Aim Assist Pro Documentation

June 2022

Initial release, version 1.0.0

Contents

1 Greetings

Thank you for downloading my asset Aim Assist Pro. The asset intends to help developers of the shooter genre enhance their games' player experience with an assisted aiming system, helping the player feel more powerful and less stressed about practicing fine adjustments while still feeling in complete control over their aim. The system helps developers serve their players with better gameplay and enemies instead of making the AI stand still so they can be actually hit.
The documentation contains all the information needed to integrate Aim Assist Pro into your project.

2 About the asset

The asset consist of C# scripts that calculate rotation / pitch addition on top of your player's input. It is also equipped with demo scenes so you could try out the settings and tailor them to your game's profile. The asset is intended for the shooter genre, especially for controllers to help players aim. See the general descriptions for the type of aim assists below to get a feeling of how they would serve you to take your FPS game's experience to the next level. The documentation also contains considerations that were made to make the asset perform better by reducing wasteful calls to Unity's API.

3 Supported input systems

The asset works by calculating the necessary rotations for turn or pitch, or scaling the magnitude of the player input. The outputs are either the changed input values or rotation adjustments in degrees for the sideways turn and the pitch, respectively. The asset was developed using Unity's Input System and old Input Manager but it's in no way tied to that input format - due to it being a calculator in its essence, it should work with any third party input system that is available for Unity.

Test scenes are included using Unity's Input System and Unity's old Input Manager.

4 Supported character control methods

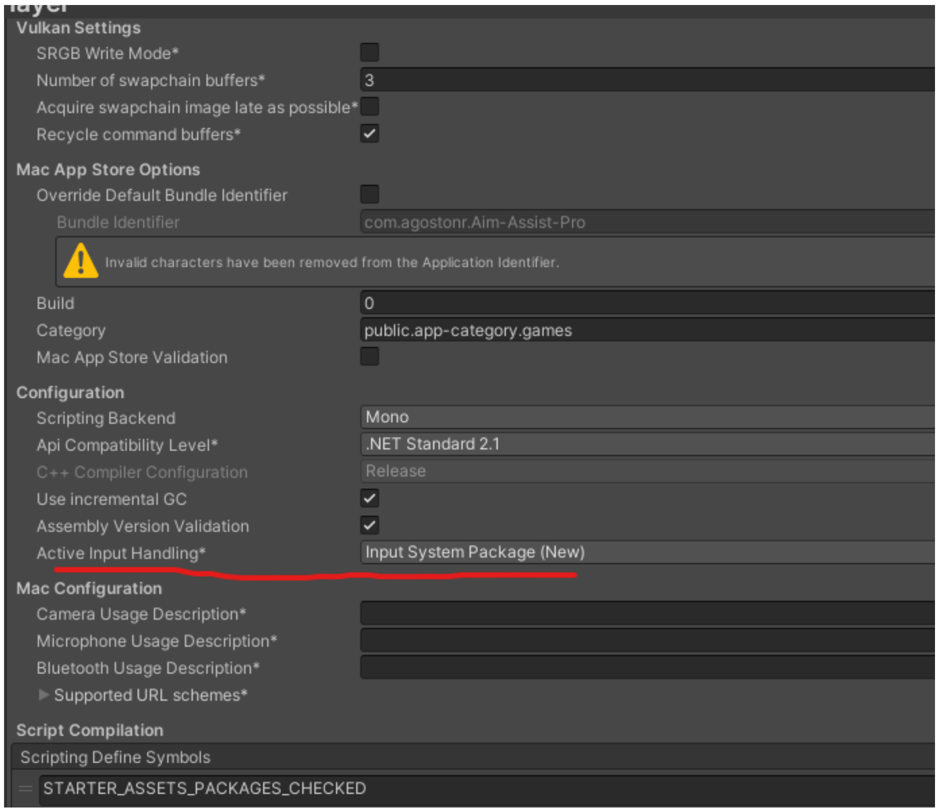
The asset works with either `RigidBody` or `CharacterController`. After all, all they do is calculate rotations. Test scenes are included for both `RigiBody` and `CharacterController` based solutions.

5 Enabling the input method for test scenes

Test scenes are implemented using the new Input System and the old Input Manager. Unity should prompt you to enable the new Input System when you import Aim Assist Pro. In case it doesn't, follow the steps below to enable it.

1. Go to File - Build Settings - Player Settings
2. Scroll down to configuration
3. Under Active Input Handling, select `Input System Package (new)`
4. Restart your editor.

After these steps the Input Manager based scenes won't work, you'd have to select `Input Manager (old)` in the same spot for that. If you select `Both` then the new input system will take effect as this is how the example script was written.



