

Spacecraft Mission

Alex Freeman

March 28, 2025

1 Introduction

This report will cover all parts of assignment one in the Aerospace 720 course

2 Mathematics

To derive the necessary state function we have:

$$\ddot{\mathbf{r}} = -\frac{\mu}{r^3}\mathbf{r} \quad (1)$$

From here we know that $\frac{dv}{dt} = \dot{r}$ giving:

$$\frac{d\mathbf{v}}{dt} = -\frac{\mu}{r^3}\mathbf{r} \quad (2)$$

Expanding each vector as three-dimensional components in x, y, z :

$$\frac{dx}{dt} = v_x, \frac{dy}{dt} = v_y, \frac{dz}{dt} = v_z \quad (3)$$

$$\frac{dv_x}{dt} = -\frac{\mu}{r^3}x, \frac{dv_y}{dt} = -\frac{\mu}{r^3}y, \frac{dv_z}{dt} = -\frac{\mu}{r^3}z \quad (4)$$

Where $r = \sqrt{x^2 + y^2 + z^2}$

We can now define a state vector $\bar{\mathbf{X}}$

$$\bar{\mathbf{X}} = \begin{bmatrix} x \\ y \\ z \\ v_x \\ v_y \\ v_z \end{bmatrix} \quad (5)$$

Finally, deriving this state vector gives the following:

$$\dot{\bar{\mathbf{X}}} = \begin{bmatrix} v_x \\ v_y \\ v_z \\ -\frac{\mu}{r^3}x \\ -\frac{\mu}{r^3}y \\ -\frac{\mu}{r^3}z \end{bmatrix} \quad (6)$$

3 Figures

Figure example:

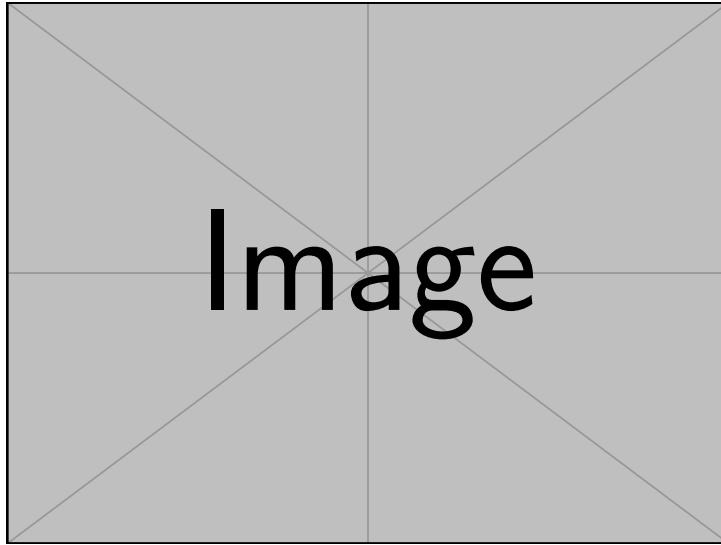


Figure 1: Example figure caption.

4 Tables

Left	Center	Right
A	B	C
1	2	3

Table 1: Example table.