

True bullet 1.03 manual

Introduction

The True bullet asset is a complete game, comprising a gun with very realistic bullet ballistics. The gun is meant to be used as a separate asset in any game that benefits from a cool gun. Sniper and artillery games especially, or any game with any shooting.

The gun solves the equations of ballistic flight for the parameters: Coriolis drift, wind drift, spin drift, bullet drop, time of flight and aiming lead. You enter the bullet's: exit velocity, air drag coefficient curve, diameter, mass, and parameters related to the spin drift.

You also give the environmental information: wind velocity, latitude, altitude, temperature, barometric pressure, air density, gravity, and hours per day. The bullet script calculates the bullet trajectory, adds force to the object it hit, and writes the ballistic information on screen.

The velocity dependent air drag coefficient is freely adjustable by a curve. The bullet trajectory respects the atmosphere changing due to the bullet's altitude.

Optionally there is an integrated wind indicator, and bullet marks can be applied at the hit. Both bullets and bullet marks are automatically created. You can set the number of bullets in the clip, and choose to have both reload and fire to be manual or automatic. The sights are adjustable with zoom.

Both the bullets and bullet marks are pooled, there are no game objects littering in the scene, and no instantiation. You can have the gun separate from the camera, but then it is your responsibility to get the gun to point where you aim. The bullet ricochets a selectable number of times before it is repooled. The asset is tested with 1000 bullets flying simultaneously.

There are three views selectable by hot keys: first person, view from behind the bullet, and world view (can be used as third person view by parenting).

Setup

- ✓ Add the Environment script to the ground, or any game object in the scene.
- ✓ Drag and drop the gun script onto any object you want to be a weapon.
- ✓ Optionally drop the GUI_True, WindIndicator, crosshair and LockCursor scripts on the main camera. Assign arrow prefabs and crosshair texture.
- ✓ Optionally assign the bullet mesh, trail renderer, bullet mark material, wind and north indicator prefabs, ricochet and gun sounds.
- ✓ Optionally add the BulletCamera script to the gun and assign a world view camera. The bullet camera is automatically created.
- ✓ Optionally add the VelocityDependentCd and SpinDrift scripts to the gun.
- ✓ Press play and left or right click.
- ✓ You can lock the cursor by pressing the L key.
- ✓ The V and C keys change the view.

You can add the gun to the Unity character controller's camera. If you do not want to use the character controller, there are auxiliary scripts included to give crosshairs and mouse look to any camera or transform.

The game code is in the GUI script. If you do not want the game you can comment out the first row in the GUI script. To use the GUI with the sliders, add the Canvas_Sliders prefab to the scene and add the gun transform to the GUI_Panel script on the panel (first child of canvas).

The bullet sends a message to execute the method ReceiveBulleHit in scripts on the transform it impacted. The message contains information that can be used to apply damage etc. An example of such a method is:

```
void ReceiveBulletHit (BulletInfo_True bulletInfo)
{
    AudioSource.Play(); // plays hurt sound
    Debug.Log(this.name + " was hit by a bullet with energy " + bulletInfo.bulletMass *
        bulletInfo.bulletVelocity.sqrMagnitude * .5f + " Joule.\n");
}
```

GUI

There are two Optional GUI. One shows the ballistic data and governs the game. This GUI is activated by adding the GUI_True script to the main camera. The other GUI_Slider is a convenient way to adjust the gun and wind with the mouse during play. It is made into a prefab that can be added to your scene. You need to assign the gun in the panel (first child). The Air resistance slider has no effect if velocity dependent Cd is chosen.

Parameters

In the gun script:

- ✓ Gun sound (optional)
- ✓ Bullet mesh, shown at the bullet position (optional)
- ✓ Trail renderer, to have the bullet leave a trail (optional)
- ✓ Bullet mark material, a material with texture to show bullet marks (optional)
- ✓ Ricochet sounds, array played randomly (optional)
- ✓ Number of bullets in clip
- ✓ Bullet speed, initial speed at muzzle
- ✓ Bullet mass
- ✓ Bullet diameter
- ✓ Bullet life time, time before bullet is deactivated and re-pooled
- ✓ Cd, bullet air drag coefficient, overridden if velocity dependent Cd is used
- ✓ Up aim, the distance the sights rise per meter forward
- ✓ Right aim, the distance the sights goes to the right per meter forward
- ✓ Hollywood factor, multiplies the impact force
- ✓ Fire cycle time, time between fire when automatic fire

- ✓ Number of ricochet bounces (can be zero)
- ✓ Ricochet Factor, ricochet attenuation (zero gives no ricochet speed)
- ✓ Bullet mark size
- ✓ Auto reload
- ✓ Automatic gun
- ✓ No gravity drop
- ✓ Use spin drift, gun must have SpinDrift script component
- ✓ Use velocity dependent air drag coefficient, requires script component
- ✓ Use fixed air density, do not calculate atmospheric changes due to bullet altitude
- ✓ World ballistic data, choose if the data and aim settings is in world or gun coordinates