Vulkan Settings	
SRGB Write Mode*	☐
Number of swapchain buffers*	3
Acquire swapchain image late as possible*	☐
Recycle command buffers*	✓
Mac App Store Options	
Override Default Bundle Identifier	☐
Bundle Identifier	com.agostonr.Aim-Assist-Pro
Invalid characters have been removed from the Application Identifier.	
Build	0
Category	public.app-category.games
Mac App Store Validation	☐
Configuration	
Scripting Backend	Mono
Api Compatibility Level*	.NET Standard 2.1
C++ Compiler Configuration	Release
Use incremental GC	✓
Assembly Version Validation	✓
Active Input Handling*	Input System Package (New)
Mac Configuration	
Camera Usage Description*	
Microphone Usage Description*	
Bluetooth Usage Description*	
Supported URL schemes*	
Script Compilation	
Scripting Define Symbols	
STARTER_ASSETS_PACKAGES_CHECKED	

Figure 1: Enable the new input system

6 General structure

As mentioned before, all aim assist types contain calculations that adjust the rotation and pitch of the player to get their aim closer to the target. See some considerations below to better understand how the assisting code works.

6.1 Target

`AimAssistTarget` is a script you need to assign to the *GameObject*s you want to shoot at. If this script is missing from it, then the aim assist is not going to pick up your target.

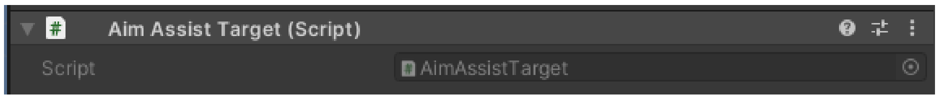

Aim Assist Target (Script)
Script AimAssistTarget

Figure 2: The simple target script to let the system know what to aim for

Besides marking *GameObject*s as targets, it also contains events that notify the subscribers when an aim assist acquired that target.

- `TargetSelected` event is called once, when an aim assist finds the given target. It isn't called repeatedly in the assist loop.
- `TargetLost` event is called once, when an aim assist doesn't see the target anymore. After this, `TargetSelected` can be invoked again.

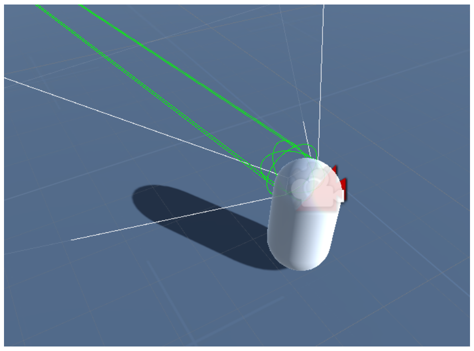
To save performance, caching is enabled to reduce unnecessary `GetComponent` calls that look for the target script. This cache is built on the fly - when the aim assist finds a collider, it looks for the aim assist component.

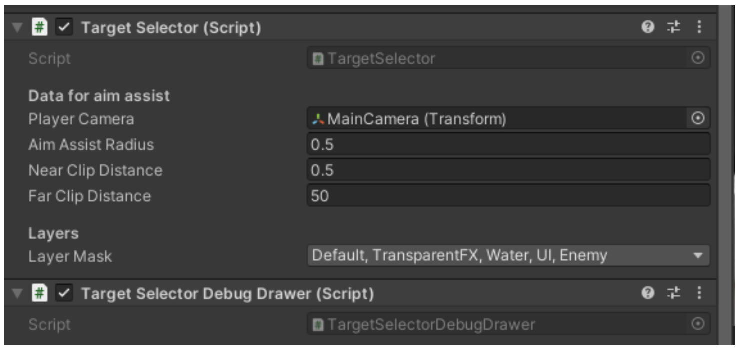
- If an assist script is already stored, it will just return that and won't call `GetComponent`.
- If it doesn't find it, it's going to cache null and won't try to look for it again. **When assigning these target scripts to *GameObject*s runtime, make sure to either add it to the cache as well or just purge the cache so it can rebuild itself**.
- If it finds it on the *GameObject* then it stores the target script and also returns it. Next time it will just find it in the cache.

6.2 Target selector

The `TargetSelector` is in charge of finding a target using Unity's built-in physics system. It requires the transform of the player camera. If it isn't set, it throws a `MissingComponentException`.

- `Player Camera` is the transform of the player's camera. Needed to know where to shoot the spherecasts and raycasts from.
- `Aim Assist Radius` is the radius or spread of the aim assist in metres. The narrower this is, the closer the player have to aim to the target for the aim assist to actually take effect. Make it too large though, the spherecast will bump into obstacles unless the target is standing in the middle of nowhere.


