Mathematical formulation

The problem can be stated as

$$\min_{h,v,m,T} \quad J = -h(T)$$

$$\begin{aligned}
\text{s.t.} \quad \dot{h}(t) &= v(t), \\
\dot{v}(t) &= \frac{T(t) - D(h(t), v(t)) - m(t)g(h(t))}{m(t)}, \\
\dot{m}(t) &= -\frac{T(t)}{c}, \\
0 \leq T(t) &\leq T_{\max}, \\
h(t) &\geq h_0, \\
v(t) &\geq v_0, \\
m_f \leq m(t) &\leq m_0, \\
h(0) = h_0, \quad v(0) &= v_0, \quad m(0) = m_0, \\
m(T) &= m_f,
\end{aligned}$$

Parameters

Parameter	Symbol	Value
Initial altitude	h_0	1
Initial velocity	v_0	0
Initial mass	m_0	1
Gravitational constant	g_0	1
Thrust coefficient	T_c	3.5
Drag coefficient	D_c	$\frac{1}{2} v_c \frac{m_0}{g_0}$
Characteristic altitude	h_c	500
Characteristic velocity	v_c	620
Characteristic mass ratio	m_c	0.6
Final mass	m_f	$m_c m_0$

where the Drag, Gravity, Fuel constant, and Maximum thrust are defined as

$$D(h, v) = D_c\, v^2 \exp\left(-h_c \frac{h - h_0}{h_0}\right), \quad g(h) = g_0 \left(\frac{h_0}{h}\right)^2, \quad c = \frac{1}{2}\sqrt{g_0 h_0}, \quad T_{\max} = T_c m_0 g_0.$$