Birch Trees 3.0

Thanks for purchasing this package.

In order to get your started right away please go to Getting Started.

If you are looking for specific shader inputs you will be covered in the chapter Shader Properties.

Do not miss the chapter Optimizations.

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Getting Started

In order to get the best visual results please make sure that your project is set to use the **linear color space** in:

Edit → Project Settings → Player.

Unity 2018.2 and above

Unity 2018.2 changed the way crossfading is handled by shaders. As the initial version of this package has been submitted using Unity 5.6.3. you may have to import the tweaked leaf shader first. Do so by importing the included **2018.2_CTI_LODLeaves_Shader_301.package.**

This will overwrite the old 5.6.3 leaf shader and replace it with a version compatible with Unity >= 2018.2. If you can't find the package mentioned above, you should have a version already updated to work with 2018.2 and above.

Deferred Rendering

In case your camera uses **deferred rendering** you have to assign the **CTI deferred lighting shaders** in:

Edit → Project Settings → Graphics:

- Under the *Built-in shader settings* change *Deferred* to *custom*, then assign the *CTI_Internal-DeferredShading* shader.
- Also change *Deferred Reflections* to *Custom* and assign the *CTI_Internal-DeferredReflections* shader.

Otherwise the trees will look pretty colorful…

Other deferred lighting and reflection shaders which should work out of the box are those of Lux Plus, AFS and ATG.

Vegetation Studio Pro

As the (customized) included CTI shaders identify as “xyz 301” Vegetation Studio Pro will not recognize them as CTI shaders.

Fix this by importing the **VSPro_CTIShaderController.package.**

Demos

The included demos lets you explore the prefabs and various settings/options.

Birch Trees Casts Demo

Gives you an overview about the included Prefabs.

LODs

If you enter play mode and move around in the scene view you will get a first impression of how **LOD blending** looks like: It pretty much fits Speed Tree's blending, fades out specified leaf planes during the transition of the mesh LODs and performs a dithered crossfading between the last mesh LOD and the billboard. **Please note:** Proper LOD blending only works in play mode.

While leaves are animated during the transition branches and any simplification made to the geometry simply pop. In case you use **temporal anti aliasing** this will already smooth out this popping a bit. In order to get an even smoother transition you may try to change the LOD fading from ***Speed Tree*** to ***Cross Fade***. This however will draw each tree **twice** during the transition and most likely be pretty costly.

LOD0 is the original modeled mesh – while LOD1 and LOD2 are pretty rough simplified versions: Here branches may get disconnected from the trunk and you will notice a lot of texture stretching. Not noticeable at a common LOD distance so i did not care about this. On the other hand it does not let you replace LOD0 with LOD1.

Wind

Entering play mode you will also see the wind in action. It is driven by a standard Unity wind zone – but as all tree materials are set to *Use Wind from Script* the wind zone also holds the *CTI Custom Wind* script. Rotating the wind zone or changing e.g. its *Main* parameter will give you instant feedback on the trees. To find out more about the relationship of the material wind settings, the *Tree* component and directional or spherical wind zones have a look here.

Rendering

The camera uses **forward rendering** by default so you do not get any visual artifacts when opening the scene but have not assigned proper deferred lighting and reflections shaders. If you want to change to deferred make sure you assign these shaders as described here.

Materials

In order to be able to draw trees efficiently **instancing** must be enabled in the material inspector.

Lighting

The CTI Leaf shader offers a lot of tweakings like *Occlusion Strength* or *Backface Normal Accuracy* and *Ambient Scattering*. According to the image effects you use you may have to play around with these to get pleasant visual results.

Textures and Texture Arrays

The bark material by default uses the “CTI/LOD Bark Array 301 shader” which allows you to use 2 different texture sets, stored in 2 texture arrays. So the lower parts of the trunks use a unique texture while the upper parts of the trunk and the branches use a generic tiling texture.

Texture arrays are provided in 0.5/1K, 1/2K and 2/4K resolutions as you may not be able to create texture arrays your own. In order to do so i recommend to get the free Texture Array Inspector from the asset store.

In case you do not care about the lower parts of the trunks being white as well you may change the shader to the “CTI/LOD Bark 301 shader”. This will help to save some bandwidth.

