DEVELOPING GENERALIZED DYNAMIC MODELS

FOR USE WITH HORIZONS FRAMEWORK

A Thesis

presented to

the Faculty of California Polytechnic State University

San Luis Obispo

In Partial Fulfillment

of the Requirements for the Degree

Master of Science in Aerospace Engineering

by

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2020

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ABSTRACT

Developing generalized dynamic models for use with HORIZONS framework

Evan A. Droz

The motivation of the work presented is to showcase the capabilities of custom Python subsystem scripting through the Horizon Simulation Framework (HSF), and the valuable information produced through the simulation of customized mission design. Increased fidelity of performance is added to the ADCS subsystem and a new antenna subsystem is added to the scripted simulation design process to track attitude as well as mechanical properties of antennae used for data collection in orbit while performing maneuvers. Additionally, image quality metrics using the NIIRS rating system is added to the EO Sensor subsystem, driving requirement constraints for the setup of the sample mission specified in Horizon’s user files. This functionality allows for higher fidelity understanding of specified components of the spacecraft. The HSF interacts with these custom scripts and utilizes the faster processing time of the v3.0 framework at runtime to produce schedules of operations unique to the user-defined system. The information calculated from the simulation framework is then visualized and utilized for potential subsystem cost-benefit and mission performance analyses.

ACKNOWLEDGEMENTS

Many have lent their time and resources to make this project possible. I especially thank the Cal Poly Aerospace Engineering Department in San Luis Obispo. Dr. Eric Mehiel graciously accepted position as my thesis advisor. Professor Dr. Kira Abercromby and Professor have played a major role in my education in Aerospace Engineering. Thanks also to Dr. David Mitchell, an outstanding physics and astronomy professor, and spurring my curiosity towards receiving my minors in both physics and astronomy. I want to express an immense gratitude to my family, whose impact cannot be underestimated. My family has provided endless love and support supplying the motivation needed to accomplish this task while growing in maturity.

TABLE OF CONTENTS

[LIST OF TABLES ix](#_Toc440909576)

[LIST OF FIGURES x](#_Toc440909577)

LIST OF ACRONYMS ..................................................................................................... xi  
LIST OF SYMBOLS ........................................................................................................ xii

CHAPTER

[I. INTRODUCTION 1](#_Toc440909578)

[II. METHODOLOGY 1](#_Toc440909580)

[III. EXISTING DESIGN 1](#_Toc440909583)

[IV. SIMULATION AND ANALYSIS 1](#_Toc440909586)

[V. ANALYSIS 2](#_Toc440909589)

[VI. PROPOSED DESIGN 2](#_Toc440909592)

[VII. CONCLUSIONS 2](#_Toc440909595)

[LIST OF REFERENCES 2](#_Toc440909598)

[APPENDIX A. Nomenclature 3](#_Toc440909601)

[APPENDIX B. IDK 3](#_Toc440909604)

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

I. INTRODUCTION

1.1 THESIS STATEMENT

In development of a spacecraft model, it is imperative to create system requirements that will fulfill needs of the mission or customer within time and budget scopes. Within this process, having near-real-time simulation and evaluation of varying subsystem design concepts allows engineers to efficiently define subsystem capabilities, and a resulting system model simulation that showcases mission fulfillment. This helps streamline the design process as the baseline system requirements are already shown to achieve mission success before any parts are manifested.

The purpose of this thesis is to showcase the utility of HSF Python scripting in implementing a model based design. Specific subsystems are defined for a unique mission case and are evaluated through a Day-in-the-Life (DITL) scenario simulation to show both successful system performance and possible missed requirements due to design bottlenecks of the custom design of the engineer’s subsystem definitions.

1.2 HORIZON SIMULATION FRAMEWORK BACKGROUND

This thesis make use of the Horizon Simulation Framework v3.0 to perform quick simulations of user-defined system performance in orbit. HSF is used to create the simulated scenario for the user to implement their system model, and is split into ‘scheduling’ and ‘modeling’ components to achieve this. The user inputs mission targets for the model so that the framework can create a schedule of tasks for the system to fulfill. This scheduler component is not directly edited by the user and runs during the simulation. HSF’s modeling component is where user-defined elements are used within the simulation. Various subsystem models are linked together and are represented with state machines. These states evaluate at each time step in the simulation whether or not the subsystem can perform a proposed scheduled task from the scheduling component. The state of completion of the task is then reported to the scheduler to determine if the proposed schedule is attainable by the system capabilities. The intended functionality of the HSF was to provide customization tools while still performing most of the foundational simulation without information about the system implemented.

II. METHODOLOGY

Implementing design of a system into the Horizon framework begins with establishing subsystem structure and hierarchy through file structure.

III. EXISTING DESIGN

IV. SIMULATION AND ANALYSIS

V. ANALYSIS

VI. PROPOSED DESIGN

VII. CONCLUSIONS

LIST OF REFERENCES

APPENDIX A. Nomenclature

APPENDIX B. IDK