Orbital Mechanics Calculator User Guide v1

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1 Introduction

The calculator is designed to provide a quick way of doing simple calculations on elliptic orbits, including coplanar single burn manoeuvres. Support for hyperbolic trajectories and non-coplanar manoeuvres will be added in the upcoming versions.

2 Structure

The workbook is divided into two sheets: the first one, "Main" is the calculator interface with orbit definition, inputs and outputs. The second sheet, "Workspace" contains intermediate steps for relatively more complicated calculations like Time-of-Flight and manoeuvres. The user is required to only interact with the Main sheet. Cells are color coded based on their I/O type. Pale orange fill indicates inputs, while grey-filled bold cells are outputs. In order to prevent corruption of the formulae, the sheet is protected allowing only the input cells to be editable. It is important to follow the units specified for each parameter for obtaining correct outputs.

2.1 Orbit Definition

The orbit definition section shall be used to provide orbital elements (Keplerian Element System) to fix the orbit in 3-D space. Although it is not required to define each and every element, at least the Semi-Major Axis (SMA) and Eccentricity are required for co-planar calculations. Defining the other angular elements often allows reliable interpretation of results from the I/O section.

2.2 Intermediates & Constants

This section is only for reference and does not need editing. All values here are calculated from the definition section and will be further used for the specific calculations.

Figure 1: A screenshot of the Main sheet

2.3 Calculator I/O section

This section deals with the specific calculations the user might be interested in performing. Most of the conversions / calculations are self explanatory if the user has a little background in orbital mechanics. If not, please see the references section for reading.

3 Glossary

Most of the parameters are named and/or abbreviated as per convention used in either the literature or the industry. Nevertheless, some of them are listed below for convenience of the user.

1. SMA — Semi Major Axis
2. RAAN — Right Ascension of Ascending Node
3. AoP — Argument of Perigee
4. mu — μ - Product of gravitational constant and mass of the body
5. Vesc — Escape Velocity
6. Sp. — Specific
7. Nu — ν - True Anomaly
8. FPA — Flight Path Angle
9. ToF — Time of Flight
10. deg — degrees - planar angle
11. (SI) — meaning *'in SI units'*

4 Author & Feedback

This work is available on my github. Feedback is most welcome.

- Github

- This work

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References

[1] NASA "Basics of Space Flight", Section-1, Chapters 3-5, https://solarsystem.nasa.gov/basics/chapter3-1

[2] Vallado, David A., 1997, "Fundamentals of Astrodynamics and Applications".

[3] NASA "General Mission Analysis Tool (GMAT)", https://software.nasa.gov/software/GSC-17177-1