

Rocket motion notes

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1 Introduction

This document presents useful definitions and formulas for the study of rocket propulsion.

2 Fundamentals

The movement of rockets is dominated by Newton's second law. In its most basic form, this law can be expressed as follows:

$$\sum F = \frac{d(mv)}{dt} \quad (1)$$

...

Thrust can be defined according to the following formula:

$$T = \dot{m}c_{\text{eff}} \quad (2)$$

The **specific impulse** is a very important definition:

$$I_{\text{sp}} = \frac{T}{mg_0} = \frac{c_{\text{eff}}}{g_0} \quad (3)$$

2.1 The rocket equation

One of the most important relations in rocket propulsion is the **rocket equation**, also called Tsiolkovsky's equation due to its author. relates the change of velocity of a variable-mass system with the mass difference:

$$\Delta v = c_{\text{eff}} \ln \left(\frac{M_0}{M_e} \right) \quad (4)$$

3 Launch trajectories

3.1 Vertical flight

3.2 Coasting flight

References