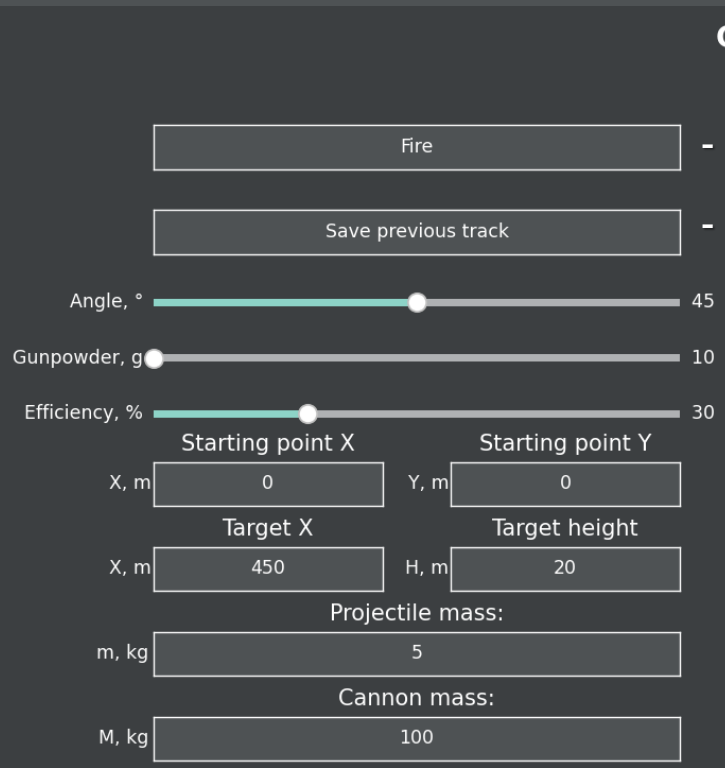
Cannon Firing Simulator

Complete Documentation

App description

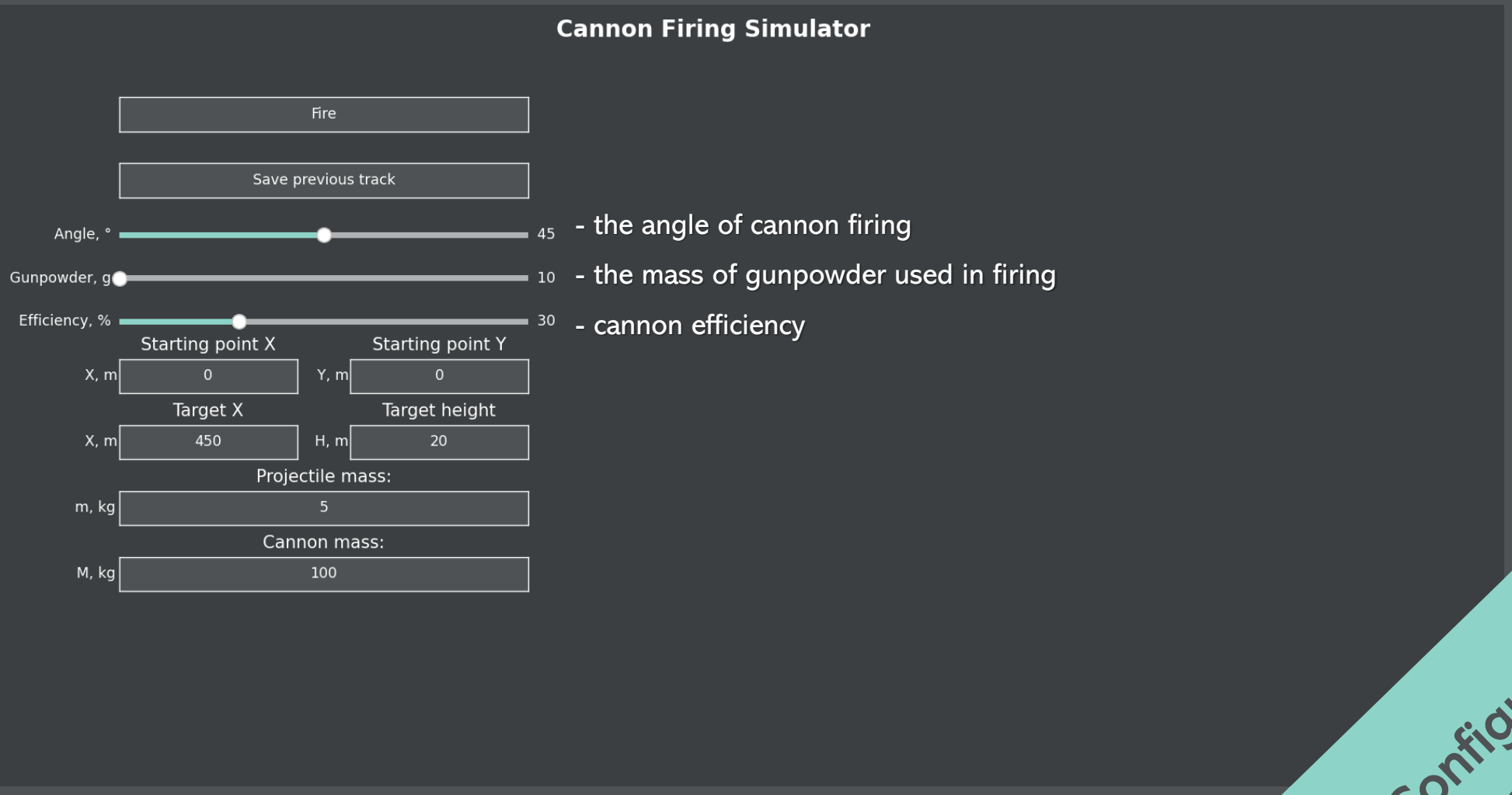
This application solves the problem of visualizing the ballistic movement of a projectile after firing from a cannon as a function taking into account the recoil of the cannon. Options help to determine the geometric dimensions of the cannon, its mass, as well as the geometric dimensions and masses of projectile and target. Additionally, diagrams of forces, impulses and velocities for the cannon and projectile are also constructed. The projectile hitting the target is visualized on the graph, and the size of the target is also configurable.

