UE4 C++ CODE PLUGIN – FOOT IK

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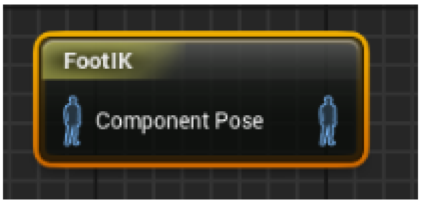
Introduction

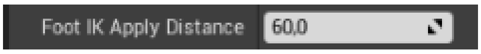
This plugin contains a single Skeletal Control Node for Foot IK Application.



FootIK

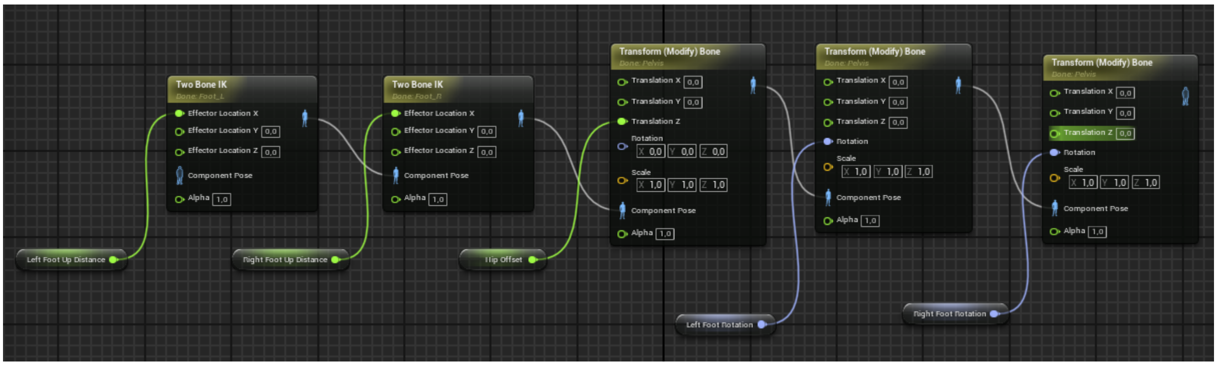
Component Pose

With the help of two line traces beginning from FVector(Foot.X, FootY, Actor.Z) position with a length of l = (Capsule Half Height + Apply Distance),



Foot IK Apply Distance 60,0

the offset between Foot and Ground is calculated. This offset is then applied to the Pelvis in the negative direction. So that our Character touches the ground at the exact needed position. To compensate the offset for the other foot, its height will be increased as the exact same amount in the opposite direction with the help of Two Bone IK. Application of Inverse Kinematics (IK) will allow us to get a natural foot and leg position. This process is usually made by calculations in the Event Graph and passing results to the Anim Graph for Bone Transforms.



Two Bone IK
Bone: Foot_L
Effector Location X
Effector Location Y 0,0
Effector Location Z 0,0
Component Pose
Alpha 1,0

Two Bone IK
Bone: Foot_R
Effector Location X
Effector Location Y 0,0
Effector Location Z 0,0
Component Pose
Alpha 1,0

Transform (Modify) Bone
Bone: Pelvis
Translation X 0,0
Translation Y 0,0
Translation Z
Rotation X 0,0 Y 0,0 Z 0,0
Scale X 1,0 Y 1,0 Z 1,0
Component Pose
Alpha 1,0

Transform (Modify) Bone
Bone: Pelvis
Translation X 0,0
Translation Y 0,0
Translation Z 0,0
Rotation
Scale X 1,0 Y 1,0 Z 1,0
Component Pose
Alpha 1,0

Transform (Modify) Bone
Bone: Pelvis
Translation X 0,0
Translation Y 0,0
Translation Z 0,0
Rotation
Scale X 1,0 Y 1,0 Z 1,0
Component Pose
Alpha 1,0