(a) Aim assist radius


Target Selector (Script)

Script	TargetSelector
Data for aim assist	
Player Camera	MainCamera (Transform)
Aim Assist Radius	0.5
Near Clip Distance	0.5
Far Clip Distance	50
Layers	
Layer Mask	Default, TransparentFX, Water, UI, Enemy

Target Selector Debug Drawer (Script)

Script	TargetSelectorDebugDrawer

(b) Selector settings

Figure 3: Target selector and its settings

- `Near clip distance` - if the player is closer to the target than this, then the aim assist won't take effect. Useful when the aim assist would get annoying if the player moves close to enemies.
- `Far clip distance` - how far the aim assist perceives targets.
- `LayerMask` - which layers are actually taken into consideration when using the aim assist. **If you only add the enemy layer then obstacles and cover will be ignored, tracking the enemy through walls**.

The `TargetSelector` uses a SphereCast first, with the radius set by the developer in the Inspector, through *Aim assist radius*. If this doesn't find anything, then a corner might be blocking the target you're looking at - so it shoots a raycast too. If that doesn't find anything either, then we have no target to assist against. If there are multiple targets, the selected one is at the discretion of Unity's spherecast and raycast.

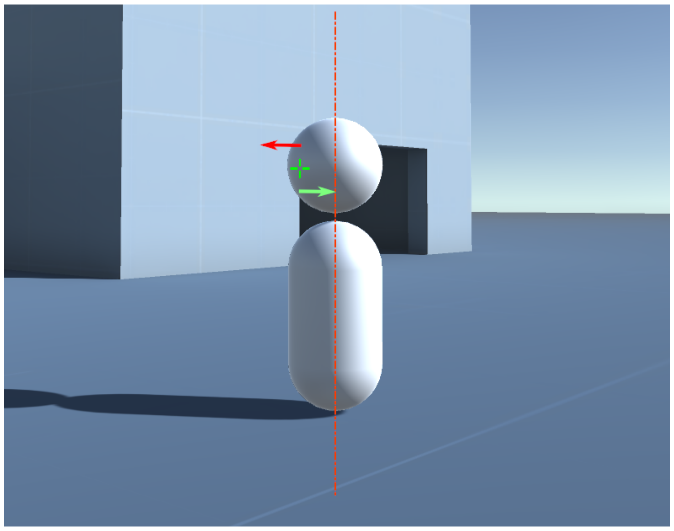
Once there's a target, If we weren't already looking at it, the `TargetSelected` event is fired. If we found no target but used to see one (one frame ago) then the `TargetLost` event is fired.

Since you may use multiple aim assists, most of them rely on this selector to provide them with a target. This eliminates all of them shooting sphere and raycasts over and over again, hindering performance.

6.3 Magnetism

Dubbed by the community of a famous shooter game, Magnetism works by smoothly compensating for the player's strafing movement to make it easier to keep track of the enemy. It returns the rotation adjustment in degrees that you add to your rotations.
To understand what the comments mean in the script and documentation let's walk you through a couple of terms for the sake of clarity.

- Moving **towards** the target is the movement represented by the **green** arrow on figure **a**. It basically means that the player is strafing sideways in the target's direction and is not yet facing the target, thus moving towards its center. Figure **b** shows with a **green** arrow how Magnetism will compensate that strafe to prevent dropping the crosshair right to the target.


