



Diagram of a rocket with velocity \vec{v} and acceleration \vec{g} .

$$\Sigma F = ma = \dot{p}(t) = -G \Delta t$$
$$m \Delta v + u \Delta m + \Delta v \Delta m = -G \Delta t$$
$$m \frac{\Delta v}{\Delta t} + u \frac{\Delta m}{\Delta t} + \Delta v \frac{\Delta m}{\Delta t} = -G$$
$$\Delta t \rightarrow 0$$
$$m v'(t) + u m'(t) = -mg$$
$$v'(t) + g = -u \frac{m'(t)}{m} \quad || \int dt$$
$$v(t) + u \ln(m) = -gt + C$$
$$v(0) = 0 \Rightarrow C = u \ln(m_0)$$
$$v(t) = -gt + u \ln \frac{m_0}{m}$$

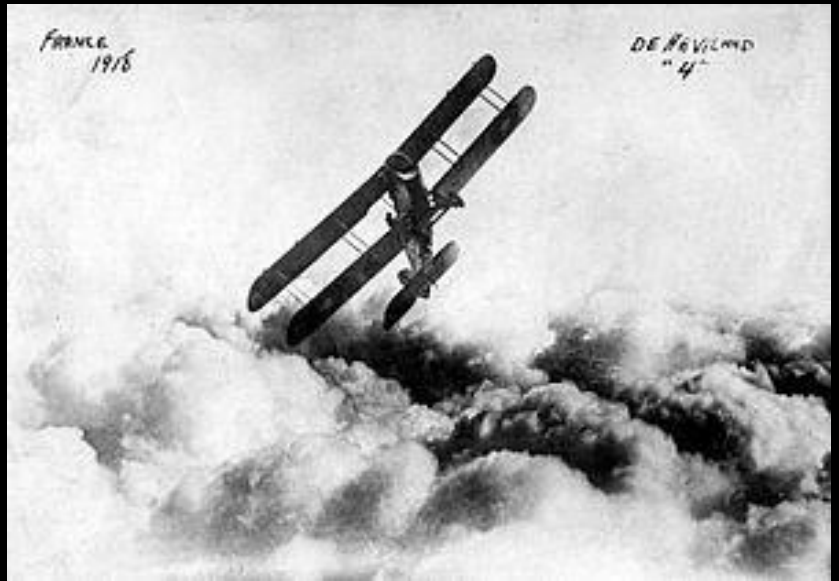
Don't Stay Behind!

Evolution of Jets' Analysis and Simulation



C4dynamics

1920'S



Airco DH.4

British two-seat bomber

Performance Analysis:

- Physical testing
- Visual observation



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1940'S



Lockheed P-80 Shooting Star

First USA jet fighter

Performance Analysis:

- First computer-based calculations:
- Digital Differential Analyzer (DDA).
- Written in Assembly.



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1960'S



McDonnell Douglas F-4 Phantom II

American jet interceptor and fighter-
bomber

Performance Analysis:

- MIT Flight Control Analysis Program
- Simulation of wide range of flight conditions.
- Fortran



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1980'S



General dynamics F-16 Fighting Falcon

American single-engine multirole fighter

Performance Analysis:

- General Dynamics EFS (Engineering Flight Simulator)
- Air-to-Air combat simulation
- Assembly & Fortran



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2000'S



Lockheed Martin F-35 Lightning II

American single-engine multirole combat
aircraft

Performance Analysis:

- DFCS (Digital Flight Control System)
- Complex mission scenarios
- C & C++ & Python & MATLAB



C4dynamics

2023

Complete 6 Degrees-of-Freedom simulation with a single python framework

```
import C4dynamics as c4d
```

```
missile = c4d.rigidbody()  
target  = c4d.datapoint(x = 4000, y = 1000, z = -3000  
                        , vx = -250, vy = 0, vz = 0)  
seeker  = c4d.seekers.lineofsight(dt, tau1 = 0.01, tau2  
= 0.01)  
ctrl    = mcontrol_system.control_system(dt)  
eng      = mengine.engine()  
aero     = maerodynamics.aerodynamics()  
...  
...
```



