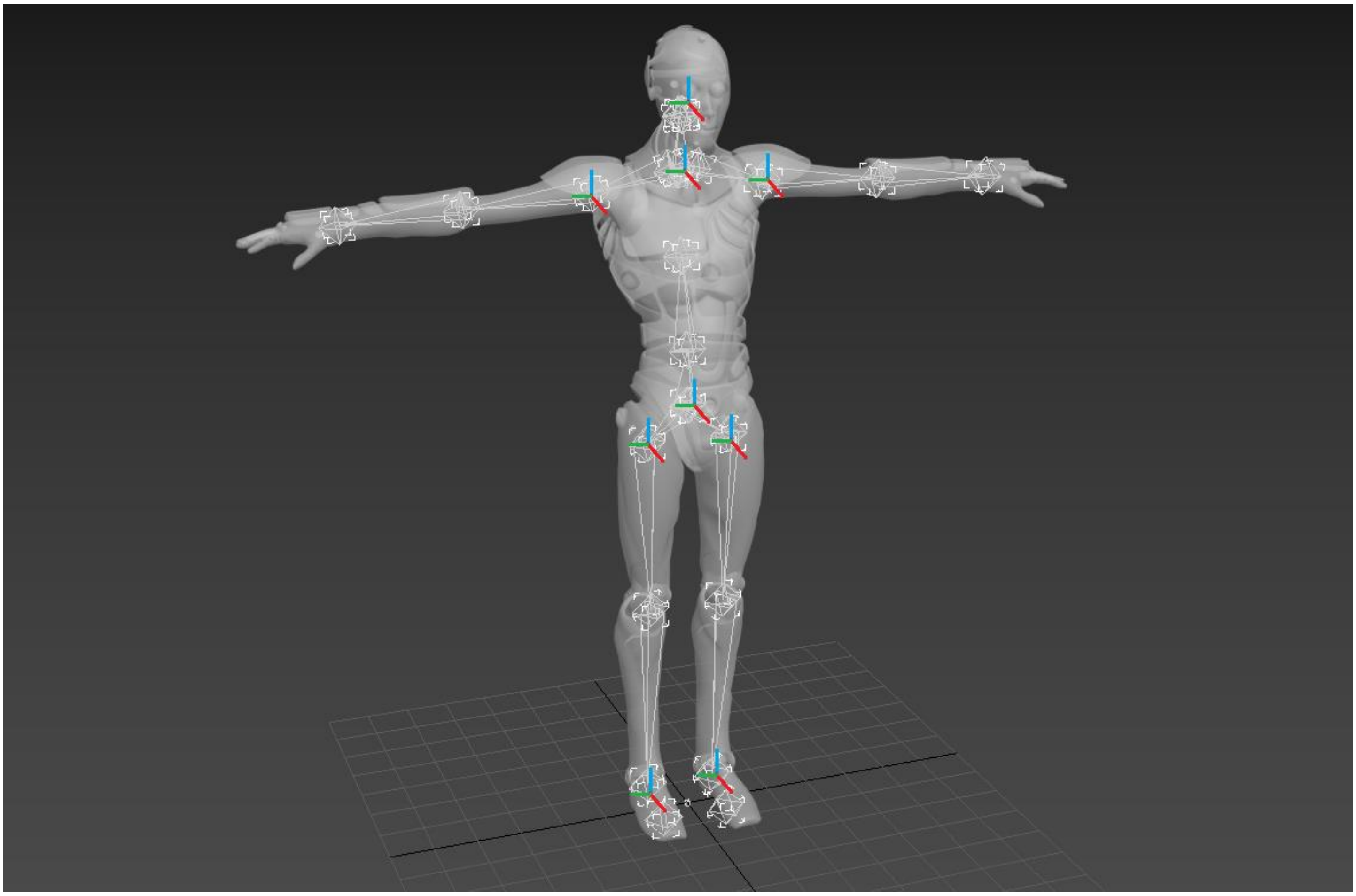
VR IK Body

How to set up VR project to use VR IK Body

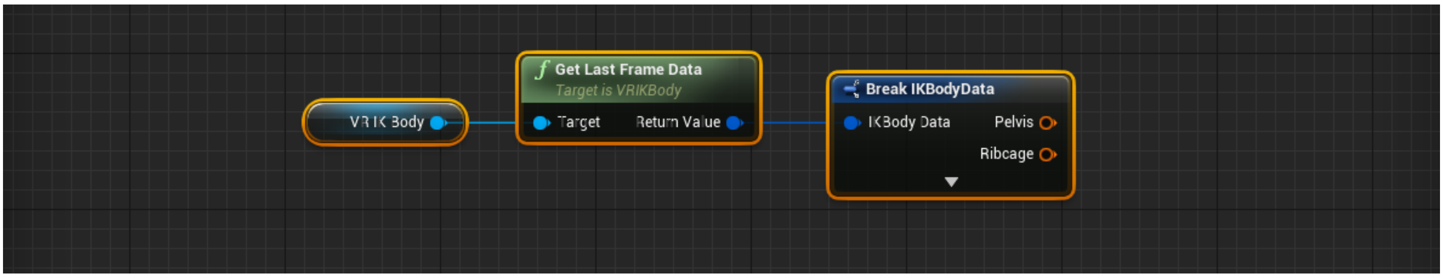
Import your skeletal mesh and create an animation blueprint.

Open you player pawn blueprint. Add skeletal mesh component, set its **Skeletal Mesh** (your skeletal mesh), **Animation Mode** (Use Animation Blueprint) and **Anim Class** (your animation blueprint) properties.

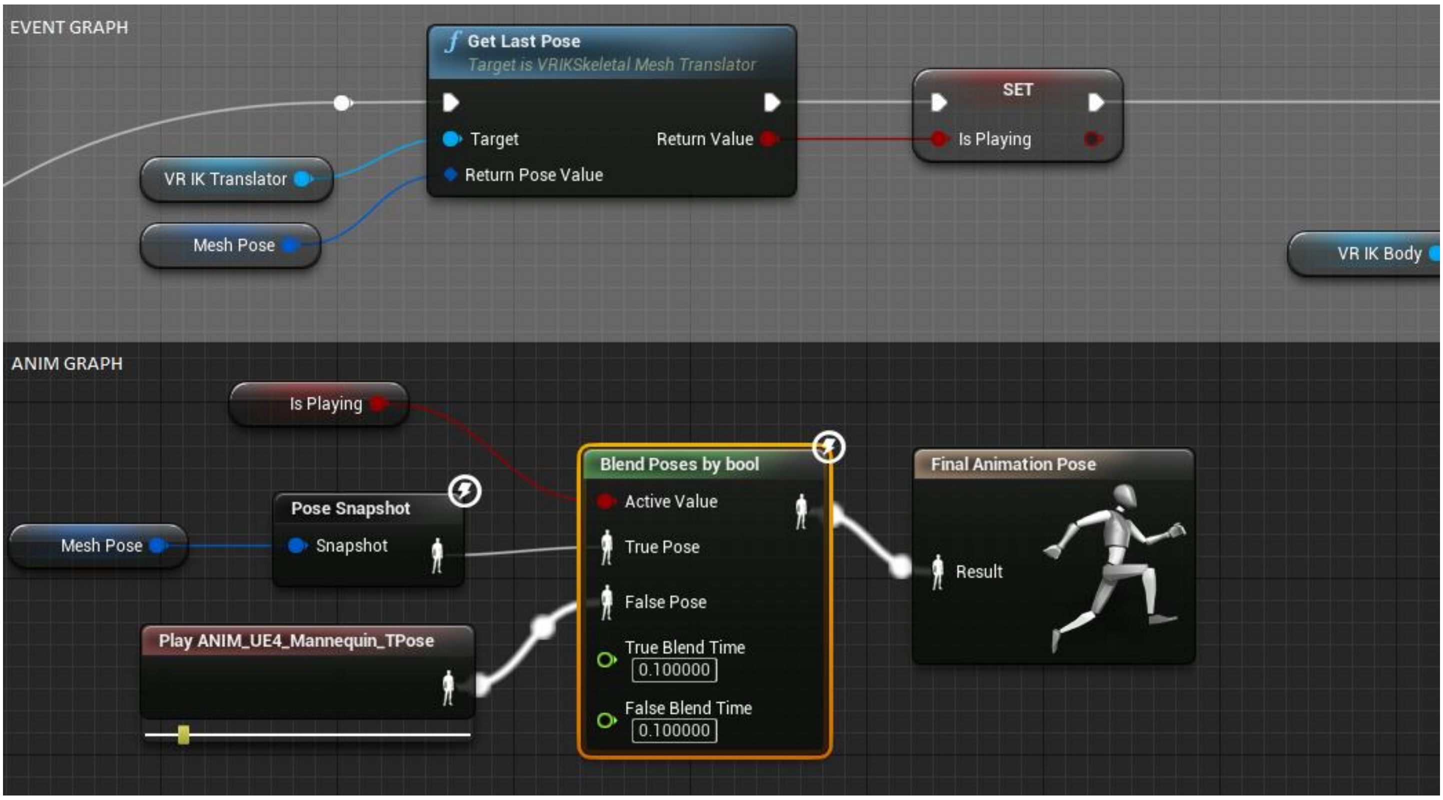
Add two actor components: VRIKBody and VRIKSkeletalMeshTranslator. VRIKBody is responsible for body calibration and calculating instant body state adjusted to player's size. It returns transforms for some virtual bones in world space and for the follow bone rotators:



You can get access to this data by calling VRIKBody::GetLastFrameData



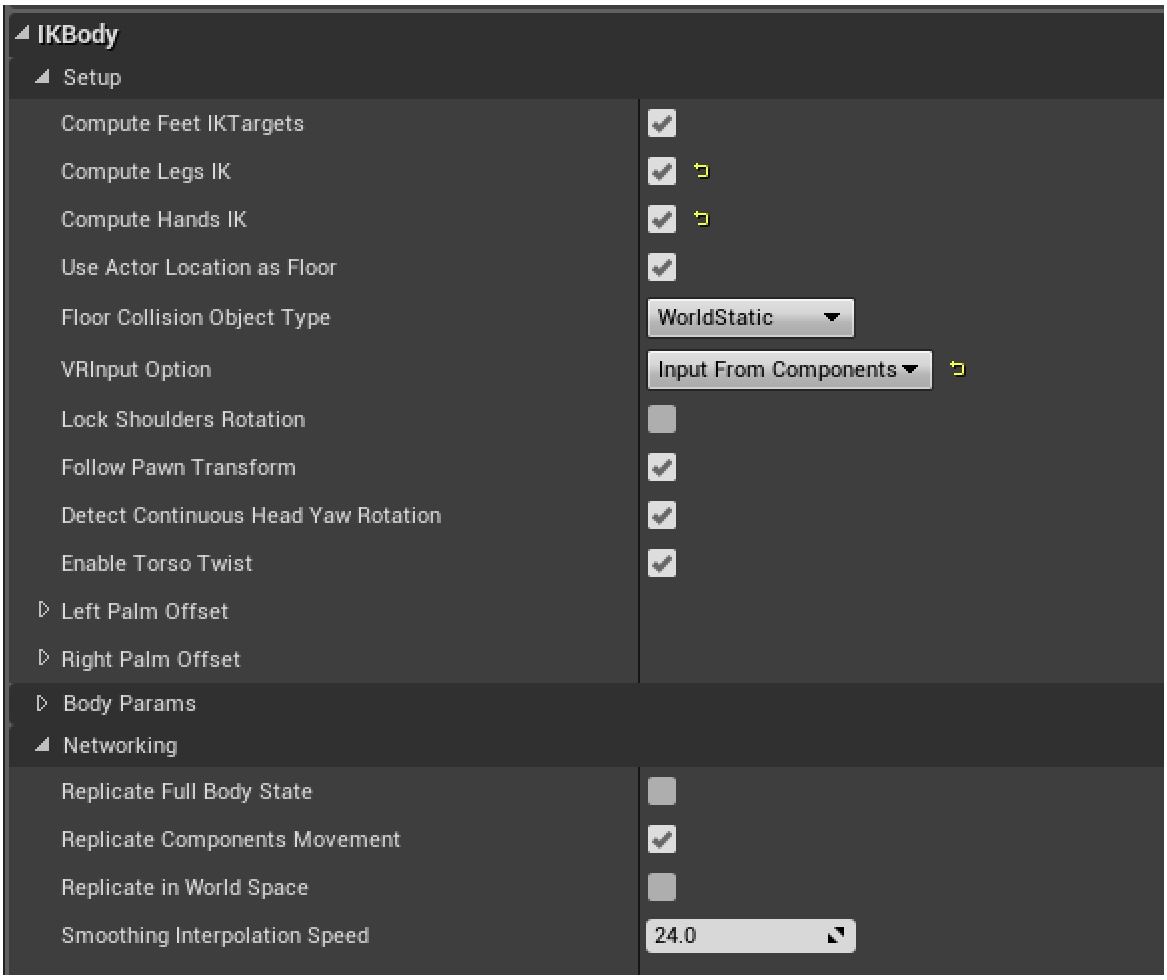
VRIKSkeletalMeshTranslator translates this virtual skeleton to any custom skeletal mesh. It returns PoseSnapshot object.



Simple animation blueprint setup is presented above. **VR IK Translator** is a reference to player's VRIKSkeletalMeshTranslator component. Mesh Pose is a **PoseSnapshot** variable.

Both VRIKBody and VRIKSkeletalMeshTranslator components must be initialized in player pawn's blueprint BeginPlay event.

Major VRIKBody properties



IKBody

Setup

Compute Feet IKTargets ☑

Compute Legs IK ☑

Compute Hands IK ☑

Use Actor Location as Floor ☑

Floor Collision Object Type: WorldStatic

VRInput Option: Input From Components

Lock Shoulders Rotation ☐

Follow Pawn Transform ☑

Detect Continuous Head Yaw Rotation ☑

Enable Torso Twist ☑

Left Palm Offset

Right Palm Offset

Body Params

Networking

Replicate Full Body State ☐

Replicate Components Movement ☑

Replicate in World Space ☐

Smoothing Interpolation Speed: 24.0

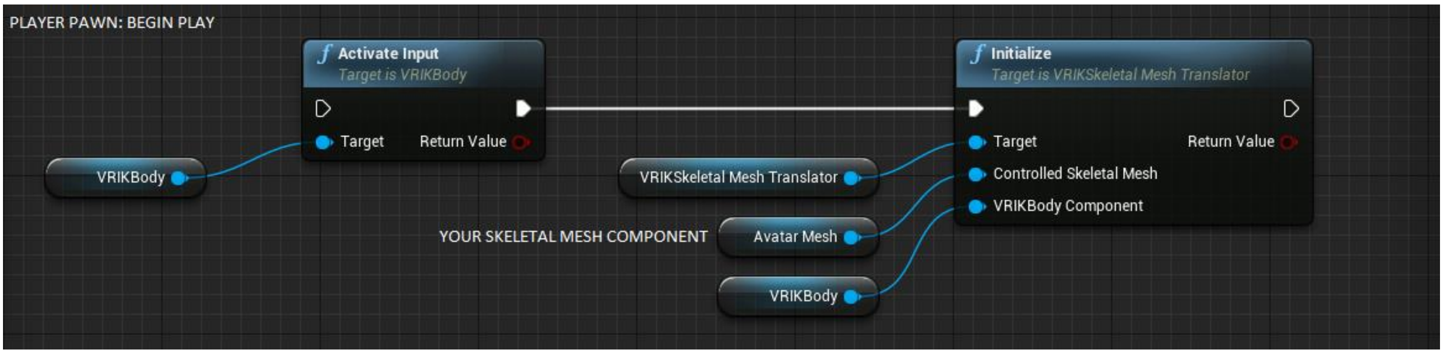
Check **ComputeLegsIK** and **ComputeHandIK** to enable IK calculations.