(a) Movement to and away from target

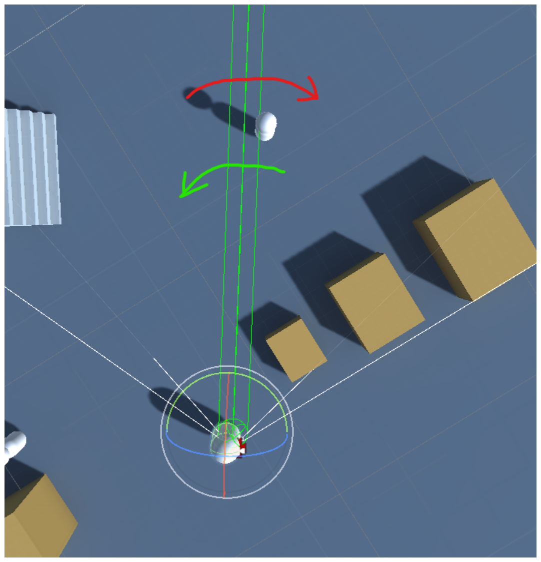

(b) Turn compensation for movement

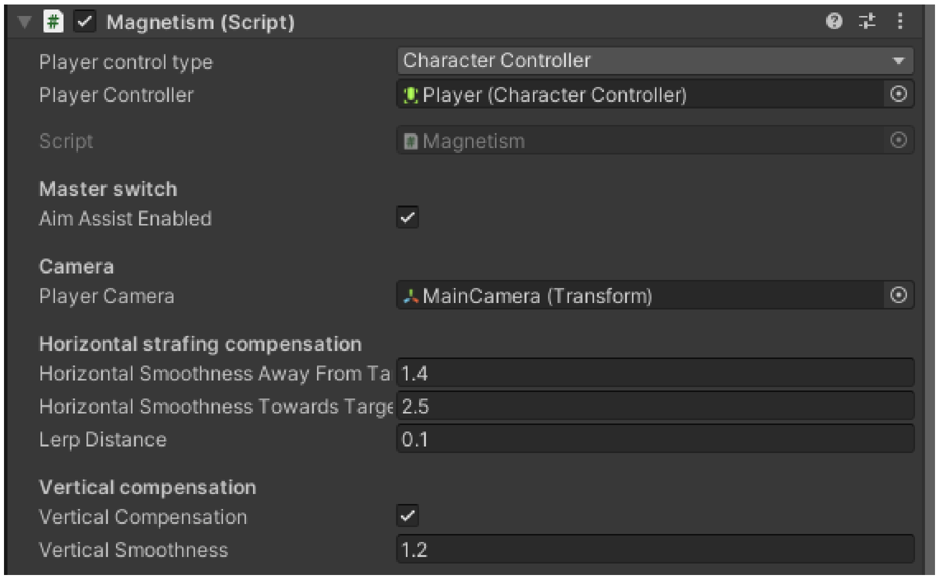
Figure 4: Magnetism

- Moving **away** from the target is the movement represented by the **red** arrow on figure **a**. It means that the player is strafing sideways and is moving the opposite direction, away from the target's center. Figure **b** shows with a **red** arrow how Magnetism will compensate for strafing by rotating the camera back towards the target.

So strafe compensation means turning the camera the opposite direction of the player's strafe direction. Magnetism does this but slowed down by a given factor, and that factor differs whether the player moves towards, or away from the target. This separation allows for keeping track of the target when the player moves away while still allowing for a smooth mirror strafing to follow the target's movement.

See the settings detailed below.

- `Player control type` select your player's controller setup: either `CharacterController` or `Rigidbody`.
- `Player Controller` or `Player Body` Drag the reference of the `CharacterController` or `Rigidbody` here.
- `Master switch` enable or disable the aim assist.
- `Player camera` the transform of the player's camera, needed for all calculations.
- `Horizontal smoothness away from target` smoothness, as a divisor for the rotation that compensates the strafing of the player while they are moving *away* from the target (defined above). The larger this number the less the compensation is for the strafing. It's capped above 1, but if the value would be set to 1, you would "lock" your aim next to the target and hard track that spot instead of letting the crosshair reach the target.



Magnetism (Script)

Player control type	Character Controller
Player Controller	Player (Character Controller)
Script	Magnetism
Master switch	
Aim Assist Enabled	✓
Camera	
Player Camera	MainCamera (Transform)
Horizontal strafing compensation	
Horizontal Smoothness Away From Ta	1.4
Horizontal Smoothness Towards Targe	2.5
Lerp Distance	0.1
Vertical compensation	
Vertical Compensation	✓
Vertical Smoothness	1.2

Figure 5: Magnetism settings

- `Horizontal smoothness towards target` smoothness, as a divisor for the rotation that compensates the strafing of the player while they are moving *towards* the target (defined above). The larger this number the less the compensation is for the strafing. It is ideal to set it a bit larger than `Smoothness away from the target` to allow for mirror strafing, that is, tracking the target's movement with your own movement.

- `Lerp distance` is the distance in the middle of the target that interpolates between the *towards* and *away* smoothness. It should be less than the aim assist radius - it it is set to more, it is clamped anyway. Without this when your speed matches the target's while mirror strafing there would be a noticeable stutter present at lower frame rates due to the aim assist switching between the two smoothnesses abruptly.

- `Vertical compensation` whether the aim assist should compensate for the player's vertical movement e.g. jump. Useful when walking on stairs or dropping from a highground - it keeps track of the height of your aim so you don't end up aiming at the ground.