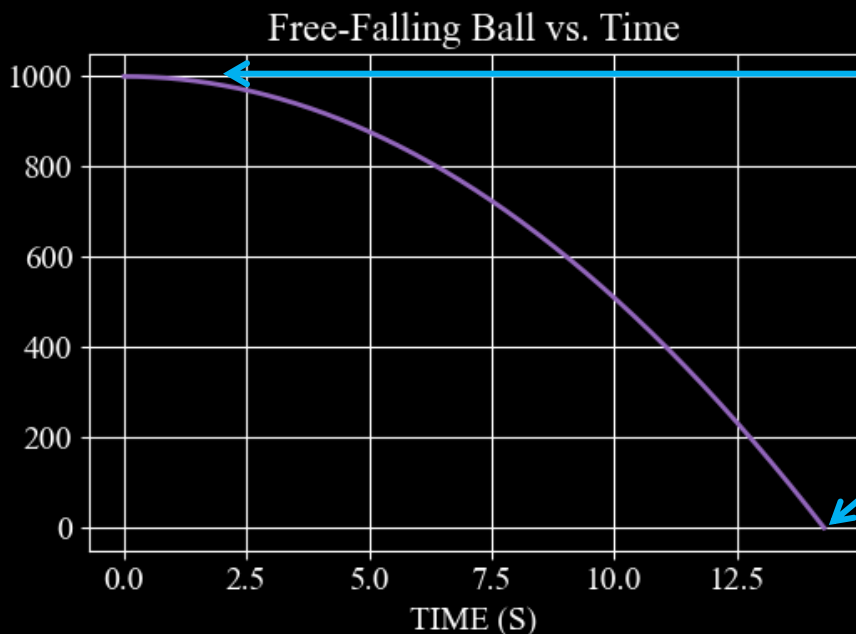
C4dynamics

Want to make fun while developing cool algorithms for physical systems too?

Download now C4dynamics and run dof6sim.ipynb. Follow the instructions there.

<https://github.com/C4dynamics/C4dynamics/blob/main/examples/freefall.py>

C4dynamics is a cutting-edge, high-standard algorithms development framework.

