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Pathways Intern Showcase

Joseph "Tyler" Hurt



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About Me





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Roman Space Telescope

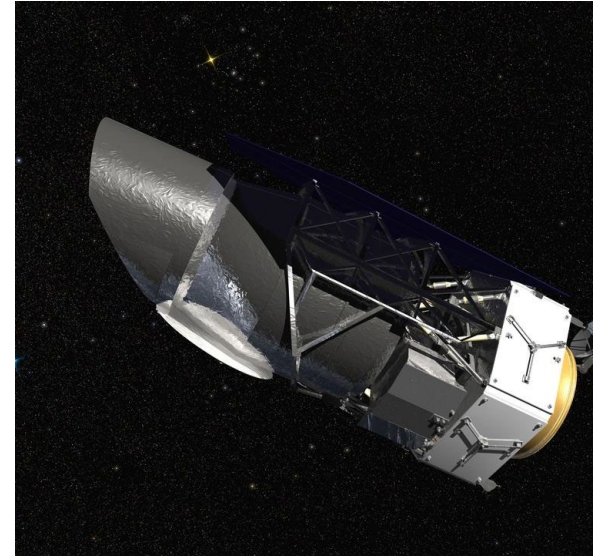


- **Formerly known as Wide Field Infrared Survey Telescope (WFIRST)**
- **Named after Nancy Roman Grace**
 - **Considered the “Mother of Hubble”**
- NASA observatory designed to settle essential questions in the areas of dark energy, exoplanets and infrared astrophysics.
- The telescope has a primary mirror that is 2.4 meters (7.9 feet) in diameter and is the same size as the Hubble Space Telescope's primary mirror.
- The Roman Space Telescope is designed to have two instruments, the Wide Field Instrument and a technology demonstration Coronagraph Instrument.
- The Wide Field Instrument will have a field of view that is 100 times greater than the Hubble infrared instrument, allowing it to capture more of the sky with less observing time
- The Coronagraph Instrument will perform high contrast imaging and spectroscopy of individual nearby exoplanets
- **Set to launch in the mid-2020s**

Reference:

<https://roman.gsfc.nasa.gov/>

<https://images.nasa.gov/>





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Project Overview



Conduct an early separation analysis for the Roman Space Telescope utilizing the Universal Separation Analysis Tool (USAT) created by LSP's GNC group

Followed an industry standard for quality and testing procedures/standards called 3-sigma

Apply a magnitude of different testing parameters and analysis

Evaluate case results to see if RST can meet its separation dynamic requirements and identify significant influences and sensitivities