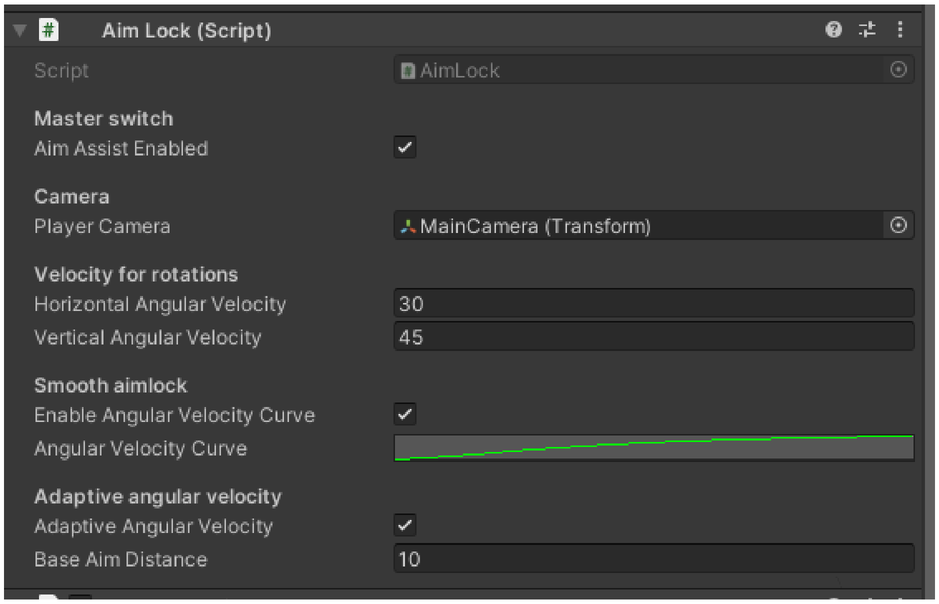
- `Vertical smoothness` smoothness of the vertical aim, similar to the others defined above.

6.4 Aimlock

A smooth aimlock that tracks the target for you. You can use a curve to smooth out the tracking, giving it a more natural, spring-like feel. The aimlock is going to end up aiming at the center of the target, e.g. its `transform.position`. Set up your scripts to the target's hitbox accordingly. It returns the adjustments that you add to your rotation in degrees.

- `Master switch` enables or disables the aim assist.

- `Player camera` the player's camera



Aim Lock (Script)

Script	AimLock
Master switch	
Aim Assist Enabled	✓
Camera	
Player Camera	MainCamera (Transform)
Velocity for rotations	
Horizontal Angular Velocity	30
Vertical Angular Velocity	45
Smooth aimlock	
Enable Angular Velocity Curve	✓
Angular Velocity Curve	
Adaptive angular velocity	
Adaptive Angular Velocity	✓
Base Aim Distance	10

Figure 6: Aimlock settings

- `Horizontal angular velocity` the rotation angular velocity in degrees per second for the camera turn when tracking the target.
- `Vertical angular velocity` the rotation angular velocity in degrees per second for the camera pitch when tracking the target.
- `Enable angular velocity curve` enables or disables the smoothing curve for the aimlock's angular velocities.
- `Angular velocity curve` a curve that serves as a multiplier based on how close the player's crosshair is to the center of the target. The X axis is the aim assist's radius with 0 being the crosshair and 1 being the outer edge. The Y axis is a multiplier that is applied to the angular velocity. It is advised to keep both axes between 0 and 1. You can set any curve you prefer, though keep the following in mind for the best results. The example curve presented doesn't lock your aim at all when you're already looking at the center of the target and it also falls rapidly. This allows for some wiggle room when already aiming at the target and also prevents unnecessary stutter due to the aimlock assisting back and forth for every small adjustment.
- `Adaptive angular velocity` enable or disable adaptive angular velocity. This feature is useful when distance varies greatly between the targets you pick (which is, like, almost always). To aim for targets farther a small adjustment is enough. Without this, when you aim for targets far away your aim becomes snappy due to the too high angular velocity.
- `Base aim distance` a distance to the target where if you are farther from, the angular velocity is going to be scaled down linearly - the farther you are, the slower your aimlock is. If you are closer than this value, the angular velocities are not adjusted.