There are two ground detection methods.

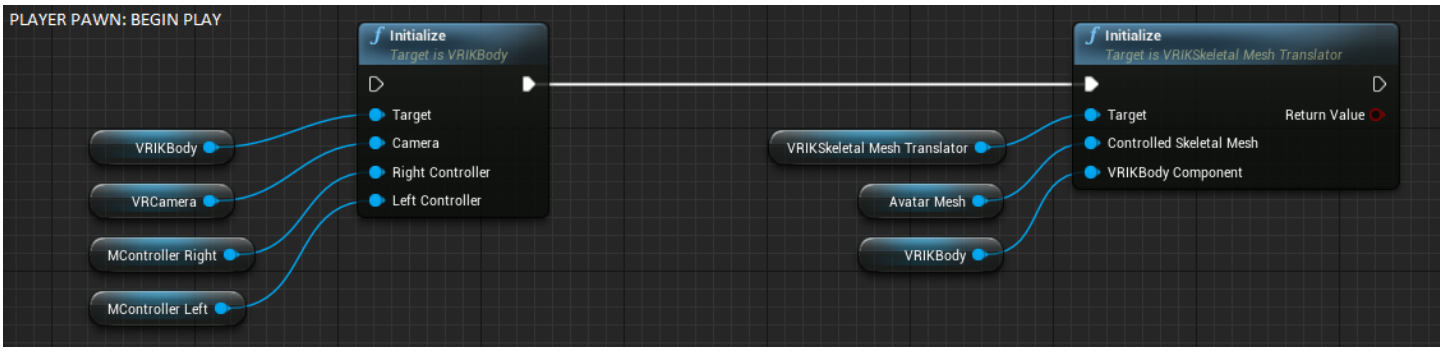
- **UseActorLocationAsFloor** is true. VRIKBody assume GetActorLocation().Z is a ground level.
- **UseActorLocationAsFloor** is false. VRIKBody perform LineTraceByObjectType to detect ground level below head. **FloorCollisionObjectType** must be set.

There are three **VR input Option** settings.

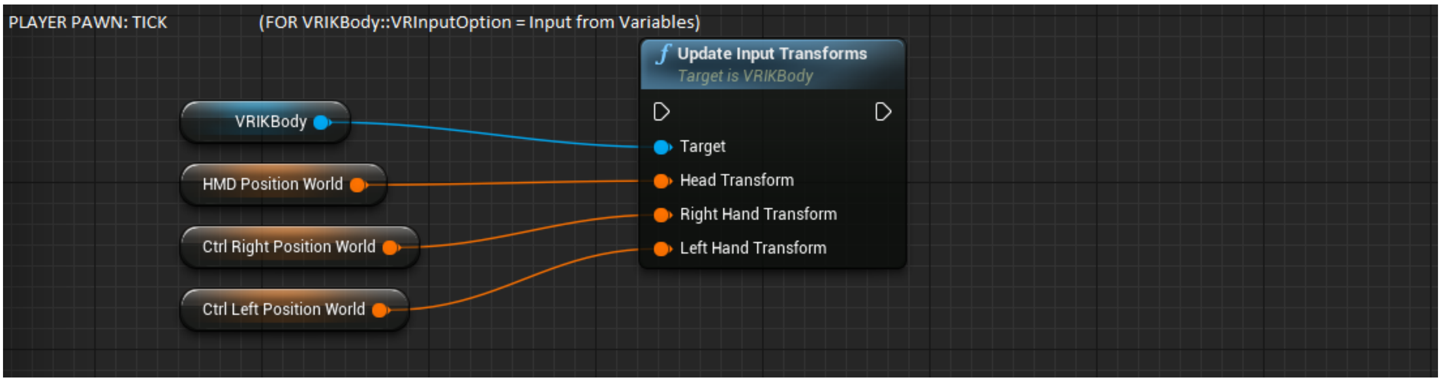
- Direct VR Input. The components takes HMD and motion controllers positions from UE4 VR API. VRIKBody component must be initialized by ActivateInput() call.



- Input from components. This option is useful if you already have camera and motion controller components and/or want them smoothly replicated in networking. You also can use simple scene and primitive components with this option to emulate VR input. Use Initialize(…) call instead of ActivateInput() to initialize references to input components in the VRIKBody.

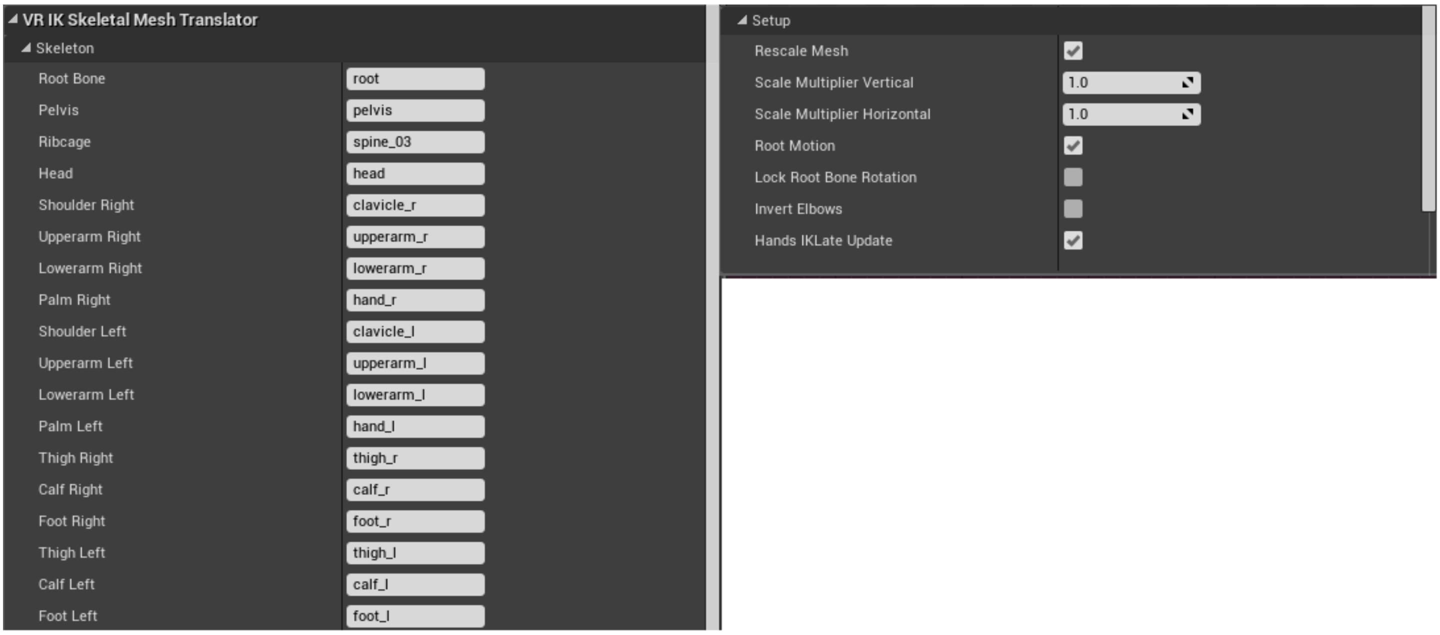


- Input from variables. Another way to simulate VR input. Initialize as Direct VR Input and call UpdateInputTransforms in Tick. This method doesn't work with replication.