Left Foot Up Distance

Right Foot Up Distance

Hip Offset

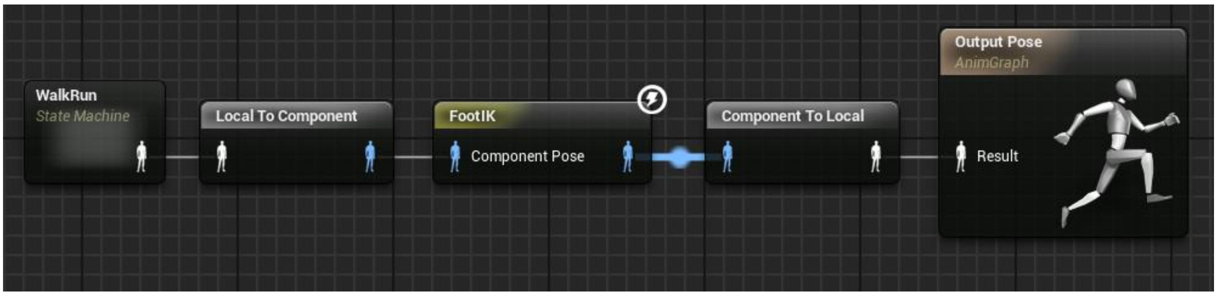
Left Foot Rotation

Right Foot Rotation

As seen in the picture there are 5 different Skeletal Control Nodes needed for this process. 2 AnimNode_TwoBoneIK for each foot and 3 AnimNode_ModifyBone for Pelvis Translation and each foot Rotation. As calculations are not made in the AnimNodes, they will also have to be replicated manually.

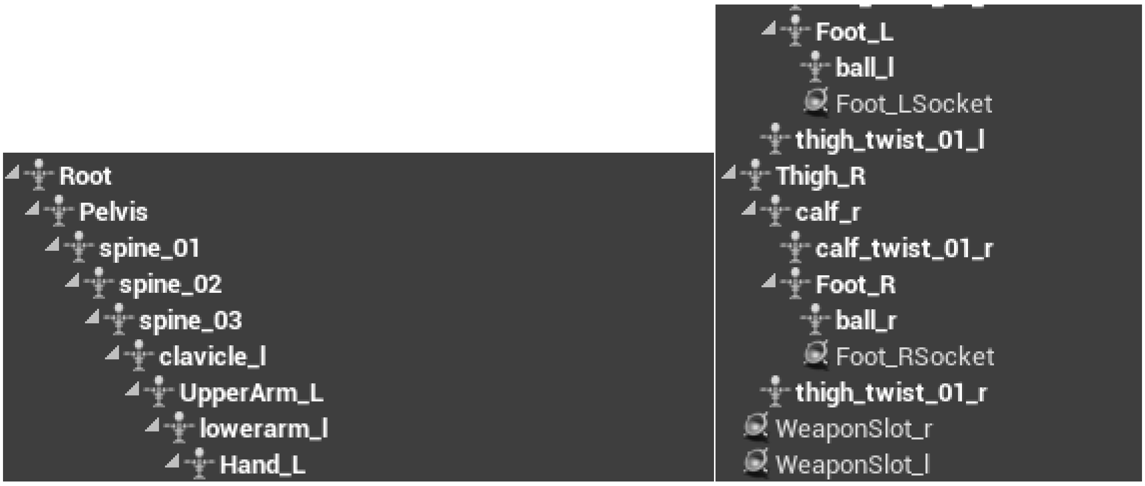
This plugin aims to give user a simple and clean application of Foot IK, as well as eliminate all unnecessary steps during this process to increase performance. It is replicated by default for multiplayer use.

Installation



This is pretty much it, enable plugin after installing it from the Epic Game launcher, search for the name “Foot IK” in the Animation Graph and connect it between your Default pose and Output.

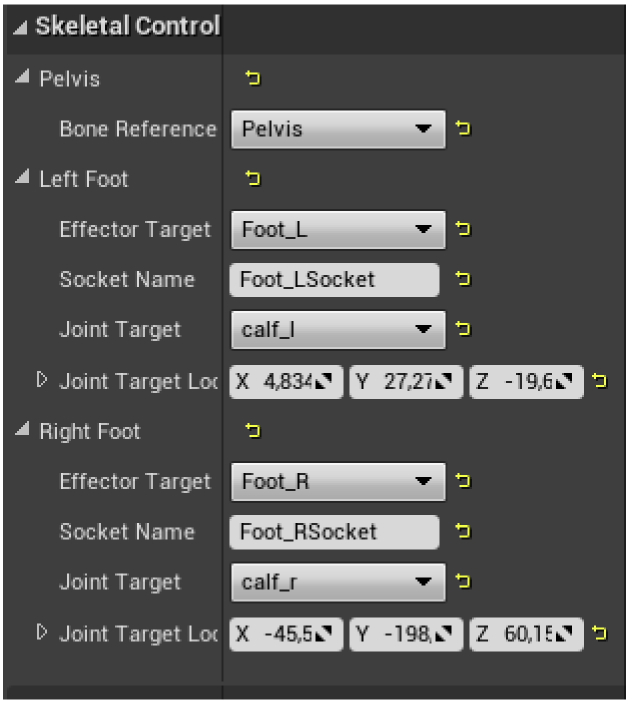
There are 3 Bones we are going to use for this: Pelvis, Foot and Calf (Knee).



```
Root
 Pelvis
  spine_01
   spine_02
    spine_03
     clavicle_l
      UpperArm_L
       lowerarm_l
        Hand_L
```

```
    Foot_L
     ball_l
     Foot_LSocket
   thigh_twist_01_l
 Thigh_R
  calf_r
   calf_twist_01_r
   Foot_R
    ball_r
    Foot_RSocket
  thigh_twist_01_r
 WeaponSlot_r
 WeaponSlot_l
```