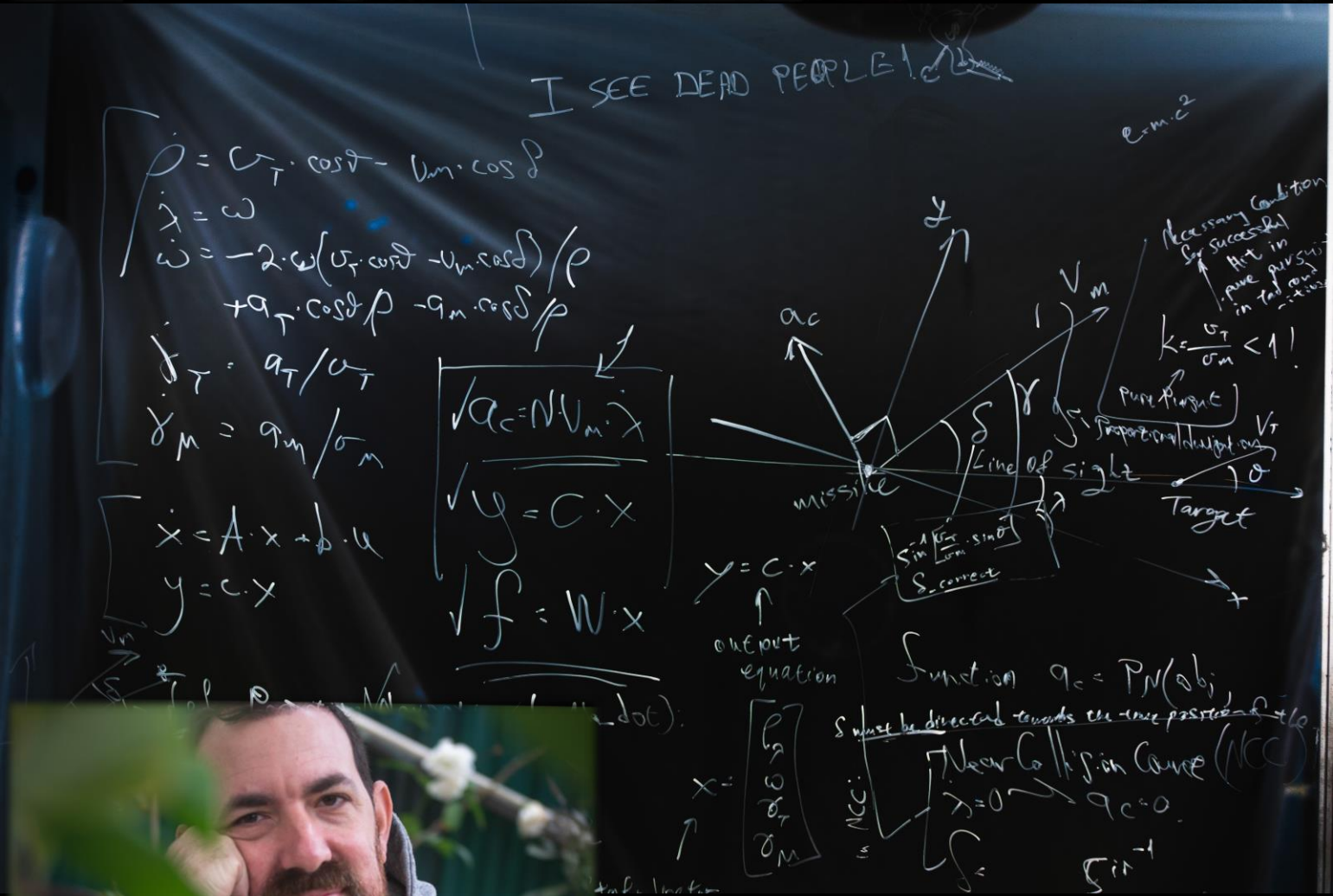
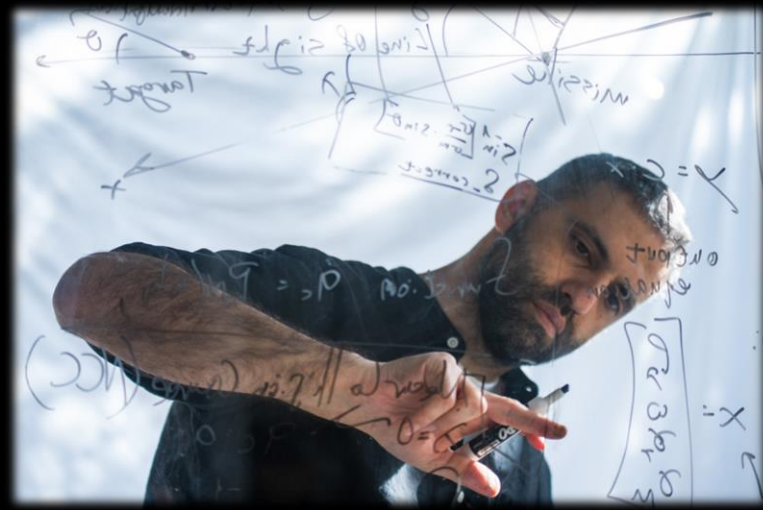


**Starting in 1000m
at $t=0$**

**Hits the ground at
 $t=14.3s$**



C4dynamics



Gavriel Weinberger
Visual Content Creator



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