LeftPalmOffset and **RightPalmOffset** variables set constant hand position relative to motion controllers. Default values are for Vive wands controlles. Edit this values Oculus Touch controlles.

Major VRIKSkeletalMeshTranslator properties



◢ VR IK Skeletal Mesh Translator

◢ Skeleton

Root Bone	root
Pelvis	pelvis
Ribcage	spine_03
Head	head
Shoulder Right	clavicle_r
Upperarm Right	upperarm_r
Lowerarm Right	lowerarm_r
Palm Right	hand_r
Shoulder Left	clavicle_l
Upperarm Left	upperarm_l
Lowerarm Left	lowerarm_l
Palm Left	hand_l
Thigh Right	thigh_r
Calf Right	calf_r
Foot Right	foot_r
Thigh Left	thigh_l
Calf Left	calf_l
Foot Left	foot_l

◢ Setup

Rescale Mesh	☑
Scale Multiplier Vertical	1.0
Scale Multiplier Horizontal	1.0
Root Motion	☑
Lock Root Bone Rotation	☐
Invert Elbows	☐
Hands IKLate Update	☑

Skeleton subcategory contains the map of skeleton bone names. If you skeletal mesh doesn't have separate root bone, set it to None (empty).

Uncheck **RescaleMesh** to reset skeletal mesh scale to 1 unit.

If **RescaleMesh** is true, you can apply additional adjustment to skeletal mesh scale by **ScaleMultiplierVertical** and **ScaleMultiplierHorizontal** variables.

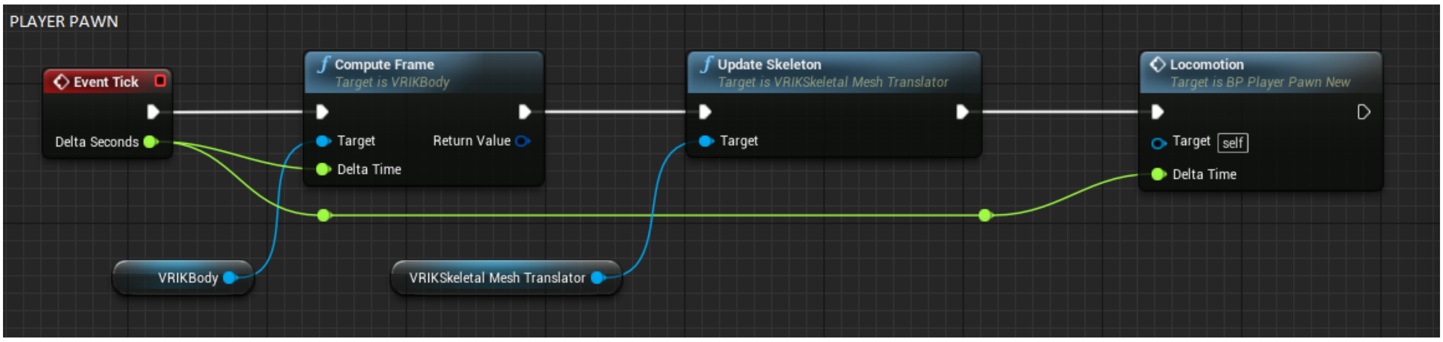
RootMotion = true forces VRIKSkeletalMeshTranslator to update location of rotation of the controlled skeletal mesh component.

Use InvertElbows if elbows are bended in a wrong direction.

HandsIKLateUpdate forces VRIKSkeletalMeshTranslator to apply additional hands IK calculation when building PoseSnapshot to make sure hands are in an accurate positions. Uncheck it to save CPU time if you manually update hands by TwoBoneIK nodes in your animation blueprint.

Body calculation

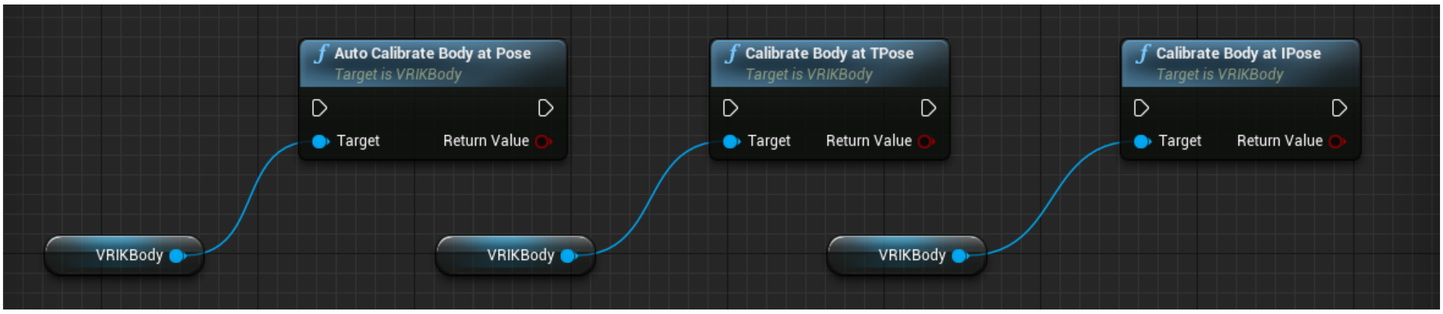
To calculate current body state, call VRIKBody::ComputeFrame and VRIKSkeletalMeshTranslator::UpdateSkeleton.



Note. If you use sliding locomotion from trackpad input, keep in mind that functions like AddActorWorldOffset or AddActorRelativeOffset or CharacterMovementComponent change actor position after animation apply. It cause delay in skeletal mesh location update. SetActorLocation(…), at the other hand, updates location instantly, so it's recommended.

