Introduction to Final IK

Heyo!

My name is Voxian

I created the Foxtaur, AvaTAUR, Betta Proot and AvianTAUR avatar bases for VRChat. I am not affiliated with Root Motion, I just use their scripts.

What is Final IK?

In the context of VRChat avatars.

"A complete collection of inverse kinematics solutions for Unity"



Inverse Kinematics

A process of calculating joint angles based on a start and end point.



(Image from Root Motion)

What do games use this for?

- Determine where your elbows and knees are in VR.
- Keep your feet on the ground, especially on slopes or stairs.
- Hold a weapon while aiming at a target.
- Map animations between characters of different proportions.
- And so much more!

VRChat uses Final IK

And they allow us to use it as well!



Whitelisted Components

- > Aim IK
- > Biped IK
- > CCDIK
- > FABRIK
- > Full Body Biped IK
- > Grounder
- > Limb IK

- > Rotation Limits
- Shoulder Rotator
- > Twist Relaxer
- **VRIK**
 - IK Execution Order



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 ROOTMOTION

 Final IK

 ★★★★★ (855) | ♥ (10727)

 \$90
 ☆ Add to Cart

Final IK is a PAID asset

How does this impact us?

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If you own Final IK

The scripts will preview correctly in the editor. (But not behave exactly the same in game)
You can upload an avatar with the whitelisted components.

There are some Final IK components that will not upload to VRChat.

If you do NOT own Final IK

- You will need to use what is called a "Stub" to setup the components.
 (VRLabs currently hosts a free stub on their Github)
- The scripts will not work in the editor at all, but they will work in VRChat!
- You can still create and upload avatars!

Distributing Content that Uses Final IK

Create content using Final IK Components

(You can use the free stub instead of the full version) Share your files without the IK scripts

The end user combines your files with the FREE stub and uploads to VRChat

Final IK Examples

And generally how to apply them

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Pole Target		Fore L POLE	Та	nget (Transf	orm)			\odot
Aim Transform		fore_L_KNE	E_AI	M (Transfor	m)				\odot
Axis	Х	-1	Y	0	Z	0			
Pole Axis	Х	0	Y	0	Z	1			
Weight						-• (1		
Pole Weight						-	1		
Tolerance	C								
Max Iterations	1								
Clamp Weight		•					0.1		
Clamp Smoothing						•	2		
Use Rotation Limits									
2D									
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	Ac	dd Componen	t						

AIM IK

Similar to an Aim Constraint, but here we can have multiple bones in the chain and we can introduce limits.

Also, since it is an IK component, it is calculated at a different time than Aim Constraints.



Spines, Tentacles, and More!

Aim IK can be applied to any chain where you only know the start and end points. You can even tell the chain to twist evenly when the endpoint is twisted.

🔻 🗰 🖌 VR IK		0 ‡ i
	# VRIK	
Fix Transforms	~	
▶ References		
▼ Solver		
IK Position Weight		1
LOD	•	0
Scale	1	
Plant Feet		
▶ Spine		
▶ Left Arm		
▶ Right Arm		
▶ Left Leg		
Right Leg		
Locomotion		
Mode	Procedural	
Weight		1
Foot Distance	0.17	
Step Threshold	0.3	
Angle Threshold	60	
Com Angle Mlp	1	
Max Velocity	0.8	
Velocity Factor	0.2	
Max Leg Stretch	•	0.9
Root Speed	1000	
Step Speed	1.4	
Step Height		
Max Body Y Offset	0.05	
Heel Height		
Relax Leg Twist Min	Ar •	20
Relax Leg Twist Spee	ed 400	
Step Interpolation	In Out Sine	
Offset	X 0 Y 0 Z 0	

VRIK

This script is a full system for mapping characters to VR Trackers.

One notable feature is the Procedural Locomotion. Which automatically makes steps whenever it detects the character is falling over.



More Legs!

Using a hidden armature, you can have VRIK calculate automatic steps for additional sets of legs!

You can also use this for followers.



IEIGHT ANIMATED	🔻 📕 🗹 VR IK	
	Script #	
	Fix Transforms	
$\nabla \widehat{M}$ Scripts	▶ References	
VRIK	▼ Solver	
VRIK BIGEST	IK Position Weight	
	LOD	•
	Scale	1
VRIK SMALLER	Plant Feet	
VRIK SMALL	▶ Spine	
	▶ Left Arm	
Hind Grounder VRIK BIGGES I	Right Arm	
Hind Grounder VRIK BIG	▶ Left Leg	
Hind Grounder VRIK SMALLEST	▶ Right Leg	
Hind Grounder VRIK SMALLER	▼ Locomotion	
	Mode	Procedural
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Grounded Hips Height	Foot Distance	0.17
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VRIK AIM TARGET	Angle Threshold	60
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unded Hips Height	Max Velocity	0.8
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	Root Speed	1000
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	Step Height	
	Max Body Y Offset	0.05
	Heel Height	
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	Relax Leg Twist Speed	400
	Step Interpolation	In Out Sine
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retch	•	- 0	.9	
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Y Offset	0.05			
t 		-		
Fwist Min Ai		- 2	0	
Fwist Speec	400			
olation	In Out Sine			
	x 0 Y 0 Z	0		
^	dd Component			
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Limitations

VRIK does NOT scale with you.