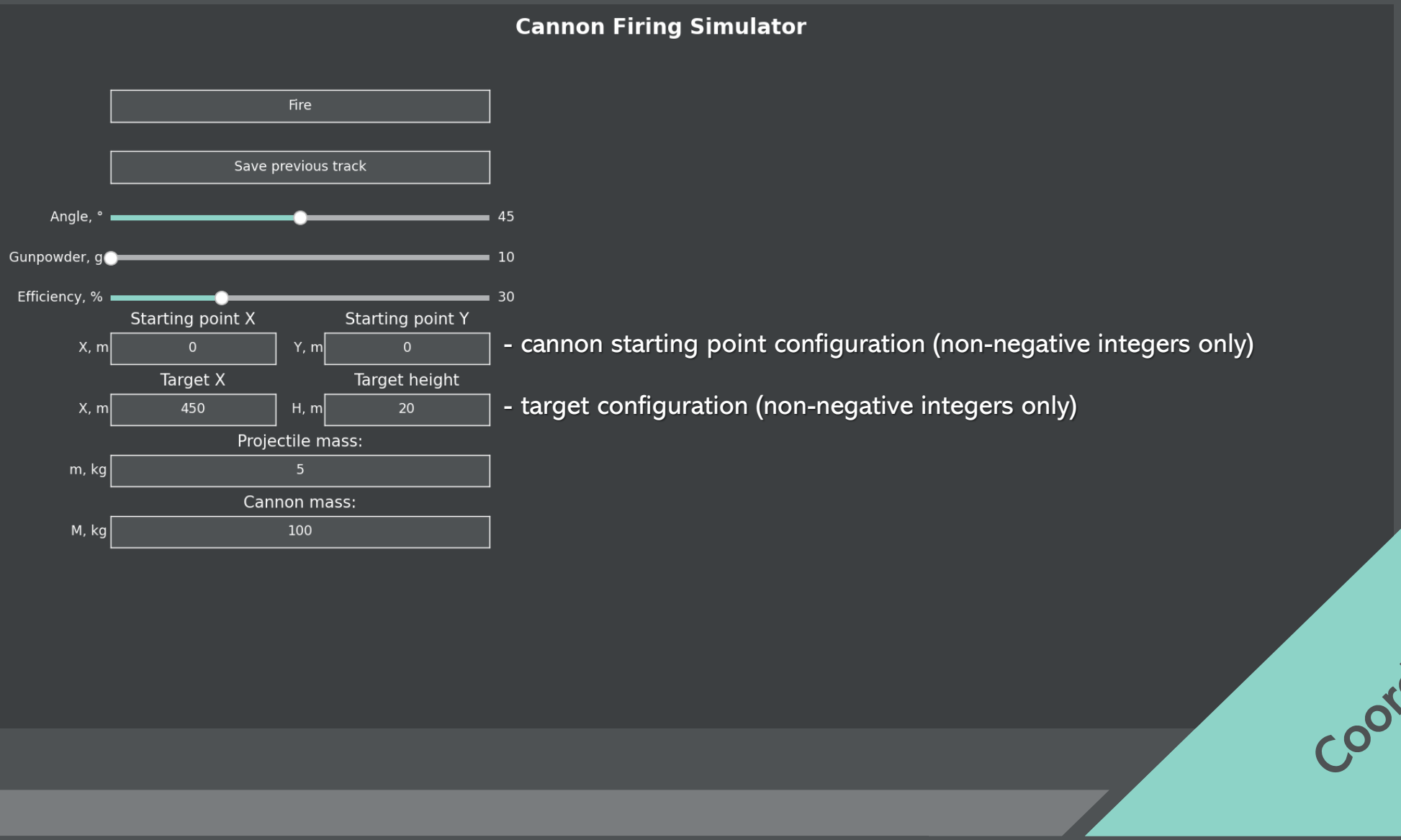