To avoid twisting of your leg you have to modify Knee (Joint Target) Location. As every character may need different Joint Target Location (due to animations they are using) this parameter may be better found with self-testing. This parameter will be used to predict Knee bend direction when moving. If you are experiencing twisting at high speeds or slopes even though you have a good Target Location position you may consider blending Foot IK to your system according to Speed or Slope.



Skeletal Control

Pelvis

Bone Reference: Pelvis

Left Foot

Effector Target: Foot_L

Socket Name: Foot_LSocket

Joint Target: calf_l

Joint Target Lo: X 4,834 Y 27,27 Z -19,6

Right Foot

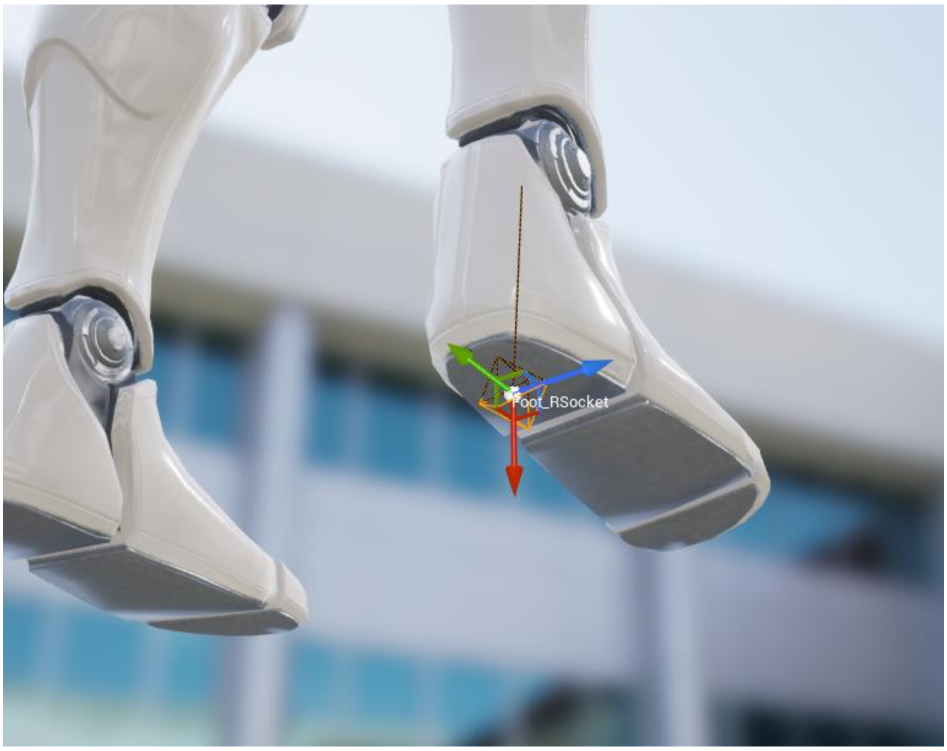
Effector Target: Foot_R

Socket Name: Foot_RSocket

Joint Target: calf_r

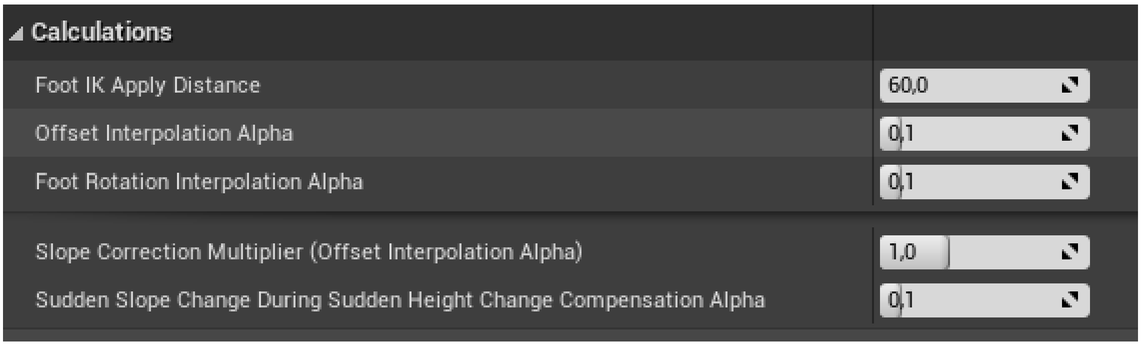
Joint Target Lo: X -45,5 Y -198, Z 60,15

Foot_LSocket and Foot_RSocket in this picture are added Sockets to Foot bone. Please refer to my Explanation Video for better visualization.



Calculations

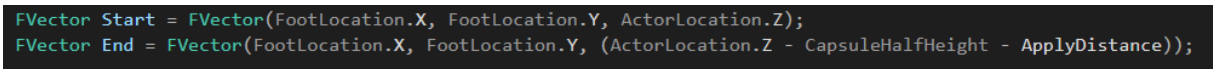
There are 5 Parameters that user can change to alter Foot IK calculations and therefore its application.



Calculations

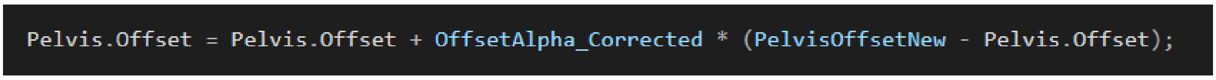
Foot IK Apply Distance	60,0
Offset Interpolation Alpha	0,1
Foot Rotation Interpolation Alpha	0,1
Slope Correction Multiplier (Offset Interpolation Alpha)	1,0
Sudden Slope Change During Sudden Height Change Compensation Alpha	0,1

- Foot IK Apply Distance: Line Trace length beginning from bottom of the foot.



```
FVector Start = FVector(FootLocation.X, FootLocation.Y, ActorLocation.Z);
FVector End = FVector(FootLocation.X, FootLocation.Y, (ActorLocation.Z - CapsuleHalfHeight - ApplyDistance));
```