You can NOT animate any settings.

Step Speed is faster in game than in the editor.

🔻 🚽 🖌 Grounder IK		다	
Weight	• ·	1	
Solver			
Layers	Default, Environment		•
Max Step	0.7		
Height Offset	0		
Foot Speed	2		
Foot Radius	0.15		
Prediction	0.05		
Foot Rotation Weight	_ _	0.1	
Foot Rotation Speed	7		
Max Foot Rotation Angle	•	45	
Rotate Solver			
Pelvis Speed	10		
Pelvis Damper	•	0.5	
Lower Pelvis Weight	0.5		
Lift Pelvis Weight	0.5		
Root Sphere Cast Radius	0.1		
Overstep Falls Down			
Quality	Simple		•
▼ Legs	2	2	
Element 0	🔁 LEG L FABRIK GROUNDED (FABRIK)		•
Element 1	🔁 LEG R FABRIK GROUNDED (FABRIK))	•
	+		Γ
Pelvis	+ Hips GROUNDED (Transform)		0
Character Root	♣ Root GROUNDED (Transform)		0
Root Rotation Weight	•	0	
Root Rotation Speed	5		
Max Root Rotation Angle	45		

GROUNDER

This script searches for the nearest surface and keeps the "feet" touching and rotated to match.



Deep Dive

Grappling Hook Robot

Grappling Hook Demo

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How to Use

Tap your shoulder while pointing to activate.
 Point at anything and the turret will aim at it.
 Make a finger gun (lift your thumb) and the turret will fire.

4. Make a fist and the turret will retract.



Aim IK

We need the turret to aim at the location we are pointing at.

We cannot use an aim constraint, because we will be adding limits to how far it can rotate.





Rotation Limits

We don't want the turret pointing inside our body or clipping through itself, so we will set rotation limits.

This will limit the AIM IK movement.



🔻 🚰 FABRIK	6) .
Fix Transforms	✓	
Target	None (Transform)	
Weight	•	
Tolerance	0	
Max Iterations	20	
Use Rotation Limits	×	
2D		
Bones (3)		
- 👃 Aiming GROUNDER TH	IIGH (T ⊙	
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FABRIK

A large invisible leg attached to our finger and the turret.

The length of this leg is the maximum firing distance.

🔻 <table-cell-rows> 🖌 🖌 Grounder IK</table-cell-rows>		0 :
	⊎ [‡] GrounderIK	
Weight		• 1
▼ Solver		
Layers	Mixed	
Max Step	7	
Height Offset	0	
Foot Speed	10	
Foot Radius	0.1	
Prediction	0.05	
Foot Rotation Weight		• 1
Foot Rotation Speed	7	
Max Foot Rotation Angle		• 90
Rotate Solver	~	
Pelvis Speed	5	
Pelvis Damper	•	- 0
Lower Pelvis Weight	0	
Lift Pelvis Weight	0	
Root Sphere Cast Radius	0.1	
Overstep Falls Down		
Quality	Simple	
▼ Legs		1
Element 0	Aiming GROUNDER (FABRIK)	\odot
		+ -
Pelvis	Aiming GROUNDER FAKE HIP (Transfor \odot
Character Root	Aiming GROUNDER FAKE ROO	Г (Transf⊙
Root Rotation Weight	•	— [0
Root Rotation Speed	5	
Max Root Rotation Angle	45	

Grounder

Next we create a grounder script and attach the FABRIK to it.

This will allow the arm to seek out the nearest "ground" in front of it.





World Constraint

When the turret is ready to fire, we need to lock that location in world space.

The IK target is inside a world constraint and parented constrained to the end of the FABRIK "leg". We will disable this constraint when we fire.

Animator Controller





Credits

- Laser Raptor for developing and testing many of these techniques
- > Ahzelion for creating the Scuttle Gun
- Presentation template by SlidesCarnival
- Photographs by Startupstockphotos
- > Illustrations by TheCatnamedFish
- The Virtual Limbs community in general for supporting our work

THANK YOU!

Any questions?

Join the Virtual Limbs community: discord.gg/limbs