In Environment script

- ✓ Gravity
- ✓ North, direction of north, because Coriolis drift depends on direction
- ✓ Wind velocity (wind indicator size change with wind speed)
- ✓ Direction of north (there is an optional north indicating arrow in the wind script)
- ✓ Latitude
- ✓ Air density, overridden if not “Use fixed air density” selected
- ✓ Length of day
- ✓ Altitude, the gun's altitude, above the reference level (see below)
- ✓ Temperature at the reference level, in degrees Celsius
- ✓ Barometric pressure at the reference level, in Pascals

In VelocityDependentCd script

- ✓ Cd multiplier, scales the air drag coefficient curve
- ✓ Cd curve, horizontal axis in Mach number

In SpinDrift script

- ✓ $dM_d\alpha$, derivative of overturning moment, with respect to angle of attack
- ✓ $dC_f_d\alpha^2$, derivative of C_d , with respect to angle of attack squared
- ✓ Rifle pitch in calibers, length of one revolution of barrel twist, in bullet diameters

In auxiliary scripts

- ✓ Arrow pointer, a prefab to be used to indicate wind direction (optional)
- ✓ Mouse sensitivity
- ✓ Zoom, magnification when right clicking to zoom
- ✓ Mouse sensitivity when zoomed in
- ✓ Move velocity, for the WASD keys

- ✓ Lock elevation, transforms stay on ground or flies
- ✓ Limit rotation
- ✓ Crosshair size
- ✓ Game duration
- ✓ Camera position relative to bullet (used when in bullet view mode)

Ballistic data printed on screen

- ✓ Distance to bullet impact position
- ✓ Bullet velocity at impact
- ✓ Time of flight
- ✓ Total lead, the distance you must have aimed ahead of target to hit it
- ✓ Name of transform hit
- ✓ Total bullet drop, the closest distance from the line of aim to the impact
- ✓ Bullet drop from Coriolis
- ✓ Coriolis drift right
- ✓ Wind drift right
- ✓ Bullet drop from wind
- ✓ Spin drift right
- ✓ Bullet drop from spin drift

Bullet drop and drift values are the shortest distance from hit to line of sight, through the crosshair.

Miscellaneous information

The ricochet velocity and bullet force implementations are not yet super accurate. Works well when the bullet is light and the target is heavy.

If you have not seen the videos, look at them here:

<https://www.youtube.com/watch?v=qYIruFpimyE>

<https://www.youtube.com/watch?v=D29GFOr6pus>

https://www.youtube.com/watch?v=S89_8tS1JHE

Web player here:

<http://www.kavorka-racing.com/web-player-game.html>

If you want to mess with the ricochet sound, the code that sets the sound volume is line 445 (or thereabouts) in the bullet script. It looks like this:

```
float ricochetSoundVolume2 = ricochetSoundVolume * (3f -
(bulletHit.point - birthPosition).magnitude / 200f) *
ricochetVelocity / velocity.magnitude * ricochetVelocity /
bulletSpeed * Vector3.Dot(-velocity_Hat, bulletHit.normal);
```

You can also add a sound source of your own configuration in the soundSourcePrefab field of the gun script.

Inspector screenshots

The image displays four screenshots of the Unity Inspector panels for various scripts related to a gun simulation. Each panel shows a list of properties and their current values.

Gun_True (Script)

- Script: Gun_True
- Bullet Mesh Prefab: bulletMesh_use_
- Trail Renderer Prefab: TrailRendererPre
- Gun Sound: GunshotBoomy3
- Bullet Mark Material: BulletMark
- Ricochet Audio Prefab: None (Transform)
- Ricochet Sounds
 - Bullet Clip Size: 16
 - Bullet Speed: 200
 - Bullet Mass: 0.009
 - Bullet Diameter: 0.009
 - Bullet Life Time: 16
- Cd: 0.2
- Up Aim: 0
- Right Aim: 0
- Hollywood Factor: 4
- Fire Cycle Time: 0.15
- Ricochet Factor: 1
- Ricochet Max Bounces: 2
- Ricochet Sound Volume: 0.3
- Gun Sound Volume: 0.5
- Bullet Mark Size: 0.2
- Auto Reload:
- Automatic Gun:
- No Gravity Drop:
- Use Spin Drift:
- Use Velocity Dependel:
- Use Fixed Airdensity:
- World Ballistic Data:

Velocity Dependent Cd_True (S)

- Script: VelocityDepende
- Cd Multiplier: 1
- Cd Curve:

Spin Drift_True (Script)

- Script: SpinDrift_True
- DM_d Alpha: 0.003
- D Cd_d Alpha Squarec: 0.05
- Rifle Pitch_in_calibers: 30

Bullet Camera_True (Script)

- Script: BulletCamera_Tr
- World Camera Transfc: WorldCamera (T
- Camera Position
 - X: -0.5
 - Y: 0.5
 - Z: -2

Environment_True (Script)

- Script: Environment_Tr
- Gravity
 - X: 0
 - Y: -9.81
 - Z: 0
- North
 - X: 0
 - Y: 0
 - Z: 1
- Wind North: 0
- Wind East: 30
- Wind Up: 0
- Latitude: 60
- Air Density: 1.204
- Hours Of Day: 24
- Altitude: 0
- Temperature: 20
- Barometric Pressure: 101300