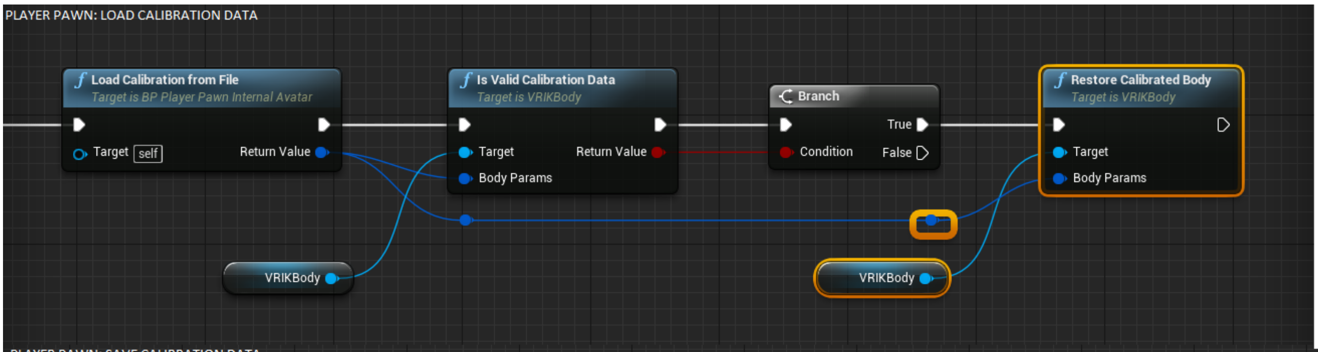
Calibration

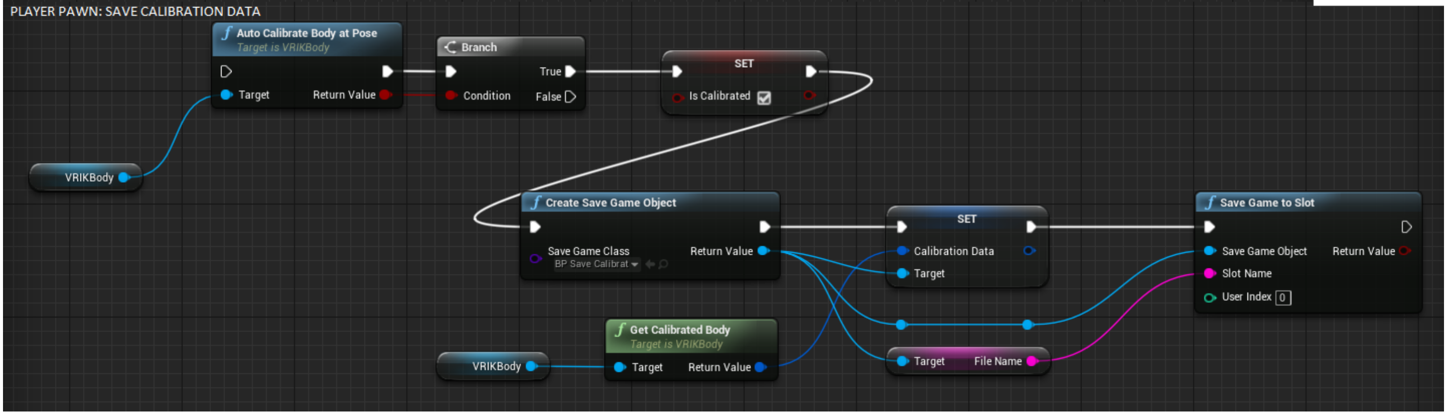
The plugin requires two-step calibration: hands to the left and right (T-Pose) and hand down (I pose). To perform calibration, call VRIKBody::AutoCalibrateBodyAtPose or VRIKBody::CalibrateBodyAtTPose or VRIKBody::CalibrateBodyAtIPose. All this functions return true if calibration is fully complete for both poses.



Note that VRIKSkeletalMeshTranslator requires body calibration. Call VRIKSkeletalMeshTranslator::ForceSetComponentAsCalibrated to activate it with default body params.

You can get current body calibration data by calling VRIKBody::GetCalibratedBody and load it by VRIKBody::RestoreCalibratedBody. Use this functions to save and load calibration data between sessions. IsValidCalibrationData is useful to check if loaded BodyParams value is valid.

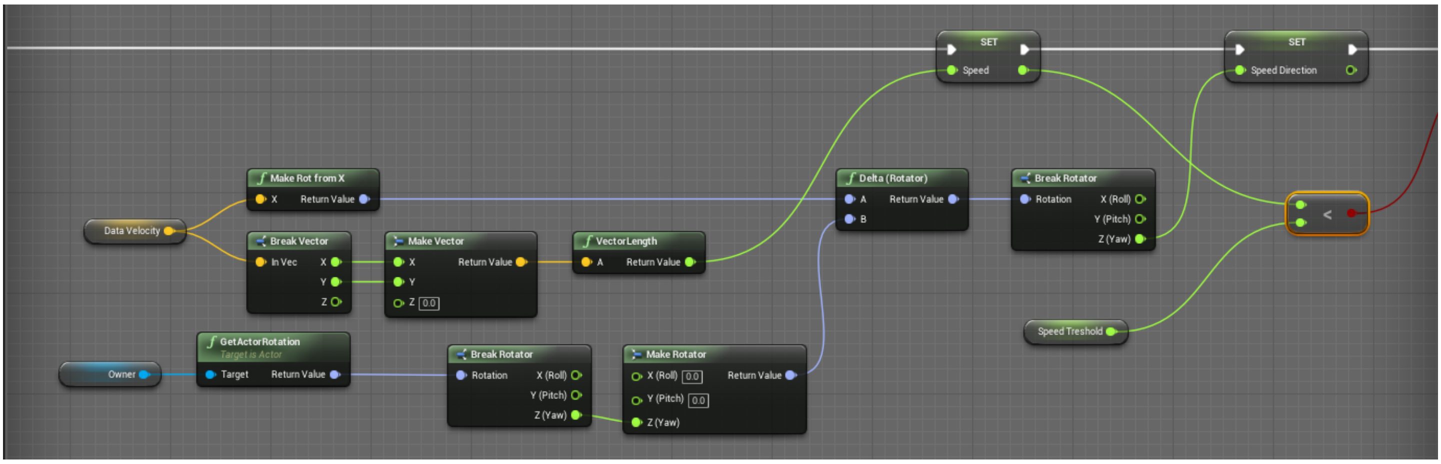




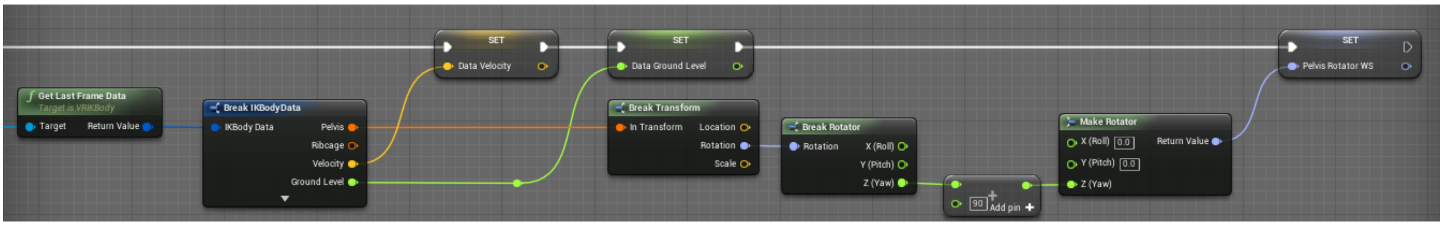
Using strafe animation for legs

The plugin provides some tools to use custom legs animation instead of default walking cycle. Follow this steps to achieve it:

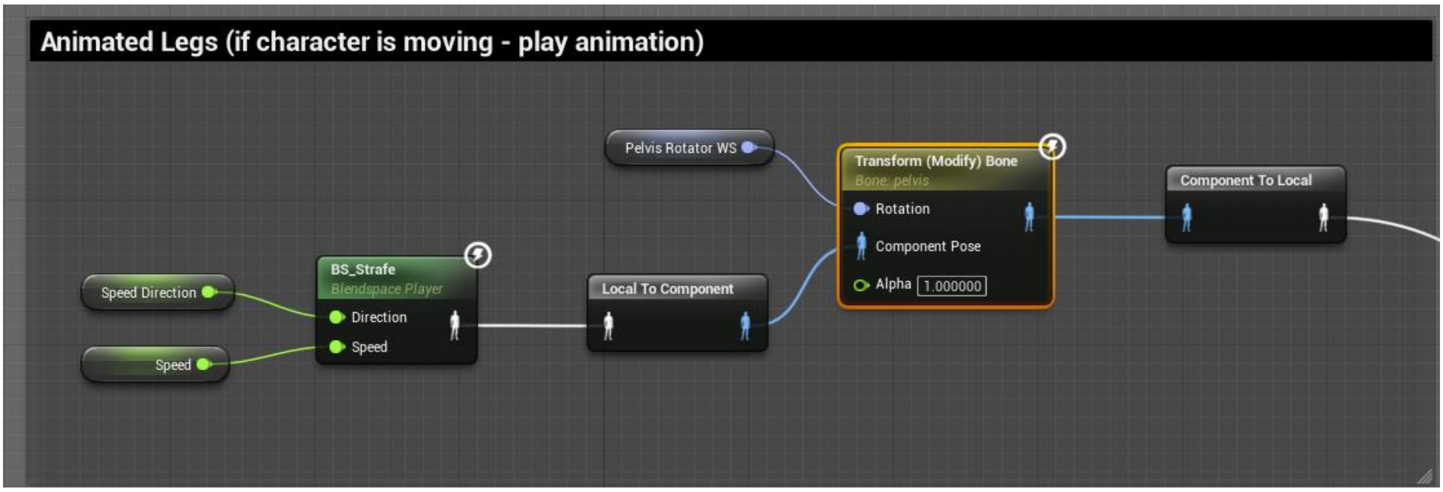
- Use VRIKBody::GetLastFrameData to get current velocity (*DataVelocity*) vector and calculate walking direction (Yaw) relative to torso forward direction.