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How Does Separation Work

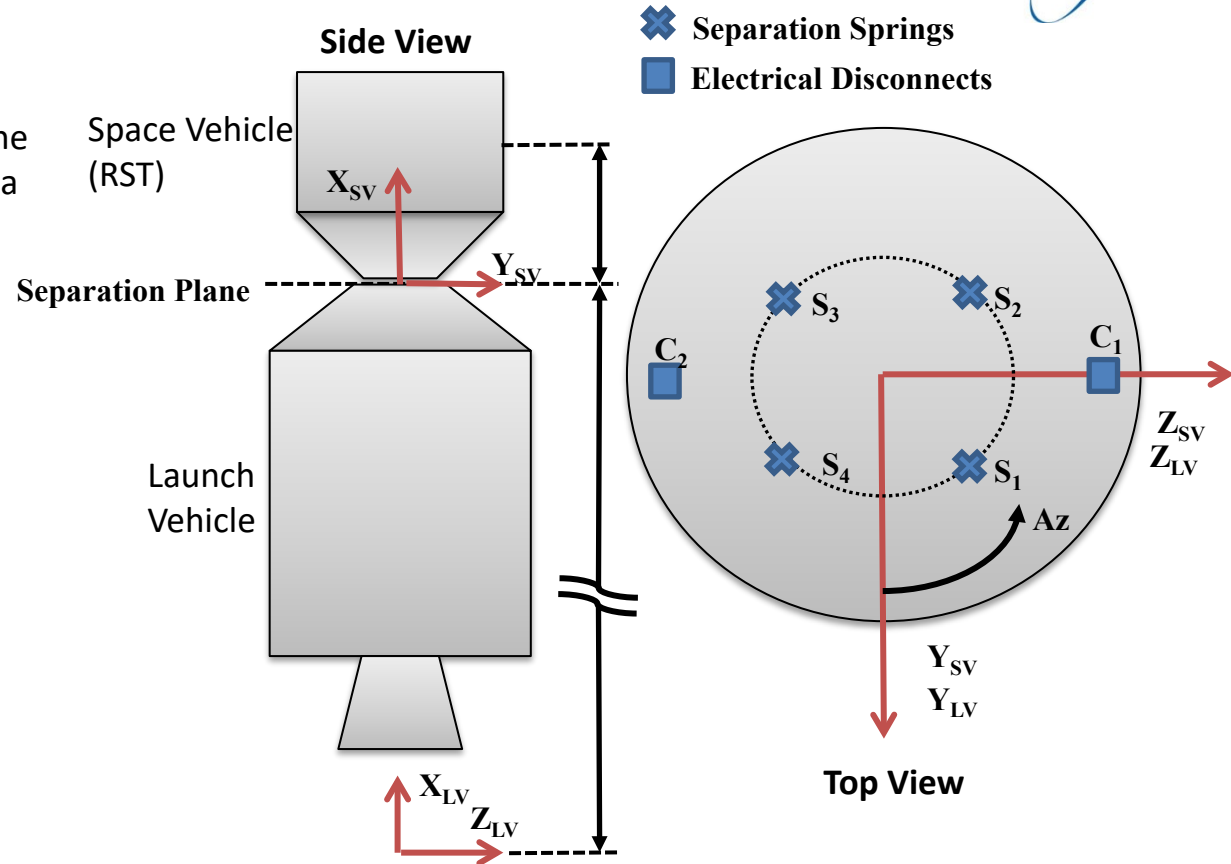


The Process

- The space vehicle (RST) and the launch vehicle are attached via a clamband.
- When separation starts the clamband releases allowing springs to drive the SV away from the LV

Some of the Items to Consider

- Mass properties
- Deliverable Spring Energy
- Initial Rates
- Connectors





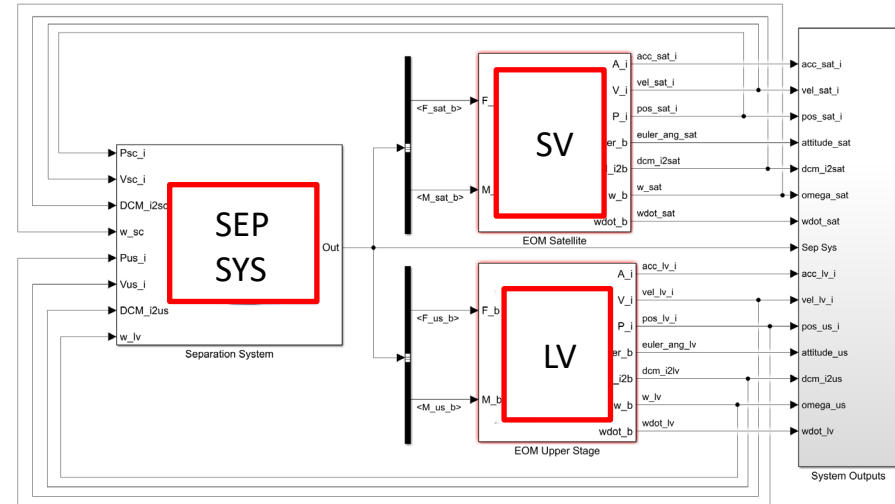
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Universal Separation Analysis Tool



- Simulink Model created by the GNC group in Mathworks'® MATLAB software
- 12 degrees of freedom model
- Input Decks
 - SV and LV mass parameters
 - Separation system parameters
 - Simulation options
 - Dispersions
- Outputs separation dynamics as a function of time