- Offset Interpolation Alpha (Between 0 and 1): Translations are interpolated through next position with an Alpha value to avoid stutter and sharp changes. You can check “Lerp” function from Kismet Math Library for its declaration.

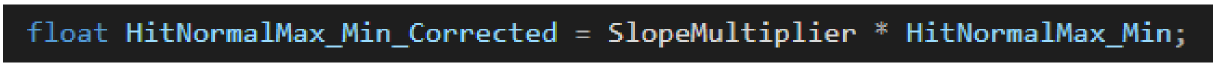


```
Pelvis.Offset = Pelvis.Offset + OffsetAlpha_Corrected * (PelvisOffsetNew - Pelvis.Offset);
```

- Foot Rotation Interpolation Alpha: Similar to Offset Interpolation Alpha; for foot rotation.

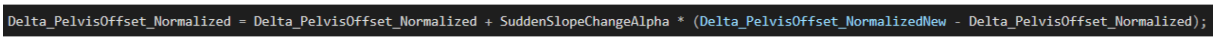
More Advanced Settings:

- Slope Correction Multiplier for Offset Interpolation Alpha (Between 0.5 and 2.0): Offset Interpolation is calculated differently regarding the steepness of slope. This is because for slopes we need less Interpolation for better accuracy and on even terrain like stairs we need more Interpolation due to stutters would occur otherwise. With this multiplier this behaviour can be altered.



```
float HitNormalMax_Min_Corrected = SlopeMultiplier * HitNormalMax_Min;
```

- Sudden Slope Change During Sudden Height Change Compensation Alpha: This is another layer of interpolation. When our character goes directly from an even ground to a higher sloped terrain its Offset Interpolation Alpha will be high, therefore it will go there directly without any interpolation. This will cause sudden shift of Pelvis. Our aim is to make this shift smoother.



```
Delta_PelvisOffset_Normalized = Delta_PelvisOffset_Normalized + SuddenSlopeChangeAlpha * (Delta_PelvisOffset_NormalizedNew - Delta_PelvisOffset_Normalized);
```

Summary

For further information please also refer to my Explanation Video. If you encounter any unexpected behaviour when using this plugin please let me know through my given communication channels in my marketplace profile.