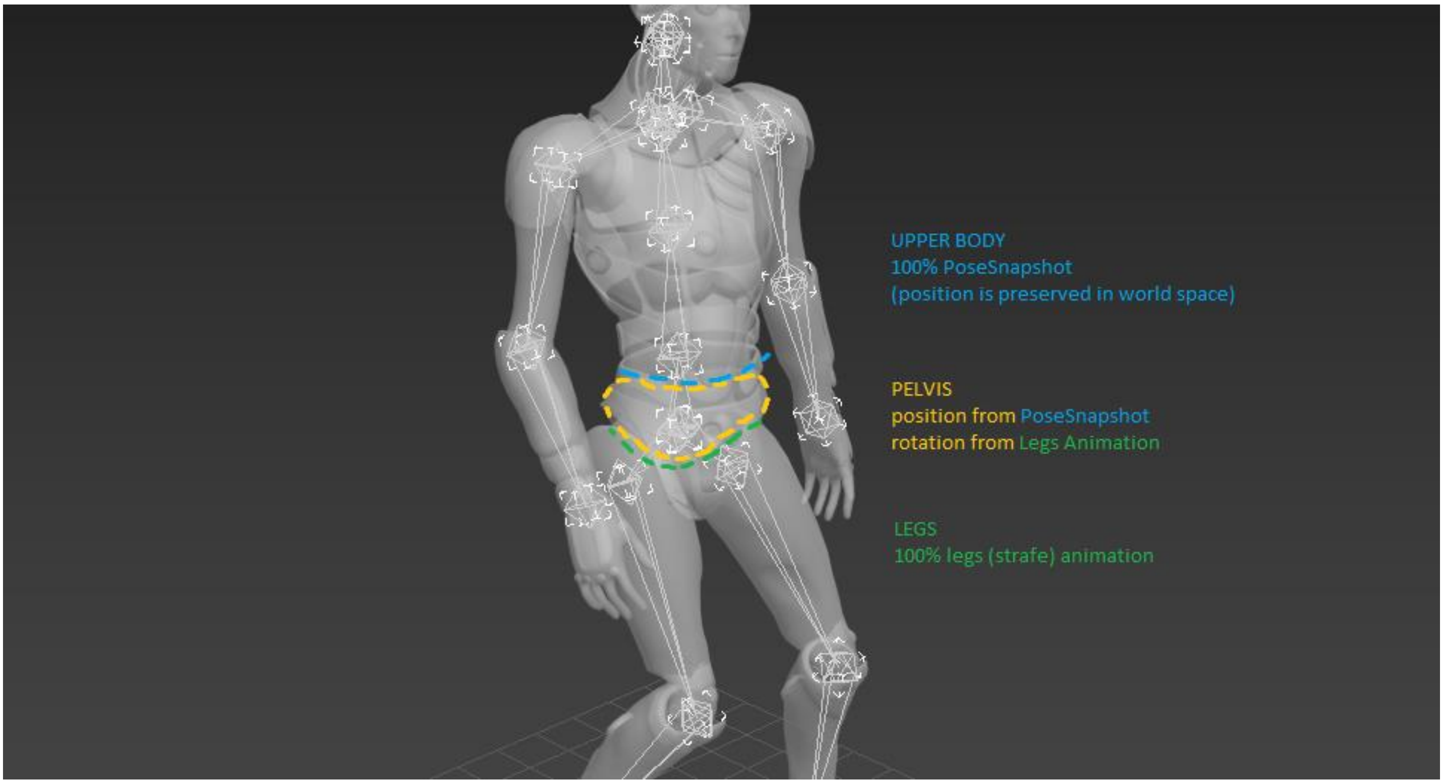
- Use VRIKBody::GetLastFrameData to calculate current torso direction (Yaw) in world space

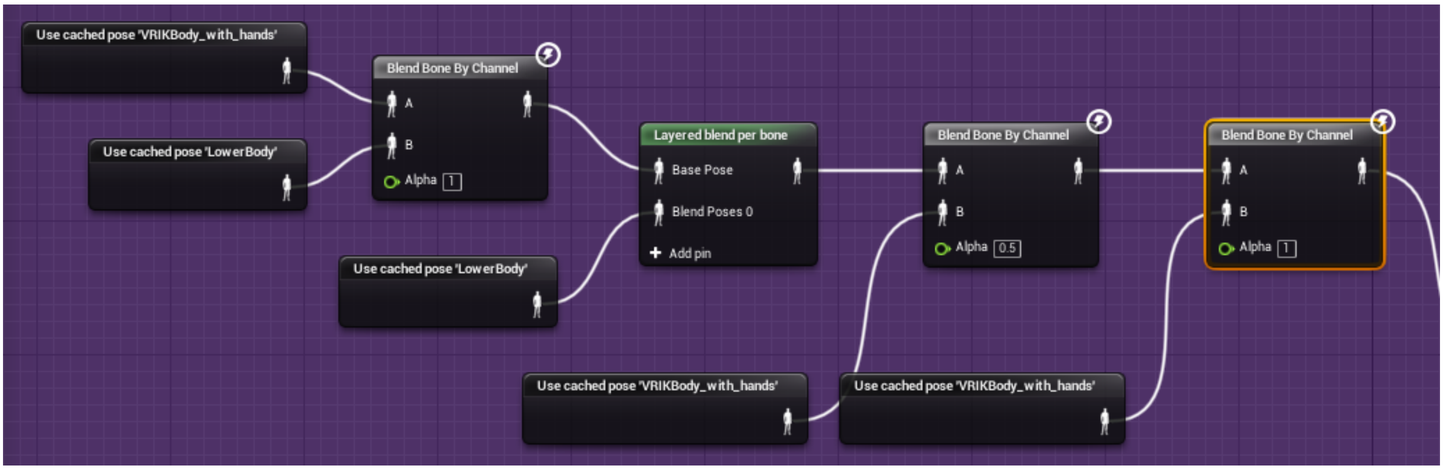


- In Anim Graph apply Torso Rotation to pelvis bone of strafe animation (in world space) to reorient it in a correct way