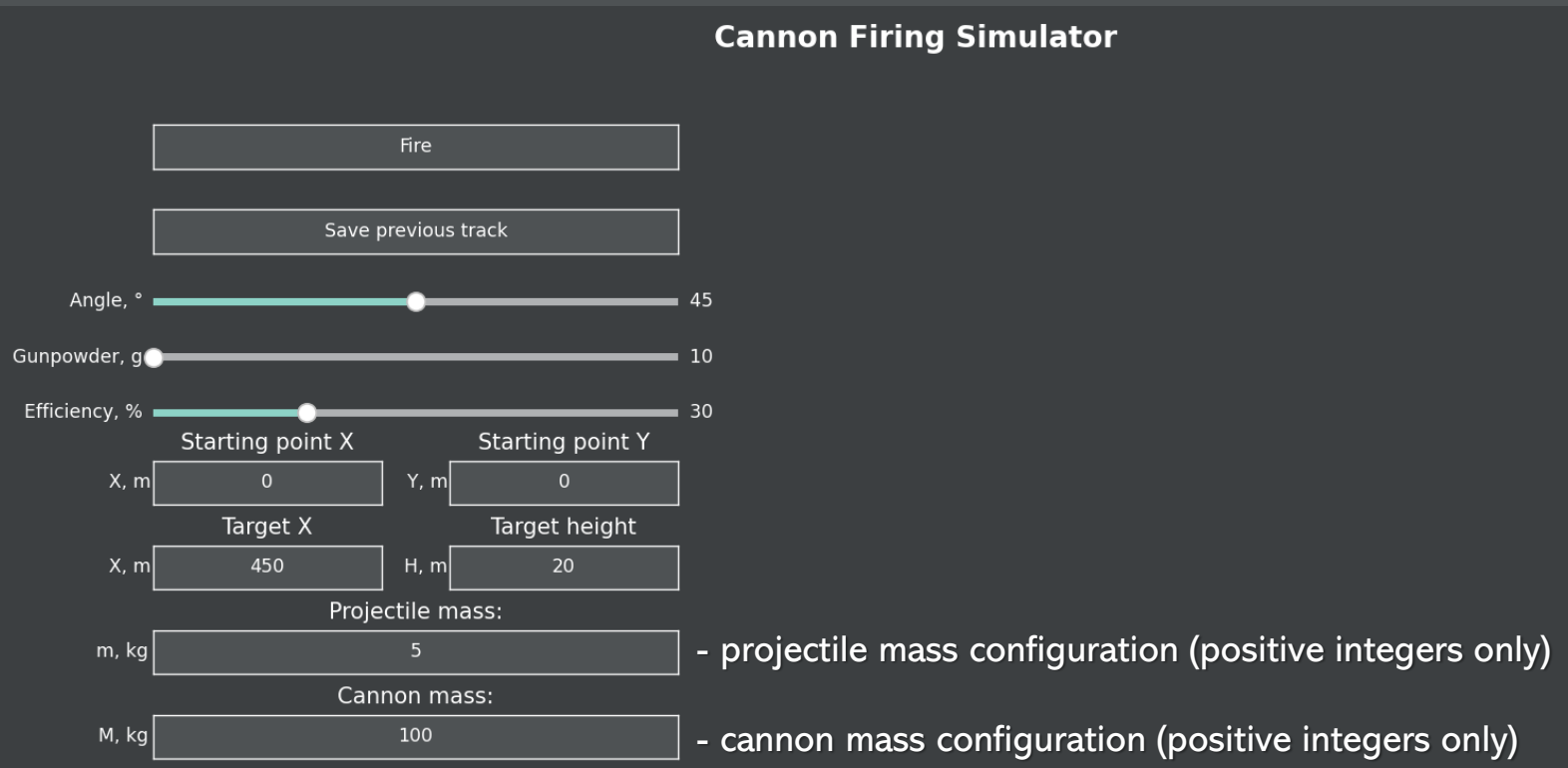
- press to fire (visualize graphs)