Birch Trees Wind Demo

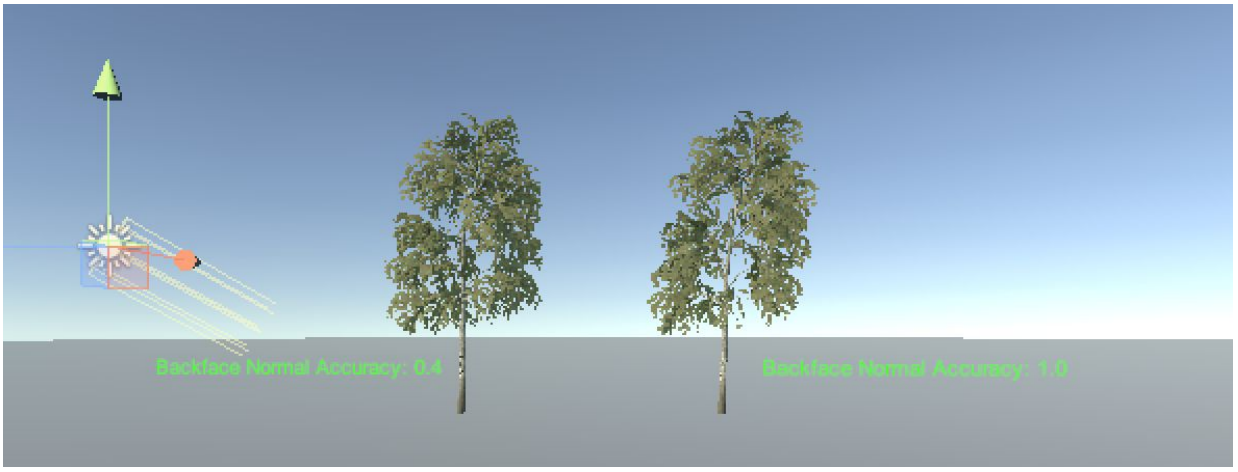
Shows the different wind settings as described here. Drag and move around the spherical Wind Zone to see how trees might be affected if they are placed as single game objects and their materials are set to not “Use Wind from Script”.

Birch Trees Lighting Demo

The lighting demo lets you compare the effect of the “Backface Normal Accuracy” parameter in the leaf shader as described here.

It contains two instances of the same tree: one using a “Backface Normal Accuracy” of 0.4, the other one uses 1.0. Latter gives you correct backface lighting and proper specular highlights as backface normals are calculated using VFACE. However proper backface lighting does not really reveal the tree’s “shape”:

As shown in the screenshot below the tree using a “Backface Normal Accuracy” of 0.4 better reflects the light direction and the tree’s overall shape (shadows are turned off to better visualize the effect).



But the final lighting depends on a lot of different factors:

- **SSAO** may completely change the overall look of the trees. They come with per pixel and per vertex baked ambient occlusion already.
- **Color Grading** as well may totally change the final look.
- By lowering the translucency **View Dependency** or raising the **Ambient Scattering** amount you may work against parts of the leaves getting too dark.

Birch Trees Terrain

Shows trees placed using the terrain engine.

CTI Shaders

The trees use a custom branch of the advanced tree shaders from the Custom Tree Importer giving you a nice bending and beautiful lighting.

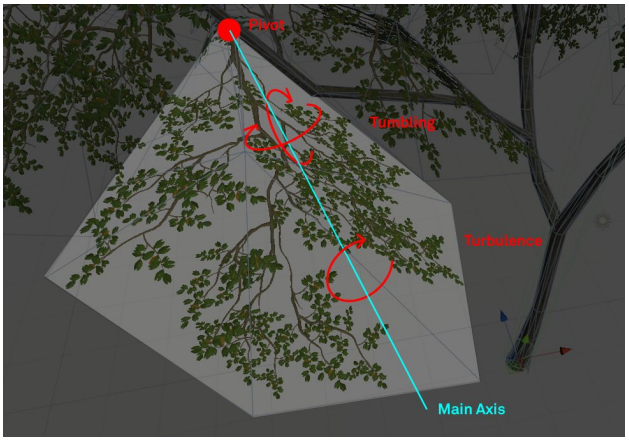
Wind

The bending animation is driven by a Unity *Wind Zone* which provides direction, strength and turbulence. The shaders translate this information into several bending animations which gets calculated and mixed in the vertex shaders:

- **Main bending** Bending of the entire tree along the wind direction.
- **Branch bending** Bending of the branches and leaves.
- **Edge flutter** high frequent bending of the outer edges of the leaf planes.

On top of this pretty common tree bending invented by Crytek and used e.g. by the built in tree creator shaders the CTI shaders support:

- **Leaf Tumbling** rotates each leave plane around its original pivot according to the wind's direction and strength.
- **Leaf Turbulence** will rotate each leaf plane around its original pivot according to the main axis of the leaf plane.
- **Advanced edge flutter** will add a periodic wave animation along the main axis of the leaf plane.



The "Tree" component

As you may have noticed all game objects within the tree prefabs contain a "Tree" component, which Unity usually adds to tree creator trees or speed trees to provide these with wind.

If you place the trees as single game objects they actually use this component and get wind from directional **and** spherical wind zones (unless you have checked *Use Wind from Script* in the materials).