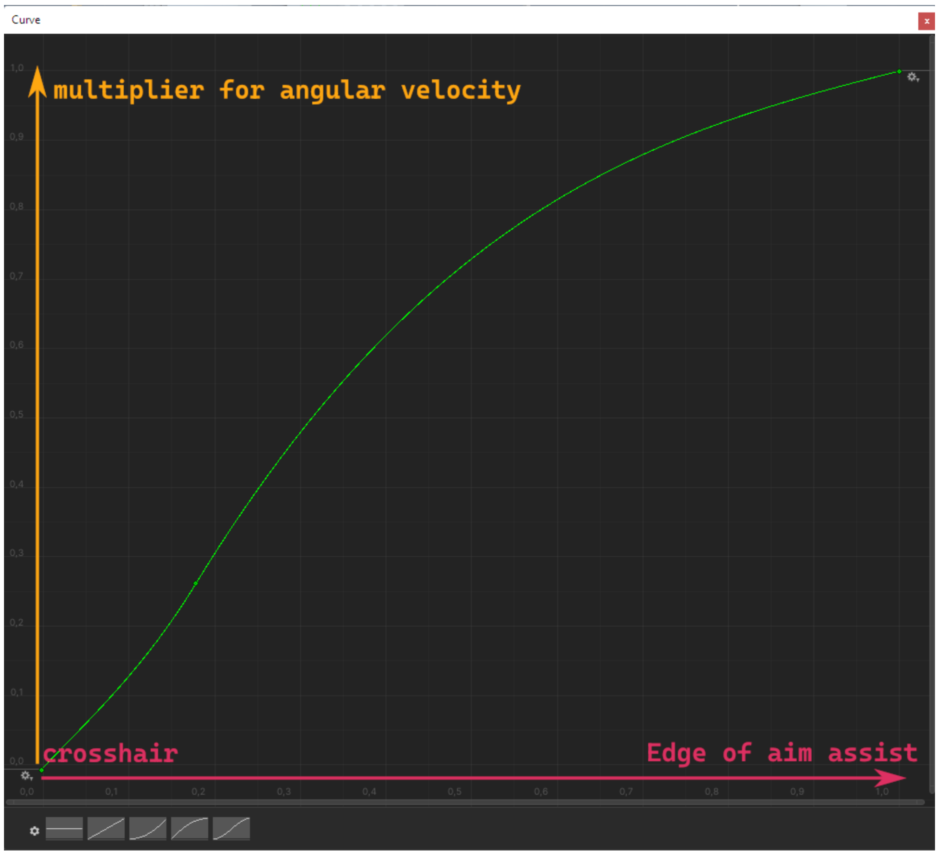
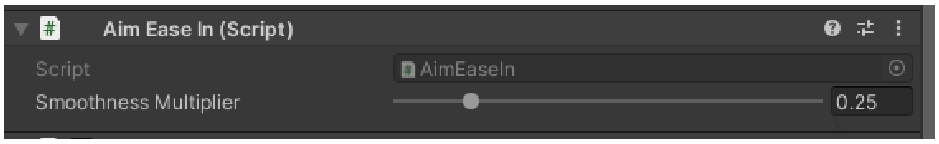


Figure 7: Aimlock angular velocity curve

6.5 Aim ease in

A very simple aim assist which selects a dominant axis (the one where your delta is higher) and downscales the other. This allows for a convenient horizontal or vertical aim instead of going diagonally. It takes in the look input delta `Vector2` and returns a modified look input delta `Vector2` so you just have to run your look input through this before using it in your script for look rotations. Differs from other aim assists that it doesn't even require a `TargetSelector` - its behaviour is present always and is not tied to a target.



Aim Ease In (Script)

Script AimEaseIn

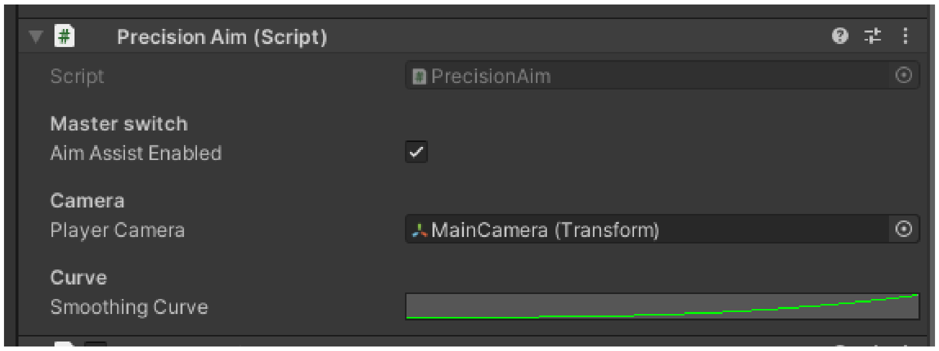
Smoothness Multiplier 0.25

Figure 8: Aim ease in settings

- `Aim assist enabled` a master switch to enable the aim assist.
- `Smoothness multiplier` a multiplier for the less dominant axis.

6.6 Precision aim

Simply scales down the input delta using a curve provided. The curve works the same as in Aimlock. Just run your input delta through this script before using it in your look rotations.



Precision Aim (Script)

Script	PrecisionAim
Master switch	
Aim Assist Enabled	✓
Camera	
Player Camera	MainCamera (Transform)
Curve	
Smoothing Curve	

Figure 9: Precision aim settings

- `Aim assist enabled` a master switch to enable or disable aim assist.
- `Player camera` the player camera
- `Smoothing curve` the curve to apply to the input delta, works similarly to the Aimlock's velocity curve, but X axis is the input delta while Y axis is the multiplier.

7 Integrating the aim assist scripts to your code

To see how to integrate the aim assist scripts to your code, follow the steps below.

7.1 Integrating Aim assist target

1. Make sure your GameObject has a collider
2. Make sure you select the appropriate layer so the `TargetSelector` takes this into consideration
3. Assign the `AimAssistTarget` script to the object.

If you also want the notifications when targets are found, subscribe to the events on the script. `TargetSelector` handles the invocation. These events can be useful when e.g. you have abilities in your game that you assign to certain NPCs or other players, it gives you a more generous hitbox and you don't have to perfectly look at your target.