- press to show current projectile track the next firing

Main buttons options


Cannon Firing Simulator
Fire
Save previous track
Angle, °
45
Gunpowder, g
10
Efficiency, %
30
Starting point X
Starting point Y
X, m
0
Y, m
0
Target X
Target height
X, m
450
H, m
20
Projectile mass:
m, kg
5
Cannon mass:
M, kg
100
- the angle of cannon firing
- the mass of gunpowder used in firing
- cannon efficiency
Configurable values

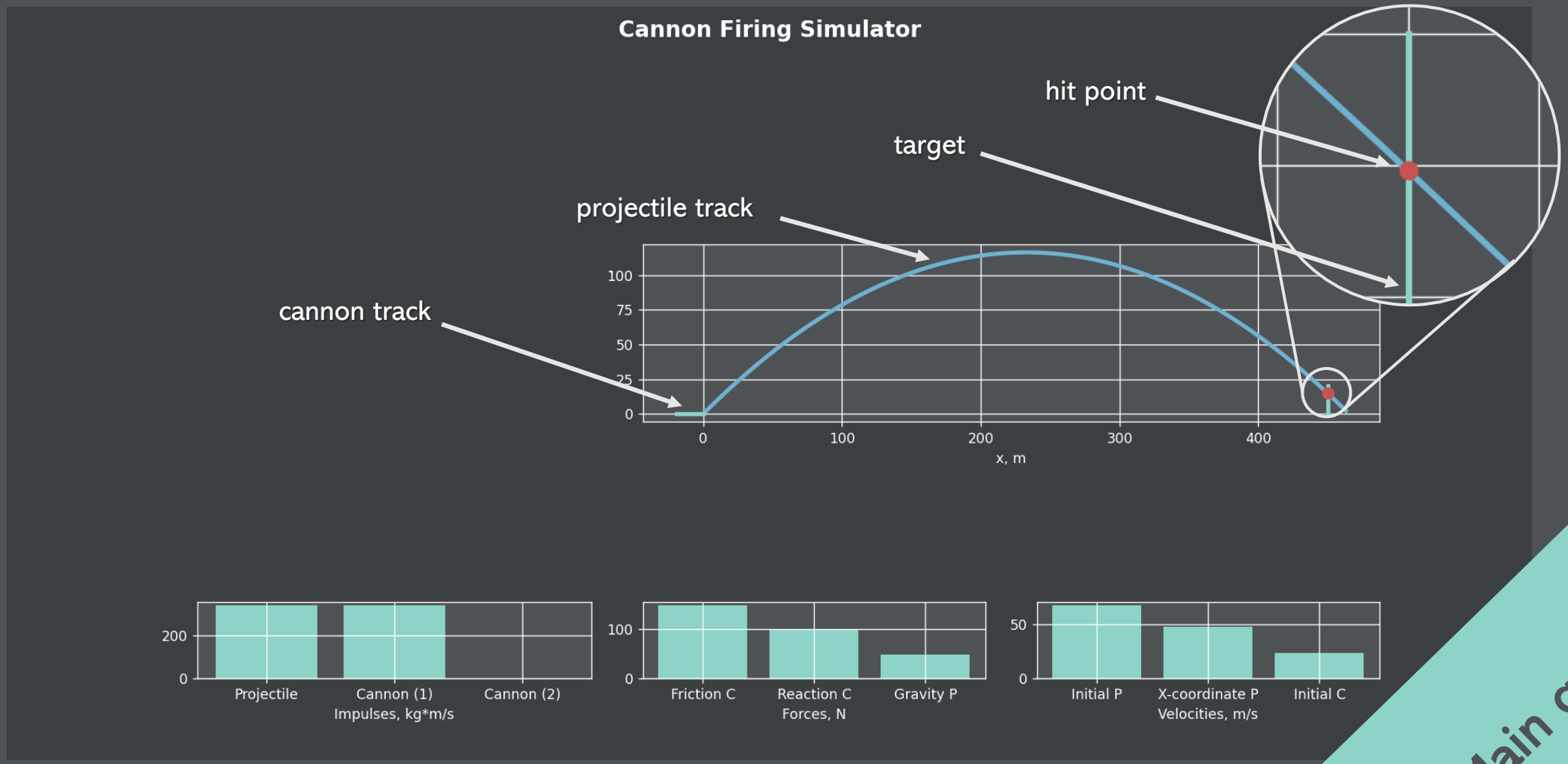

Cannon Firing Simulator
Fire
Save previous track
Angle, °
45
Gunpowder, g
10
Efficiency, %
30
Starting point X
Starting point Y
X, m
0
Y, m
0
- cannon starting point configuration (non-negative integers only)
Target X
Target height
X, m
450
H, m
20
- target configuration (non-negative integers only)
Projectile mass:
m, kg
5
Cannon mass:
M, kg
100
Coordinates