When using the terrain engine or Vegetation Studio Pro the “Tree” script is useless and you have to check *Use Wind from Script* in the materials. If so you may remove the “Tree” component to save some overhead.

You also have to attach the "CTI_CustomWind" script to your wind zone. Or you can simply use the **"CTI Windzone" Prefab**.

Please note: The shipped prefabs do have the *Tree* component assigned but the materials are set to *Use Wind from Script.*

Lighting

The CTI tree shaders support physically inspired direct and ambient translucent lighting in both forward and deferred rendering. Lightmapping is not supported.

The CTI leaf shader lets you do proper **backface lighting** (using VFACE) which however may produce rather harsh results by revealing the single leaf planes. For this reason you may adjust the backface normals and even tweak them so that the backface normals equal those of the front faces (just like SpeedTree does). False specular highlights may be suppressed by reducing backface smoothness. The package provides baked normal textures for the billboards using a normal accuracy of 1.0 only.

As translucency and specular highlights beyond the real time shadow distance look pretty odd you may **fade out translucency** and smoothness according to the shadow distance.

Optimizations

Trees are expensive to render as leaves usually produce a lot of overdraw putting a lot of pressure on the raster units of the GPU (fill rate) and the memory bandwidth. At least latter can easily be addressed.

Bandwidth

CTI already use highly optimized combined textures but actually we can do even better:

- Use the lowest texture resolution feasible – especially on all leaf textures.
- Use a dedicated *Shadow Map Alpha* texture in the shadow caster pass: Doing so the GPU does not have to sample a 21.3 MB 4K RGBA texture but only a 10.7 MB 4K RGB texture (BC4 compressed). In case you use **deferred rendering** you can even think about lowering the resolution of the *Shadow Map Alpha* texture from e.g. 4K to just 1K. Actually i use a texture resolution of only 256 by 256 pixels. In case you use **forward rendering** please make sure that the import settings for the Shadow Map match those of the albedo texture (mip maps, wrap mode, filter mode, aniso level) as otherwise you may get gaps in the shadows and depth buffer.
- Use different resolutions on the different textures: The combined AO/Translucency/Smoothness texture may not need 4K while the Albedo texture does.
- In case you do not need or want the darkened lower part of the bark (because it is hidden by other foliage such as fern anyway or or whatever reason else) simply change the bark shader from the array version to the regular one and assign the proper textures: This will cut the bandwidth needed for bark rendering by half.

Fillrate

- Try to skip back faces in the shadow caster pass. Do so by setting *Shadow Caster Culling* to *Back*. In case you use **forward rendering** *Shadow Caster Culling* should to be set to *Off* tho as the shadow caster pass is also used to render the trees during the depth pass.

Further optimizations

- Deactivate Animations like tumbling, turbulence or advanced edge flutter if you think your game can do without these.
- Setting “Ambient Scattering” to 0.0 will make the pixel shader skip a 2nd lookup of the ambient lighting.
- Tweak the LOD settings and make sure that the billboards kick in as early as possible.

Shader Properties

CTI/LOD Bark and CTI/LOD Bark Array Shader

Shader Inputs

Color Variation Trees will be slightly different tinted according to their position in world space. RGB defines the tint color, alpha the strength of the tint. Always make sure that all shaders (leaves, bark and billboard) share the same color variation values.

Albedo (RGB) Smoothness (A) Diffuse texture which contains **smoothness** (unlike the leaf shader which expects transparency) in the alpha channel.
In case you use the Array shader the shader expects a texture array with 2 different textures.

Normal Map (GA) Specular (R) AO (B) contains the combined normal, specular and ambient occlusion map. The channel layout of this texture differs from that of the leaf shader.
In case you use the Array shader the shader expects a texture array with 2 different textures.

R = Specular as simply grayscale as dielectric materials do not have a colored specular. Gets compressed pretty lossy... . You can specify different shades of gray in your texture but please note that the associated billboard shader simply uses a simple spec color value.
Please note: Spec color here is **linear**, so Unity’s default 51,51,51 is way too bright. It should be RGB = 6,6,6 – but that seems rather dark. RGB around 10,10,10 however looks fine.
G = Green channel of the regular normal map
B = Ambient Occlusion
A = Red channel of the regular normal map

Please note: As this texture is NOT a regular diffuse texture nor a normal map you have to switch its import settings to "Advanced" and check "ByPass sRGB Sampling" – or uncheck “sRGB (Color Texture)”. Trilinear filtering is recommended.

Secondary Maps (need UV2) In case you have created UV2 and made the importer to add it this drop down lets you specify how the shader should handle the secondary maps.
The trees in this package have no UV2 set.