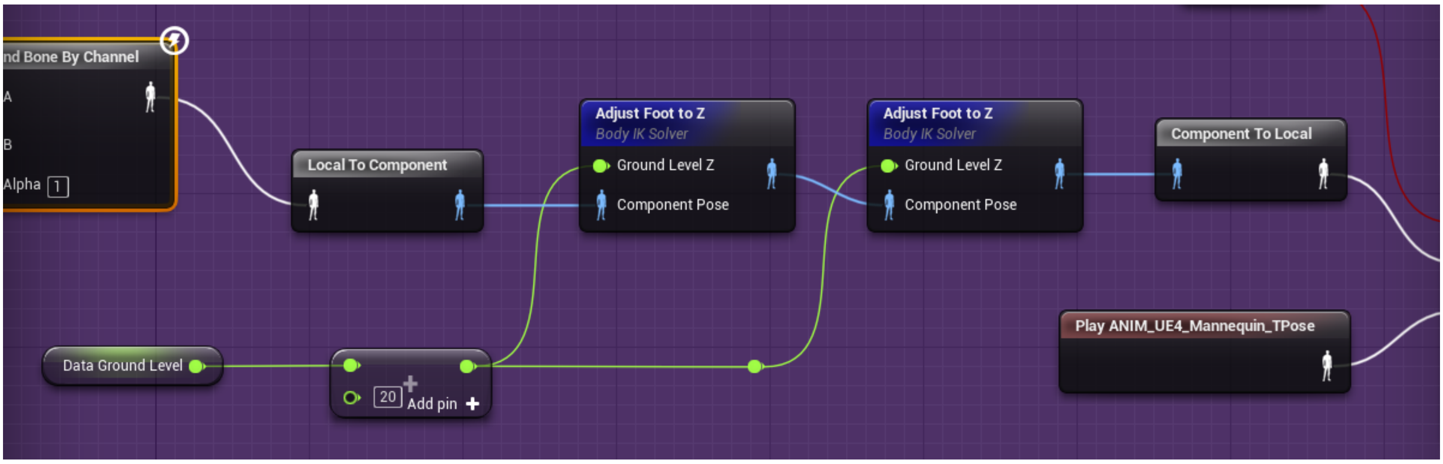
- Then blend strafe animation to PoseSnapshot data. This isn't simple part. Legs in a strafe animation rely on pelvis rotation and location, so we need to keep at least pelvis rotation to preserve a correct animation. At the other hand, head and hands must be kept at the locations defined in a pose snapshot. If strafe animation change pelvis position, it would create error in hands and head placement. I suggest to keep pelvis location from the pose snapshot and update its rotation from the strafe animation using *BlendBoneByChannel* node. Then, restore upped body in world space from the pose snapshot since the first spine bone after pelvis.


UPPER BODY
100% PoseSnapshot
(position is preserved in world space)
PELVIS
position from PoseSnapshot
rotation from Legs Animation
LEGS
100% legs (strafe) animation


Use cached pose 'VRIKBody_with_hands'
Use cached pose 'LowerBody'
Blend Bone By Channel
A
B
Alpha 1
Use cached pose 'LowerBody'
Layered blend per bone
Base Pose
Blend Poses 0
Add pin
Blend Bone By Channel
A
B
Alpha 0.5
Blend Bone By Channel
A
B
Alpha 1
Use cached pose 'VRIKBody_with_hands'
Use cached pose 'VRIKBody_with_hands'

In this setup I have semi-blended first spine bone with fully-restored second spine bone to get more smooth transition. Both *BlendNobeByChannel* nodes here only update rotation in world space.

- And finally, return animated feet on the ground by using custom *AdjustFootToZ* animation node. Ground level Is stored in a structure returned by VRIKBody::GetLastFrameData.



That's all!

Information

IKBodyData Struct

All transforms are in World Space or relative to Player Pawn origin if both **VRInputFromComponents** and **FollowPawnTransform** flags are false.

MEMBER	TYPE	DESCRIPTION
Pelvis	*Transform*	Pelvis Transform
Ribcage	*Transform*	Ribcage/Spine Transform

Neck	*Transform*	Neck Transform
Head	*Transform*	Head Transform
UpperarmRight*	*Transform*	Right Upperarm Transform (only if ComputeHandsIK is true)
ForearmRight*	*Transform*	Right Forearm Transform (only if ComputeHandsIK is true)
HandRight	*Transform*	Right Palm Transform
UpperarmLeft*	*Transform*	Left Forearm Transform (only if ComputeHandsIK is true)
ForearmLeft*	*Transform*	Left Forearm Transform (only if ComputeHandsIK is true)
HandLeft	*Transform*	Left Palm Transform
ElbowJointTargetRight	*Transform*	IK Joint Target for right hand in world space (if ComputeHandsIK is true)
ElbowJointTargetLeft	*Transform*	IK Joint Target for left hand in world space (if ComputeHandsIK is true)
ThighRight*	*Transform*	Right Thigh Transform (only if ComputeFeetIK is true)
CalfRight*	*Transform*	Right Calf Transform (only if ComputeLegsIK is true)
ThighLeft*	*Transform*	Left Thigh Transform (only if ComputeLegsIK is true)
CalfLeft*	*Transform*	Left Calf Transform (only if ComputeLegsIK is true)
FootRightCurrent	*Transform*	Right Feet IK instantaneous Transform (only if ComputeFeetIKTargets is true)
FootLeftCurrent	*Transform*	Left Feet IK instantaneous Transform (only if ComputeFeetIKTargets is true)
IsJumping	*bool*	Flag indicates if character is jumping
IsSitting*	*bool*	Flag indicates if character is sitting
Velocity	*Vector*	Current Player Vector Velocity. Vector Length is equal to scalar speed (meters per second).
GroundLevel	*float*	Current Ground Z Coordinate

* - not updated via networking

VR IK Body Component parameters

VARIABLE	TYPE	DESCRIPTION
SETUP		
ComputeFeetIKTargets	*bool*	Set this flag to True if you need Feet Transform Predictions (**FootRightCurrent**, **FootLeftCurrent**)
ComputeLegsIK	*bool*	Set this flag to True if you need thigh and calf transforms (**ThighRight**, **CalfRight**, **ThighLeft**, **CalfLeft**). Only works if ComputeFeetIKTargets is true.
ComputeHandsIK	*bool*	Set this flag to True if you need upperarm and forearm transforms and joint targets (**UpperarmRight**, **ForearmRight**, E**lbowJointTargetRight**, **UpperarmLeft**, **ForearmLeft**, **ElbowJointTargetLeft**).
UseActorLocationAsFloor	*bool*	If true, Owning Pawn location Z will be used as floor coordinate. This approach doesn't work properly on slopes and staircases. If false, uses Line Trace to find ground level.
FloorCollisionObjectType	*Collision Channel*	Collision object type of floor if UseActorLocationAsFloor is false.
VRInputOption	*VR Input Setup*	There are three options: Direct input from VR API, Input from scene components (camera and motion controller components), input from external variables updated in tick. If use components input or networking, call Initialize(...) function on begin play.
LockShouldersRotation	*bool*	If true, shoulders don't rotate to follow motion controllers location.
FollowPawnTransform	*bool*	This flag only works if VRInputFromComponents is false. If true, component uses Pawn Actor Transform to locate body in world space. Otherwise it retuns body relative to Pawn Origin. World space calculation is required for unnatural locomotion.
LeftPalmOffset	*Vector*	Palm location relative to Motion Controller Component transform (default value is for HTC Vive Motion Controller)
RightPalmOffset		
Body Params		

BodyWidth	*float*	Y-axis (right-left) body size (modified by body calibration)
HeadHalfWidth	*float*	Approximate head radius
HeadHeight	*float*	Approximate head height
SpineLength	*float*	Approximate distance from pelvis to neck (modified by body calibration)
HandLength	*float*	Approximate distance from collarbone to palm (modified by body calibration)
FootOffsetToGround	*float*	Distance from feet to ground, useful to correct skeletal mesh feet bones Z-offset
NeckToHeadsetOffset	*Vector*	Component Space Offset from Neck to Head (X is forward, Z is up), modified by body calibration
RibcageToNeckOffset	*Vector*	Component Space Offset from Ribcage to Neck (X is forward, Z is up)
MaxHeadRotation	*float*	Max permissible angle between head and pelvis Yaw rotations (used to correct pelvis rotation)
Networking		
ReplicateFullBodyState	*bool*	If true, the component calculates body state on local PC and send it to server for other connected users. If false, component sends Head and Hands transforms to server, and every client perform body calculation for each player locally. Choose first option (true) if CPU performance is a priority in your project. Choose remote calculations (false) to optimize a project for network bandwidth.
ReplicateInWorldSpace	*bool*	If ReplicateInWorldSpace is set to false (by default), all body data would be converted to actor space before replication and reconverted to world space on remote machines. This operation adds a lot of transforms calculations, but allow to use sliding (Onward-style) locomotion which implies that pawn locations on different PCs are slightly asynchronous at the same moment. Set ReplicateInWorldSpace to true if you don't use sliding player locomotion to optimize CPU usage.