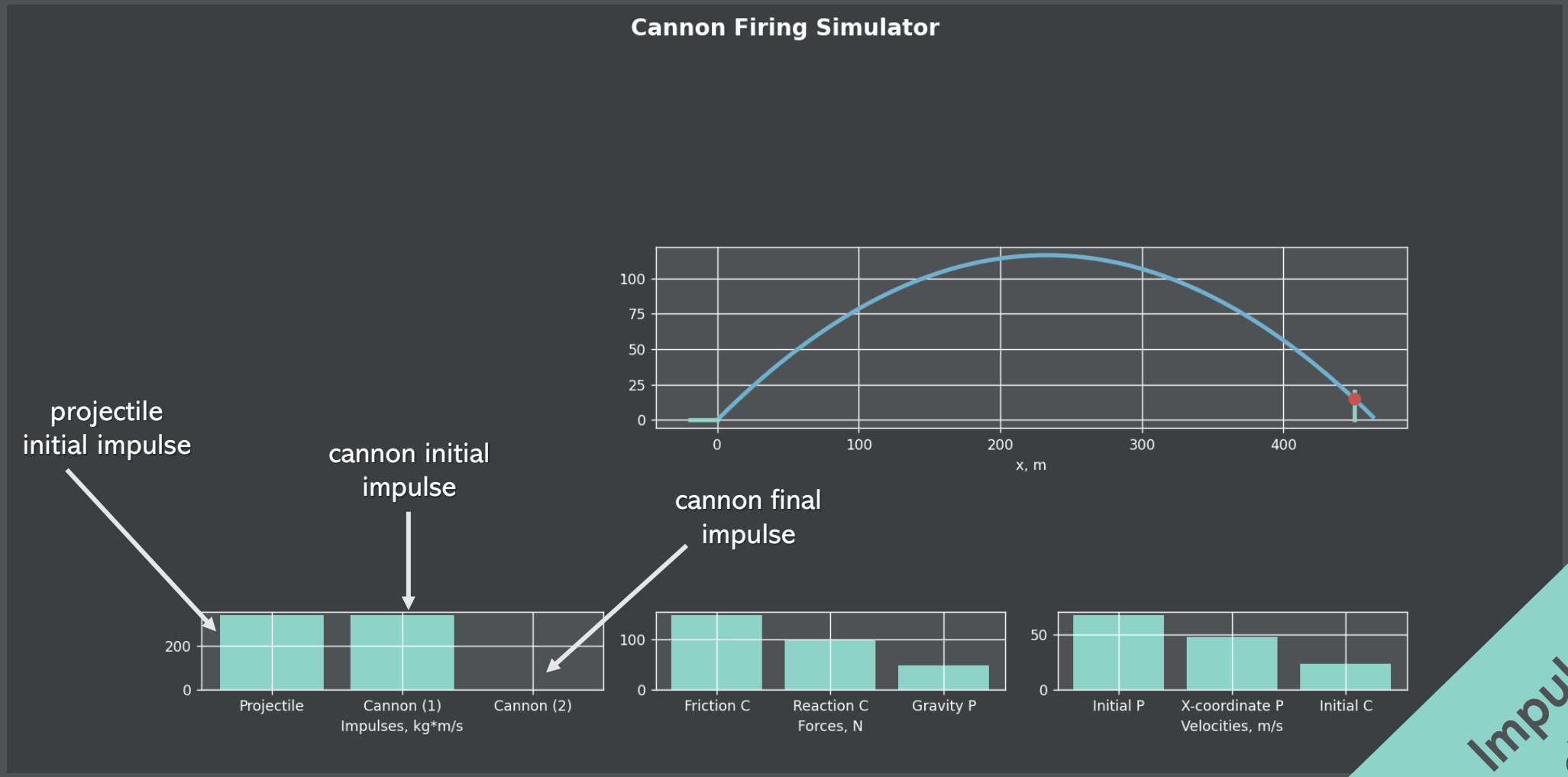
- projectile mass configuration (positive integers only)

- cannon mass configuration (positive integers only)