7.2 Integrating Target Selector

`TargetSelector` itself is added by the aim assist scripts because it's a required component. You can add it manually if you would like to though.

1. Drag the player's camera to the `Player camera` field

2. Set your aim assist radius
3. Set your near clip distance
4. Set your far clip distance
5. Set your layer masks. Again, don't forget that if you don't set covers, only layers with the Enemy then the aim assist will track your targets through walls.

There's no code integration for `TargetSelector` - target selection works on its own and aim assist scripts will then use the target that is provided by it.

7.3 Integrating Magnetism

1. Add `Magnetism` script to your player character. This also adds a `TargetSelector` as it's a required component.
2. Drag your camera to the `Player camera` reference on the script
3. Set up your smoothness values as you see fit.

After that, `Magnetism` has to be used in your C# scripts. See an excerpt below of a demo script that shows an integration of `Magnetism`.

```
public class FPSController_CC_Magnetism : MonoBehaviour {
    private Magnetism _magnetism;
    ...

    private void Awake() {
        _magnetism = GetComponent<Magnetism>();
    }
    ...

    private void LateUpdate() {
        HandleCameraRotation();
        AssistAim();
    }

    private void AssistAim() {
        var magnetismResult = _magnetism.AssistAim(new MagnetismInput(_input.move, Time.deltaTime));
        // this example is for Character Controller
        transform.Rotate(magnetismResult.TurnAddition);

        _cinemachineTargetPitch += magnetismResult.PitchAdditionInDegrees;
        _cinemachineTargetPitch = ClampAngle(_cinemachineTargetPitch, BottomClamp, TopClamp);
        CinemachineCameraTarget.transform.localRotation = Quaternion.Euler(_cinemachineTargetPitch,
            0f, 0f);
    }
}
```

Get a reference to `Magnetism` and call it in the same loop you handle your camera rotation, after you handled it. You rotate the camera the same for the aim assist as you do for player input. This example is based on Unity's Character Controller Playground example.

`MagnetismInput` contains all information necessary for `Magnetism` to work. It needs the player's movement input axis and the current time delta. Note that the result `Magnetism` gives is an addition to either the rotation or the pitch, it isn't a set direction your camera needs to face as that would eliminate player input. `TurnAddition` is the rotation addition in degrees along Y axis, a *Vector3* that is added for convenience over the turn addition in degrees.

As per Unity's exmple, you need to clamp your pitch to prevent the camera "falling over".

For a `Rigidbody` based approach the example is as follows:

```
public class FPSController_RB_Magnetism : MonoBehaviour {
    private Magnetism _magnetism;
    ...

    private void Awake() {
        _magnetism = GetComponent<Magnetism>();
    }
    ...

    private void LateUpdate() {
        HandleCameraRotation();
        AssistAim();
    }

    private void AssistAim() {
        var aimAssist = _magnetism.AssistAim(new MagnetismInput(_input.move, Time.deltaTime));

        var turnAddition = Quaternion.Euler(aimAssist.TurnAddition);
        // don't forget to keep your rotation and use Magnetism as an addition.
        // MoveRotation sets a target to look to, as opposed to Rotate before.
        _rigidbody.MoveRotation(_rigidbody.rotation * turnAddition);

        _cinemachineTargetPitch += aimAssist.PitchAdditionInDegrees;
        _cinemachineTargetPitch = ClampAngle(_cinemachineTargetPitch, BottomClamp, TopClamp);
        CinemachineCameraTarget.transform.localRotation = Quaternion.Euler(_cinemachineTargetPitch,
            0f, 0f);
    }
}
```

Using `Magnetism` for a Rigidbody based controller is very similar, the only difference is that you need to pay attention not to eliminate your old rotation as MoveRotation sets a rotation to look to. Adding *Quaternion*s and *vector*s happen by multiplying them.

With this setup you have your aim assist in place and will compensate for strafing against a target.

7.4 Integrating Aimlock

`Aimlock`'s integration works quite akin to that of `Magnetism`'s, though the script's parameters differ a little bit.

1. Add the `AimLock` script to your player object. This will add a `TargetSelector` too if not present already.
2. Drag the camera's reference to `Player camera`
3. Set your angular velocities and the velocity curve. It is highly recommended to use the angular velocity curve.
4. Set your adaptive velocity if you want to prevent a snappy aim at a distance.