SmoothingInterpolation Speed	*bool*	Speed of interpolation between current and received body state. Set to 0 to disable interpolation.

VR IK Body Component Functions

FUNCTION	RETURN VALUE	PARAMETERS
CalibrateBodyAtTPose CalibrateBodyAtIPose AutoCalibrateBodyAtPose	*bool*	(no params)
Calibrate Body Params at T-Pose (hand to the left and right) and I-Pose (hands down). Calibration will be applied automatically at the second call (order is not important). Returns true if calibration is finished successfully, i.e. after both calls. AutoCalibrateBodyAtPose() detects pose automatically.		
Initialize	*void*	**Camera**: Camera Component Reference **RightController**: Motion Controller Component Reference **LeftController**: Motion Controller Component Reference
Call this function on BeginPlay to setup component references if VRInputFromComponents is true		
ActivateInput	*void*	(no params)
This function activates VR IK Body component. If you use scene components for data input, use Initialize(…) function instead to initialize component references and activate component.		
DeactivateInput	*void*	(no params)
The function stops component. It can be reactivated later by Activateinput() call.		
ComputeFrame	*IKBodyData*	**DeltaTime**: float
Call in Tick(…) to calculate body state.		
GetLastFrameData	*IKBodyData*	(no params)
Returns a last body state struct calculated by ComputeFrame(...) . function		
ConvertDataToSkeletonFriendly	*IKBodyData*	**WorldSpaceIKBody**: IKBodyData
Converts calculated body parts orientation to skeleton bones orientation. It's useful to directly set bone transforms in Anim Blueprint using 'Modify (Transform) Bone' node. Keep in mind that transforms in the returned struct are still in world space. The function doesn't affects Pelvis. It always have X as forward axis and Z as up.		
ResetTorso	*void*	(no params)
Call this function to set Pitch and Roll of Pelvis to zero and Yaw equal to Head Yaw.		
GetCharacterHeight	*float*	(no params)

Returns calculated or calibrated character from feet to HMD. height		
GetCharacterLegsLength	*float*	(no params)
Returns calculated or calibrated legs length.		
AttachHandToComponent	*bool*	**Hand**: Controller Hand
		Component: Primitive Component **SocketName**: Name **RelativeTransform**: Transform
Function attaches hand palm to primitive component. Calculated as relative transform to component's socket (or relative transform to component itself if socket isn't specified). Affects Hand Transform. Affects Upperarm/Forearm Transforms and elbow joint target if ComputeHandsIK is true. Returns true if succeed.		
DetachHandFromComponent	*void*	**Hand**: Controller Hand
Reattach hand palm to motion controller.		
UpdateInputTransforms *void* **RightHandTransform**: **LeftHandTransform**: Transform	Transform	**HeadTransform**: Transform
Call this function in Tick() to update Head and hands transforms if VRInputOption is 'Input from Variables'		
GetCalibratedBody	*CalibratedBody*	(no params)
Returns the struct describing body calibration results. Use it to save and restore body params if you need to respawn player.		
RestoreCalibratedBody	*void*	**BodyState**: CalibratedBody
Loads body calibration parameters from CalibratedBody struct.		
ResetCalibrationStatus	*void*	(no params)
Mark body as non-calibrated. Function (replicated) keeps existing body params, but allow to recalibrate body if necessary.		
IsBodyCalibrated	*bool*	(no params)
Returns true if calibration is complete or calibration data is loaded by RestoreCalibratedBody		
IsValidCalibrationData	*bool*	**BodyParams**: CalibratedBody
Check if CalibratedBody variable is valid. Use it if you save and load calibration params.		

Events (this feature is not included in the retail version)

OnJumpStarted	(no params)	Event called when player starts a jump
OnGrounded	(no params)	Event called when player ends a jump

~~OnHeadShake~~	**Iteration**: float	Event called when player shakes a head
~~OnHeadNod~~	**Iteration**: float	Event called when player nodes a head
OnSitDown	(no params)	Event called when player finishing squatting
OnStandUp	(no params)	Event called when player stands up
OnCalibrationComplete	(no params)	Event called when player body calibration complete successfully

VR IK Skeletal Mesh Translator

Component extracts data from VR IK Body Component and returns PoseSnapshot object ready-touse with any custom skeletal mesh.

Parameters

VARIABLE	TYPE	DESCRIPTION
RootBone, Pelvis, Ribcage, Head, ShoulderRight, UpperarmRight, LowerarmLeft, PalmRight, ShoulderLeft, UpperarmLeft, LowerarmLeft, PalmLeft, ThighRight, CalfRight, FootRight, ThighLeft, CalfLeft, FootLeft	*Name*	Names of bones in a skeleton object. RootBone must be equal to Pelvis (not None) if Pelvis is a root. Ribcage is the last spine bone.
RescaleMesh	*bool*	Should Component apply player’s height to skeletal mesh scale or not. If true, scale applied on VRIKBody component’s OnCalibrationComplete event.
ScaleMultiplierVertical	*float*	Mesh scale coefficient vertical

ScaleMultiplierHorizontal	*float*	Mesh scale coefficient in a horizontal plane
RootMotion	*bool*	If true, moves both Root bone and Skeletal Mesh Component.

Functions

FUNCTION	RETURN VALUE	PARAMETERS
Initialize	*bool*	**ControlledSkeletalMesh**: Skeletal Mesh Component, **VRIKBodyComponent**: VR IK Body Component
Initialize references and build information about controlled skeletal mesh. References can be automatically extracted from the owner actor If it has a VRIKBody component and only one Skeletal Mesh Component. Skeletal Mesh Component must contain a Skeletal Mesh object in T Pose in a moment of initialization. Returns true if initialization was successful.		
IsInitialized	*bool*	(no params)
Is component initialized or not?		
GetSkeletalMeshSetup	*FSkeletalMeshSetup*	(no params)
Get current skeletal mesh bones setup. Use this function to save/restore mesh data without reinitialization.		
RestoreSkeletalMeshSetup	*SkeletalMeshSetup*	**SkeletalMeshSetup**: FSkeletalMeshSetup
Load skeletal mesh bones setup to component. Use this function to save/restore mesh data without reinitialization.		
GetLastPose	*bool, PoseSnapshot*	(no params)
Get current pose from VRIKBody component adjusted for controlled skeletal mesh. Returns PoseSnapshot object and true if the component is initialized and calibrated.		

GetMeshWorldTransform	*Vector, Rotator*	(no params)
Return current Location and Rotation of Skeletal Mesh Component in World Space if Root Motion is enabled or predicted Location and rotation if Root Motion is disabled.		
UpdateSkeleton	-	(no params)
Must be called in Tick(…) after VRIKBody::CalculateFrame and before any artificial locomotion to load calculated data and update skeletal mesh position (if Root Motion is enabled)		
ForceSetComponentAsCalibrated	-	(no params)
Function marks body as calibrated and allow to receive input from VRIKBody component. Note: function isn't replicated, call it on all clients manually.		