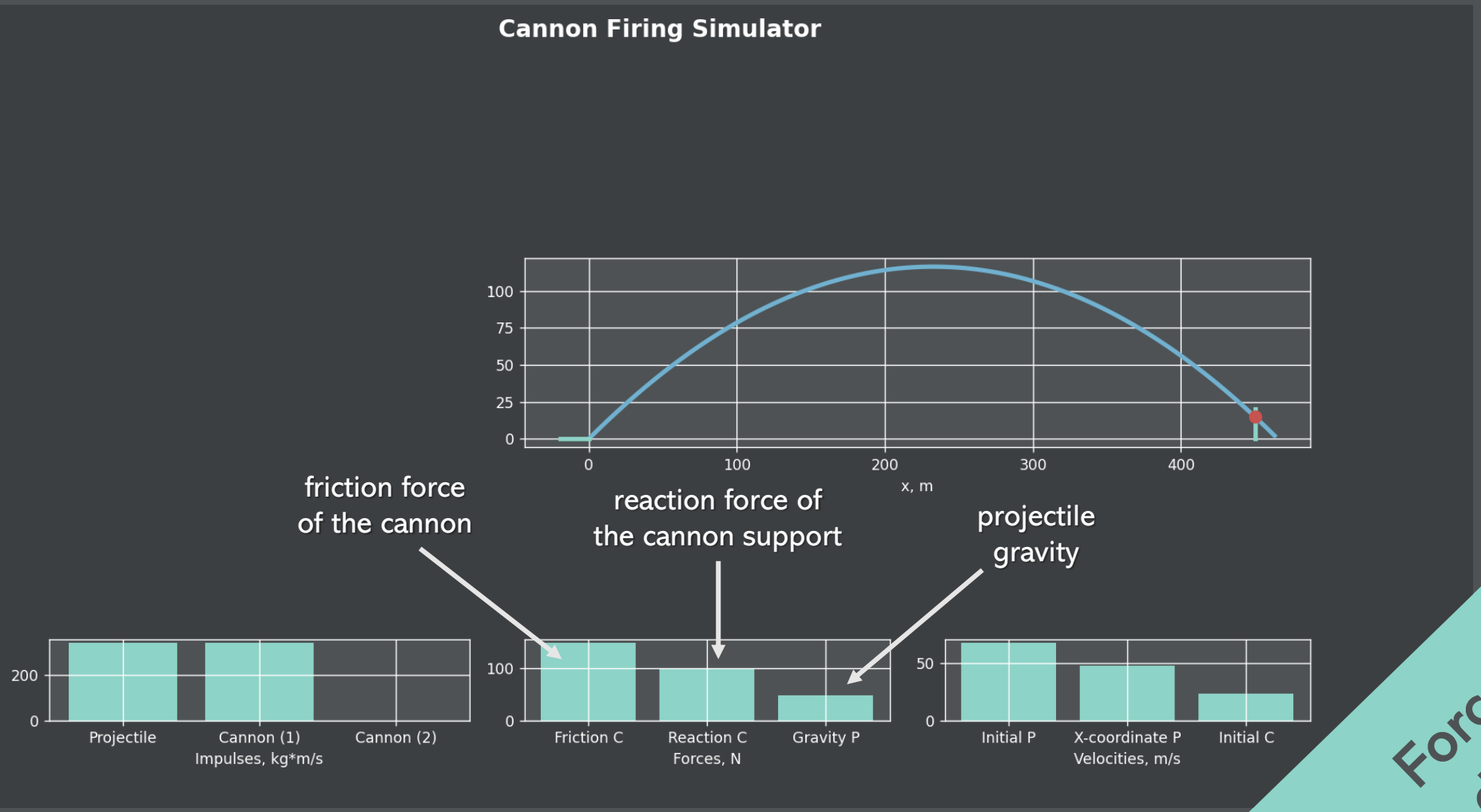
Masses


Cannon Firing Simulator
hit point
target
projectile track
cannon track
100
75
50
25
0
0
100
200
300
400
x, m
200
0
Projectile
Cannon (1)
Cannon (2)
Impulses, kg*m/s
100
0
Friction C
Reaction C
Gravity P
Forces, N
50
0
Initial P
X-coordinate P
Initial C
Velocities, m/s

