

$$\vec{q}(t) = \begin{bmatrix} v_y(t) & (1) \\ v_z(t) & (2) \\ y(t) & (3) \\ z(t) & (4) \\ \omega_x(t) & (5) \\ \vec{R}_1(t) & (6) \\ \vec{R}_2(t) & (7) \\ \vec{R}_3(t) & (8) \\ \vec{R}_4(t) & (9) \\ m(t) & (10) \end{bmatrix} \quad (1)$$

$$\vec{q}(0) = \begin{bmatrix} v_y(0) \\ v_z(0) \\ y(0) \\ z(0) \\ \omega_x(0) \\ \vec{R}_1(0) \\ \vec{R}_2(0) \\ \vec{R}_3(0) \\ \vec{R}_4(0) \\ m(0) \end{bmatrix} = \begin{bmatrix} 0 & \frac{m}{s} \\ 0 & \frac{m}{s} \\ 0 & m \\ R_T + d & m \\ 0 & \frac{rad}{s} \\ \cos(\frac{\beta}{2}) \\ \sin(\frac{\beta}{2}) \\ 0 \\ 0 \\ M_i & kg \end{bmatrix} = \begin{bmatrix} 0 & \frac{m}{s} \\ 0 & \frac{m}{s} \\ 0 & m \\ 6371025 & m \\ 0 & \frac{rad}{s} \\ 1 \\ 0 \\ 0 \\ 0 \\ 320000 & kg \end{bmatrix} \quad (2)$$

$$\vec{g}(t) = \begin{bmatrix} \frac{v_y(t)}{dt} \\ \frac{v_z(t)}{dt} \\ \frac{y(t)}{dt} \\ \frac{z(t)}{dt} \\ \frac{\omega_x(t)}{dt} \\ \frac{\vec{R}_1(t)}{dt} \\ \frac{\vec{R}_2(t)}{dt} \\ \frac{\vec{R}_3(t)}{dt} \\ \frac{\vec{R}_4(t)}{dt} \\ \frac{m(t)}{dt} \end{bmatrix} = \begin{bmatrix} a_y \\ a_x \\ v_y \\ v_z \\ \alpha_x \\ \frac{\vec{R}(t)\vec{\omega}(t)}{2}^1 \\ \frac{\vec{R}(t)\vec{\omega}(t)}{2}^2 \\ \frac{\vec{R}(t)\vec{\omega}(t)}{2}^3 \\ \frac{\vec{R}(t)\vec{\omega}(t)}{2}^4 \\ \begin{cases} -\mu \text{ si } m > M_i - M_{carburant} \\ 0 \text{ si } m \leq M_i - M_{carburant} \end{cases} \end{bmatrix} \quad (3)$$

Acceleration:

$$\begin{bmatrix} a_x \\ a_y \\ a_z \end{bmatrix} = \begin{bmatrix} \frac{F_x}{m} \\ \frac{F_y}{m} \\ \frac{F_z}{m} \end{bmatrix} \quad (4)$$

Acceleration angulaire:

$$\begin{bmatrix} \alpha_x \\ \alpha_y \\ \alpha_z \end{bmatrix} = \begin{bmatrix} (I^{-1}[\vec{\tau} - (\tilde{\omega} I \vec{\omega}))_x \\ (I^{-1}[\vec{\tau} - (\tilde{\omega} I \vec{\omega}))_y \\ (I^{-1}[\vec{\tau} - (\tilde{\omega} I \vec{\omega}))_z \end{bmatrix} \quad (5)$$