12DOF USAT Model





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Case Overview



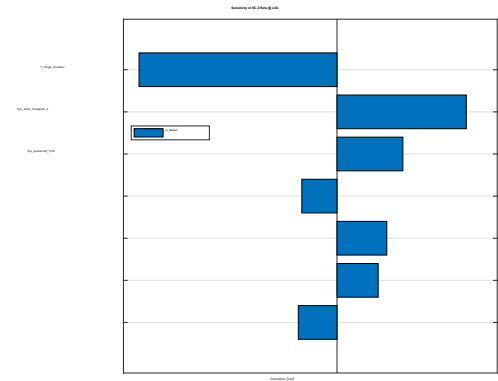
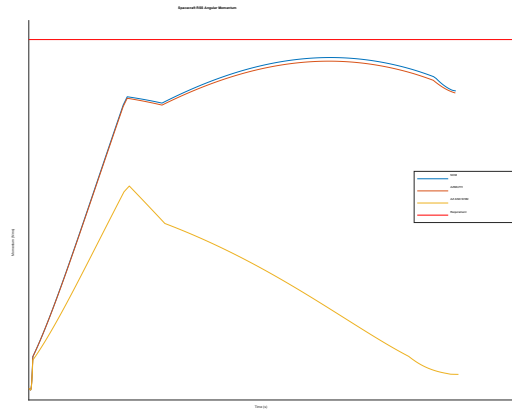
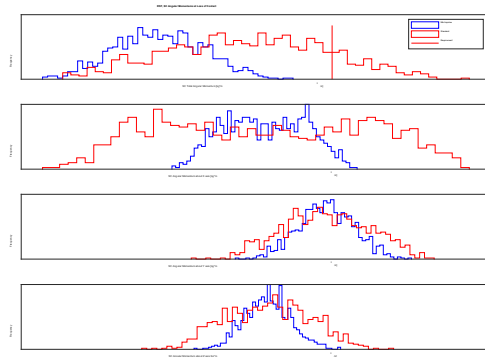
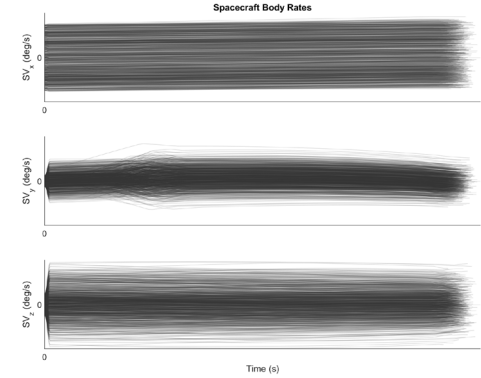
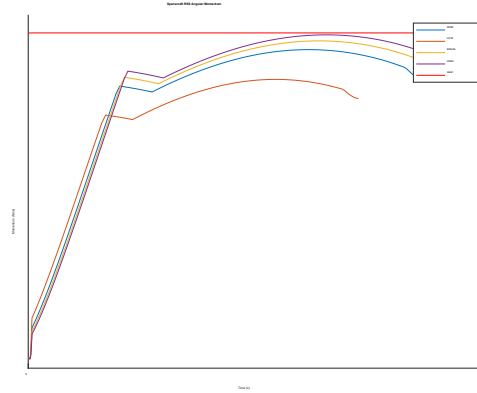
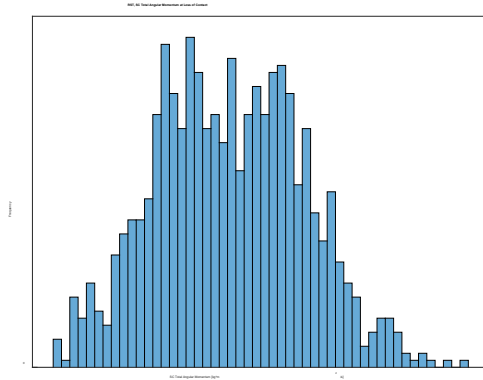
Analysis/Cases Conducted

- Typically 1000 simulations per case in typical Monte Carlo method where no failures are allowed
 1. 4 versus 8 Springs Analysis: Evaluate the sensitivity of separation dynamics based on the amount of springs driving the separation
 2. Standard: Conduct analysis with typical SpaceX and/or LSP assumptions to determine likelihood that RST momentum requirement will be met by the early separation analysis conducted by the launch vehicle provider
 3. Min Impulse Case: Predict initial rates that could be achieved by the flight system and the effects on separation dynamics
 4. High MOI Case: Determine sensitivity to SV Design MOI value
 5. Zero Initial Rate Case: Determine rate/momentum change purely due to separation dynamics
 6. Propellant Margin Analysis : Identify the sensitivity of the spacecraft separation dynamics to residual, participating launch vehicle propellant mass
 7. Spring Tuning Analysis: To perform a spring benefit analysis to counter act the ZCG bias found in the other analysis to lower the Y axis momentum and show its affects on the total angular momentum



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Analyzing Results





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What's Next?



Simple Separation Analysis Tool

- Build a simple separation analysis tool
- Ensure high fidelity results by comparing them to past separation analysis
- Make it an application that can be used by LSP customers so that quick separation analysis can be completed.