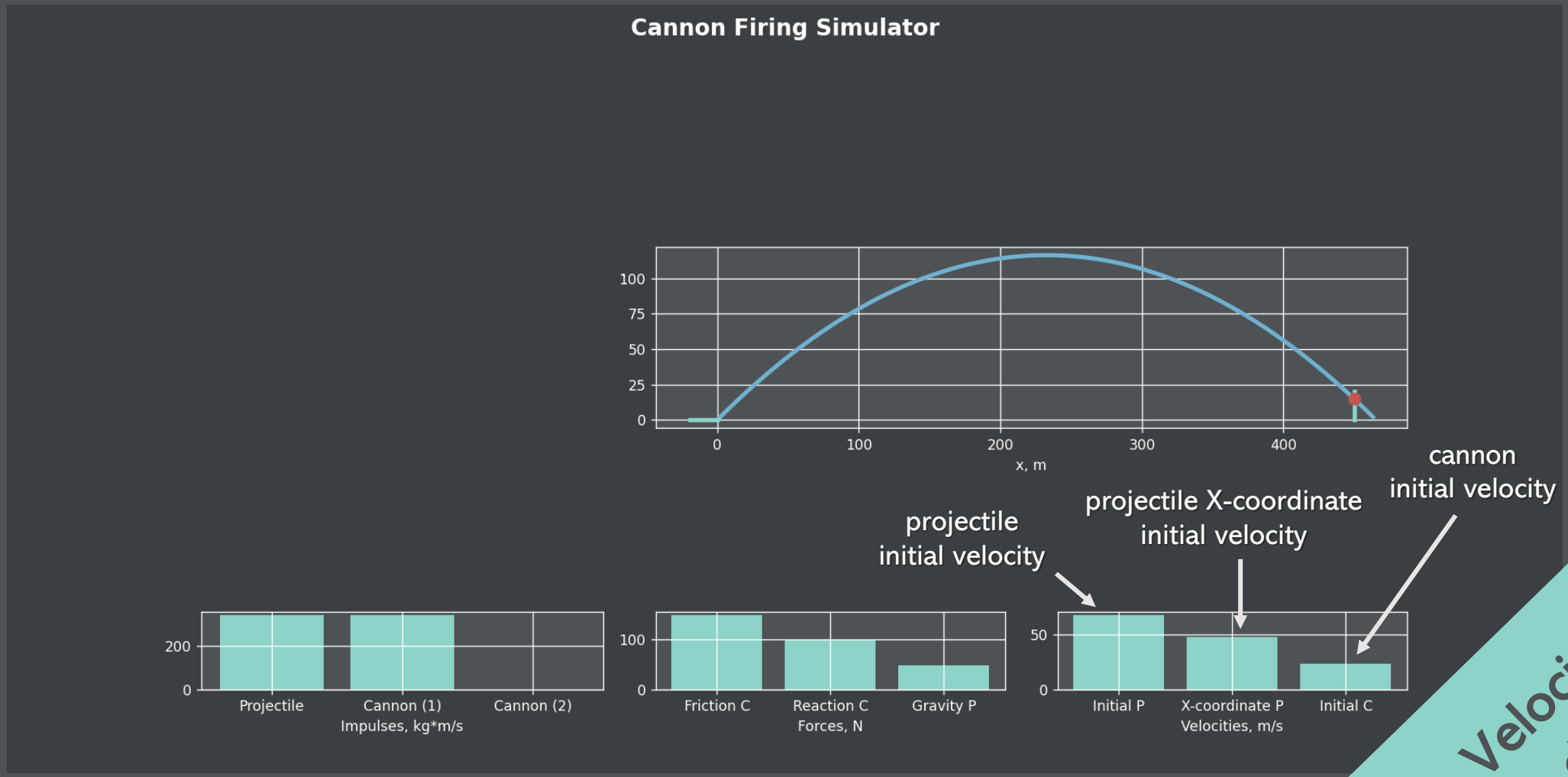
Main graph



Impulses bar diagram



Forces bar diagram


Cannon Firing Simulator
100
75
50
25
0
0
100
200
300
400
x, m
projectile
initial velocity
projectile X-coordinate
initial velocity
cannon
initial velocity
200
0
Projectile
Cannon (1)
Cannon (2)
Impulses, kg*m/s
100
0
Friction C
Reaction C
Gravity P
Forces, N
50
0
Initial P
X-coordinate P
Initial C
Velocities, m/s
Velocities
bar diagram

Kinetic energy of the projectile:

$$T_p = \frac{m_p v_p^2}{2} = \eta \cdot Q_g = \eta \cdot q_g m_g$$

where v_p is the initial velocity of projectile, η is the efficiency of cannon and Q_g is the amount of heat released during the burning of gunpowder.

The projectile X-coordinate function of time:

$$x_p(t) = x_0 + \cos\varphi \cdot v_p \cdot t$$

where x_0 is the X-coordinate of starting point and φ is the angle of cannon firing.

Used formulas

The projectile Y-coordinate function of time:

$$y_p(t) = y_0 + \sin\varphi \cdot v_p \cdot t - \frac{g \cdot t^2}{2}$$

where y_0 is the Y-coordinate of starting point.

The cannon X-coordinate function of time:

$$x_c(t) = x_0 - v_c \cdot t + \frac{F_f t^2}{2 \cdot m_c}$$

where v_c is the initial velocity of cannon, F_f is the rolling friction force of cannon and m_c is the mass of cannon.

Used formulas

The rolling friction force of cannon:

$$F_f = \mu \cdot \frac{N_c}{r_w}$$

where μ is the rolling friction force coefficient, N_c is the reaction force of the cannon support and r_w is the radius of cannon wheel.

Initial impulses equation:

$$J_p - J_c = m_p v_p - m_c v_c = 0$$

Also, the cannon impulse function of time is defined as

$$J_c(t) = \max\left(0, m_c v_c - \int F_f dt\right)$$

Used formulas