Rascal Concept of Operations Trade Study

Saint Louis University

Rascal



Last Updated: 3/5/14

Document No: RCL-O-CMQA3

Copper Operational

Test Plan

|  |  |  |  |
| --- | --- | --- | --- |
| **Team Member** | **Position** | **Email** | **Phone** |
| Tom Moline | Program Manager/Attitude Determination and Control Lead | [tmoline@slu.edu](mailto:tmoline@slu.edu) | 630-401-0791 |
| Nate Richard | Communications Lead | [nrichar8@slu.edu](mailto:nrichar8@slu.edu) | 608-732-7147 |
| Tyler Olson | Power Lead | [tolson6@slu.edu](mailto:tolson6@slu.edu) | 812-204-1098 |
| Bryant Gaume | Structures Lead | [gbryant1@slu.edu](mailto:gbryant1@slu.edu) | 636-448-0378 |
| Jennifer Babb | Command and Data Handling Lead | [jbabb1@slu.edu](mailto:jbabb1@slu.edu) | 636-579-6816 |

**Revisions Summary**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Revision** | **Description** | **Date** | **Prepared by** | **Approved by** |
| **-** | Initial Release | 3/5/2014 | Tom Moline | Insert Name Here |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Table of Contents

[1 Introduction 5](#_Toc381873093)

[1.1. Background 5](#_Toc381873094)

[1.2. Rascal Mission Statement and Overall Mission Architecture 5](#_Toc381873095)

[2 Concept(s) of Operations 6](#_Toc381873096)

# Introduction

## Background

This document serves to outline and compare two proposed concept of operations (CONOPS) associated with the Rascal mission. Each CONOPS would successfully demonstrate Rascal’s mission statement (As discussed in Section 1.2), though each would do so in drastically different fashions, as discussed in Section 2.

## Rascal Mission Statement and Overall Mission Architecture

Rascal’s mission can be summed up as:

**The Rascal mission seeks to incrementally demonstrate the capability of a small-spacecraft in performing proximity operations, rendezvous, and inspection of both a cooperating and non-cooperating resident space object.**

Though there are many other missions attempting to demonstrate similar or greater capabilities as those outlined above (Such as Tyvak’s PONSFD, Surrey’s STraND-2, and Embry-Riddle’s ARAPAIMA), Rascal is the only mission that has taken seriously the challenges associated with conducting rendezvous and proximity operation (RPO) missions of any scale and actually integrated a realistic assessment of program capability directly into its mission design.

It is from this assessment where the “incremental” part of the mission statement comes in. As opposed to seeking out another spacecraft on the same launch or going after a decommissioned spacecraft that is already in orbit, hoping that spacecraft acquisition and checkout occurs fast enough for the mission to actually be performed, Rascal will bring with it the target it seeks to perform its mission relative to. This alleviates the many risks associated with the “initial conditions” problem of orbital analysis and planning. Instead of attempting to account for the impact of perturbation forces (mainly, aerodynamic drag, third-body influences, solar-radiation pressure) on two spacecraft released at slightly different times in slightly different locations, and hoping that these initial conditions match up in a way that allow for the mission to be quickly executed, one can eliminate all the uncertainty and not start the mission until contact has been confirmed between each mission spacecraft and the ground. This allows for a more precise understanding of both where and when the mission is actually starting, which greatly increases the odds of its ultimate success.

As such, regardless of the way in which the mission will be executed, several components of the overall mission architecture will be fixed, mainly:

* **The Target spacecraft will be brought with the Interceptor**: this removes the risk of securing permission to go and inspect either another organization’s spacecraft or a company’s rocket body (as has been done in the past)
* **The Target and Interceptor will be conjoined up until mission commencement**: this removes the problem of “initial conditions”, giving the mission operators greater control over the mission as a whole.
* **The mission will be conducted “incrementally”**: this attests to the difficulties that past RPO missions have encountered over the course of their mission life, as well as realistically assesses the risks associated with RPO missions of any scale. An example of this would be performing the mission in steps, first inspecting a cooperating resident space object (with image processing visual aids, differential GPS, etc), and then incrementally removing the cooperating portions of the mission until enough confidence could be put into demonstrating inspection on a non-cooperating resident space object.

With these basic principles in mind, a greater discussion of the Rascal mission CONOPS can be made.

# Concept(s) of Operations