Integrating `Aimlock` in your scripts is very much akin to integrating `Magnetism` as discussed earlier.

```
public class FPSController_CC_Aimlock : MonoBehaviour {
    private AimLock _aimLock;
    ...

    private void Awake() {
        _aimLock = GetComponent<AimLock>();
    }
    ...

    private void LateUpdate() {
        HandleCameraRotation();
        AssistAim();
    }

    private void AssistAim() {
        var aimLockResult = _aimLock.SnapAim(new AimLockInput(_input.look, Time.deltaTime));

        transform.Rotate(aimLockResult.TurnAddition);

        _cinemachineTargetPitch += aimLockResult.PitchAdditionInDegrees;
        _cinemachineTargetPitch = ClampAngle(_cinemachineTargetPitch, BottomClamp, TopClamp);
        CinemachineCameraTarget.transform.localRotation = Quaternion.Euler(_cinemachineTargetPitch,
            0f, 0f);
    }
}
```

`Aimlock` requires the look input delta and the time delta to work. Akin to `Magnetism` it returns a struct of degrees that contain the additional rotation for your player and camera. Call this in the loop you handle your camera rotations, after you did so and the adjustments to your player rotation and camera pitch, as if you'd add rotations based on player input.

Rigidbody setup is very similar. Make sure you keep your original rotation while using Rigidbody's `MoveRotation`.

```
public class FPSController_RB_Aimlock : MonoBehaviour {
    private AimLock _aimLock;
    ...

    private void Awake() {
        _aimLock = GetComponent<AimLock>();
    }
    ...

    private void LateUpdate() {
        HandleCameraRotation();
        AssistAim();
    }

    private void AssistAim() {
        var aimAssist = _aimLock.SnapAim(new AimLockInput(_input.look, Time.deltaTime));

        var turnAddition = Quaternion.Euler(aimAssist.TurnAddition);
        _rigidbody.MoveRotation(_rigidbody.rotation * turnAddition);

        _cinemachineTargetPitch += aimAssist.PitchAdditionInDegrees;
        _cinemachineTargetPitch = ClampAngle(_cinemachineTargetPitch, BottomClamp, TopClamp);
        CinemachineCameraTarget.transform.localRotation = Quaternion.Euler(_cinemachineTargetPitch,
            0f, 0f);
    }
}
```

7.5 Integrating Aim ease in

`Aim ease in` is the simplest to use and integrate. It doesn't even require a `TargetSelector` to work as its effect is always present, not only when looking at targets.

1. Add `AimEaseIn` to your player object
2. Set the smoothness (multiplier) that downscales your less dominant look axis.

```
public class FPSController_CC_AimEaseIn : MonoBehaviour {
    private AimEaseIn _aimEaseIn;
    ...

    private void Awake() {
        _aimEaseIn = GetComponent<AimEaseIn>();
    }
    ...

    private void LateUpdate() {
        HandleCameraRotation();
    }

    private void HandleCameraRotation() {
        if (_input.look.sqrMagnitude < _threshold) {
            return;
        }

        // this single line integrates aim ease in.
        var look = _aimEaseIn.AssistAim(_input.look);
        _cinemachineTargetPitch += look.y * RotationSpeed * Time.deltaTime;
        _rotationVelocity = look.x * RotationSpeed * Time.deltaTime;

        _cinemachineTargetPitch = ClampAngle(_cinemachineTargetPitch, BottomClamp, TopClamp);
        CinemachineCameraTarget.transform.localRotation = Quaternion.Euler(_cinemachineTargetPitch,
             0.0f, 0.0f);
        transform.Rotate(Vector3.up * _rotationVelocity);
    }
}
```

The single line that is marked integrates `Aim ease in`. All you have to do is run your look input delta through the script before using it to handle player input for rotations.

7.6 Integrating Precision aim

`Precision Aim` is another simple aim assist that slows down your input by a given curve.

1. Add `PrecisionAim` to your player object. This will add a `TargetSelector` too if not present already.
2. Drag your camera to `Player camera`
3. Set the smoothness curve. See guidelines above.

Integrating `Precision aim` in your script is the same as integrating `Aim ease in`.

```
public class FPSController_CC_PrecisionAim : MonoBehaviour {
    private PrecisionAim _precisionAim;
    ...

    private void Awake() {
        _precisionAim = GetComponent<PrecisionAim>();
    }
    ...

    private void LateUpdate() {
        HandleCameraRotation();
    }

    private void HandleCameraRotation() {
        if (_input.look.sqrMagnitude < _threshold) {
            return;
        }

        // this single line integrates precision aim.
        var look = _precisionAim.AssistAim(_input.look);
        _cinemachineTargetPitch += look.y * RotationSpeed * Time.deltaTime;
        _rotationVelocity = look.x * RotationSpeed * Time.deltaTime;

        _cinemachineTargetPitch = ClampAngle(_cinemachineTargetPitch, BottomClamp, TopClamp);
        CinemachineCameraTarget.transform.localRotation = Quaternion.Euler(_cinemachineTargetPitch,
            0.0f, 0.0f);
        transform.Rotate(Vector3.up * _rotationVelocity);
    }
}
```

The line marked with a comment integrates `PrecisionAim`. All you do is run your look input delta through it before using that input delta for handling your rotation and pitch.