my original task was to combine previously modeled turbine engines with electrical generators/motors.

To constrain the scope of my task, my efforts where narrowed down to only focusing on the controllability of the NPSS integrated models within Simulink. This entailed working with the PW127 Pratt & Whitney and the Rolls-Royce M250 engine models, where I generated data that focused on finding bounds to these models operating conditions. This was visualized via graphing turbine characteristics with varying input parameterize to start gaining knowledge that will help resize and balance the turbines for necessary design specs.

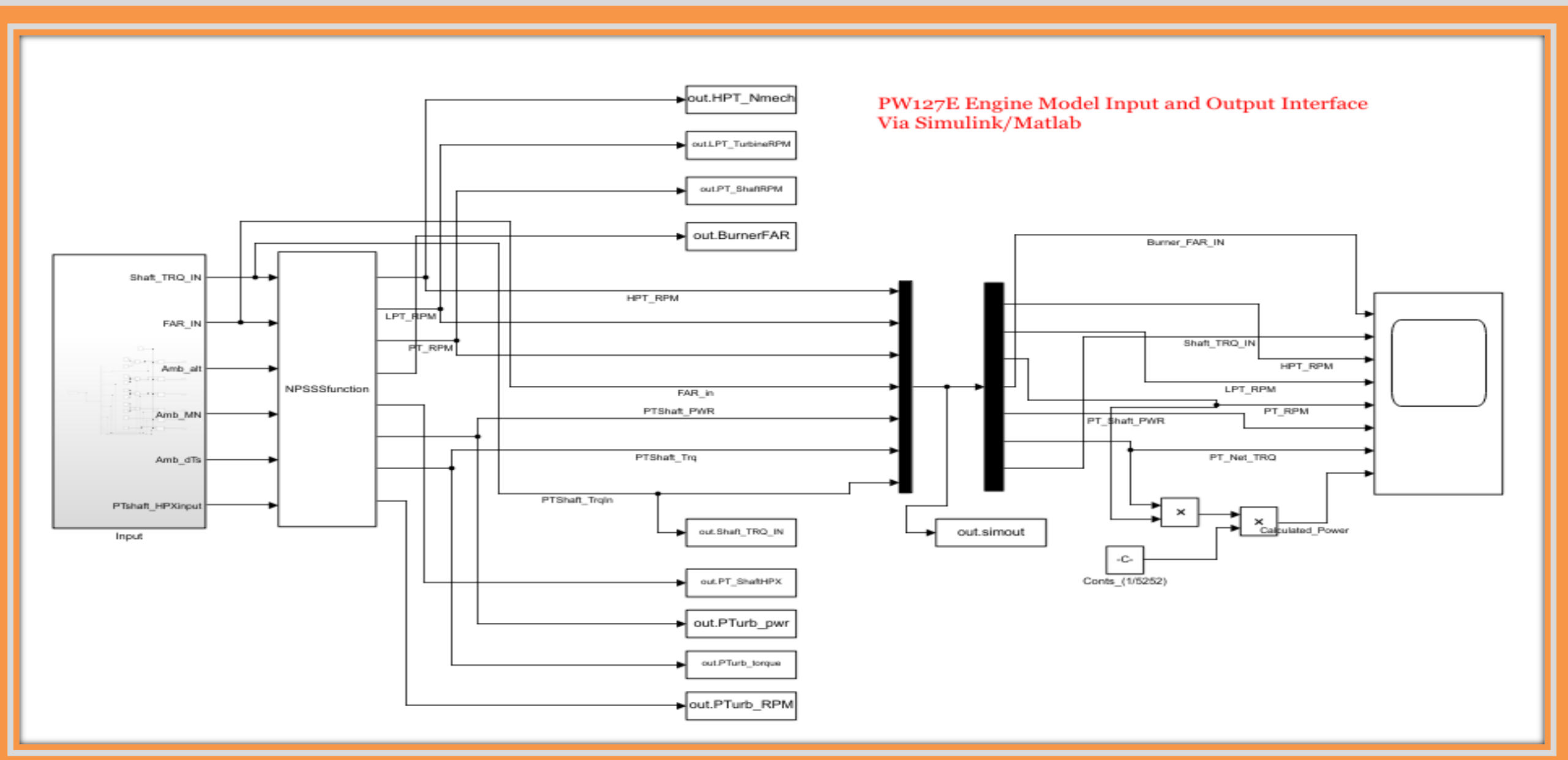
Introduction

NASA's Revolutionary Vertical Lift Technology (RVLT) project, consists of engineers, working on tools and key principles to help the rapidly growing Vertical Takeoff and Landing (VTOL) industry. The VTOL enhancements focuses on urban mobility safety, and noise reduction. NASA Armstrong's involvement in the RVLT project is the pursuit for holistic modeling of accurate control systems for VTOL training simulators. One phase will be to create routes to interface traditional turbine modeling software's with MATLAB Simulink, which is a commonly used modeling software for control systems, aerodynamics, electrical circuits, and electric motor dynamics. Combining the simulators will aid in future and current hybrid electric designs.



Challenges

- NPSS is a highly advanced software, with not a lot of external documentation found online.
- S-function block, that imports models into Simulink, is sometimes not as intuitive as one might think on the surface.
- Troubleshooting and debugging convergence errors and warnings was difficult because the multiple files and software interacting together made the source of the issues hard to track down.
- As someone with an electrical engineering background, who has more knowledge with electrical theory and controls, there was a little bit of a learning curve, related to aerodynamic, thermodynamic and turbo-generator terminology.



Conclusion

The image on the left is a Simulink model that produces output parameter characteristic graphs, so general trends of various turboprop operating regions could start to be better visualized.

This internship really brought me out of my comfort zone, due to my unfamiliarity with turbomachinery design and working principles. It also helped me gain experience in object oriented programming, creating more flexible Simulink models, and controlling Simulink model with MATLAB scripts. I also had the opportunity to learn about various hybrid electric turboprop system configurations, along with their inherent benefits and downfalls. There is still a good bit more that needs to be done for the hybrid propulsion designs, but hopefully some of my findings will prove to benefit future engineers and interns working with these modeling software.

