

The mathematical model freefall skydiver

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● The differential equation model

$$a(t) = \frac{mg - \frac{1}{2}CS\rho v(t)^2}{m} = g - \frac{\frac{1}{2}CS\rho}{m}v(t)^2 = g - kv(t)^2 = \frac{dv(t)}{dt}$$

$$\frac{dh(t)}{dt} = -v(t)$$

● General calculation of the parameter

Gravitational force: $|F_g| = mg$

Resistive force: $|F_0| = \frac{1}{2}CS\rho v^2$

The resultant: $|F| = |F_g| - |F_0| = mg - \frac{1}{2}CS\rho v^2$

The acceleration: $a(t) = g - \frac{CS\rho}{2m}v^2 = g - kv^2$

● Table of all model parameters:

g	C	S	ρ	k
Gravitational acceleration	aerodynamic drag coefficient	Windward area	density	Resistant coefficient
9.81	\.			0.03924
m/s^2	\.			m^{-1}

● Table of all state variables of the model:

v	t	h
velocity	time	height
v(0)=0	t(0)=0	h(0)=1000
m/s	s	m

● Reach the 95% speed limit

95% limit rate=47.5m/s

t=9.4 s

h=700.09 m