- **Disabled:** Secondary maps will simply be ignored.
- **Enabled:** Secondary maps will always be rendered. Use this e.g. on the material assigned to LOD00.
- **Fade Base Textures:** The base textures will be faded out towards the LOD switch. Use this e.g. on LOD01. Then use *Skip Base Textures* on LOD02.
- **Skip Base Textures:** Base textures will be totally skipped and only the secondary maps will be sampled and applied. Use this e.g. on LOD02.

  If you setup and assign the materials for the different LODs like described above LOD00 will use base and secondary textures, LOD01 will do too but fade out the base textures, while LOD03 will only use the secondary maps.
  Of course you can already fade out the base textures towards LOD01.

Swap UVS lets you swap UV0 and UV2.

Average Color (RGB) Smoothness (A) In case the shader skips the base textures on higher LODs, it still should add some "average" color and smoothness from the base texture in order to make the final result match the result from the LOD before to get smooth transitions. You may set this color manually or simply use the button *"Get average color"* at the bottom of the inspector.

Detail Albedo x2 (RGB) Smoothness (A) Secondary albedo and smoothness texture.

Normal Map (GA) Specular (R) AO (B) Secondary combined normal, specular and occlusion map.

Normal Strength Lets you adjust the strength of the secondary normal.

Wind Multipliers (XYZ) Multipliers for the baked bending strengths

- **X** main bending
- **Y** secondary or branch bending
- **Z** edge flutter

Please note that these multipliers have to be synced across bark and leaf material as otherwise leaves will lose their connection.

Use Wind from Script In case you place your LOD trees using the terrain engine you have to check this in order to make the trees receive at least proper directional wind. Must be the same for leaves and bark.

Fade out wind In case your billboards do not use wind you may create an extra material just for the *last LOD* using mesh trees, assign it to the corresponding LOD and check this feature.

CTI/LOD Leaf Shader

Culling Use "Off" in case you use single sided geometry (as the provided trees do). "Back" would be the correct choice for double sided geometry. "Front" is available just because it would be the third possibility…

Color Variation Trees will be slightly different tinted according to their position in world space. RGB defines the tint color, alpha the strength of the tint. Always make sure that all shaders (leaves, bark and billboard) share the same color variation values.

Albedo (RGB) Alpha (A) Diffuse texture which contains transparency in the alpha channel.

Alpha Cutoff If the alpha channel of the Base texture contains different shades of gray instead of just black and white, you can manually determine the cutoff point by adjusting the slider.

Normalmap (GA) Specular (B) contains the combined normal and specular map. Its channels should be set up like this:

R = unused (should be set to black)
G = Green channel of the regular normal map
B = Specular as simply grayscale as dielectric materials do not have a colored specular. You can specify different shades of gray in your texture but please note that the associated billboard shader simply uses a simple spec color value.
Please note: Spec color here is **linear**, so Unity's default 51,51,51 is way too bright. It should be RGB = 6,6,6 – but that seems rather dark. RGB around 10,10,10 however looks fine.
A = Red channel of the regular normal map

Please note: As this texture is NOT a regular diffuse texture nor a normal map you have to switch its import settings to "Advanced" and check "ByPass sRGB Sampling" – or uncheck "sRGB (Color Texture)". Trilinear filtering is recommended.

AO (G) Translucency (b) Smoothness (A) contains the combined occlusion, translucency and smoothness texture. Its channels should be set up like this:

R = unused
G = Ambient Occlusion
B = Translucency
A = Smoothness

Please note: As this texture is NOT a regular diffuse texture nor a normal map you have to switch its import settings to "Advanced" and check "ByPass sRGB Sampling" – or uncheck "sRGB (Color Texture)".

Occlusion Strength Lets you control the strength of the final ambient occlusion which contains occlusion from texture input as well as from ambient occlusion baked into the vertex color (alpha).

Shadows

Enable extra Shadow Map Check this in case you want to use an extra texture for the shadow caster pass. Find out more >

Shadow Map Alpha (R) The texture that is used during the shadow caster pass if *Enable extra Shadow Map* is checked. This texture just contains the alpha or opacity and must store opacity in the red color channel. Use BC4 compression for best results.

Shadow Caster Culling In case you have pretty dense leaf meshes you may skip double sided rendering in the shadow caster pass (Off) and go with back face culling instead (Back). Doing so may only produce some barely noticeable visual artifacts but save some fill rate. Setting culling to *Back* or *Front* needs deferred rendering.

Lighting

Backface Normal Accuracy The shader uses VFACE and thus may calculate proper normals when using single sided geometry. However this may produce rather harsh lighting revealing

the single leaf planes. For this reason you may adjust the accuracy. 1.0 will give you proper lighting while 0 would results in normals equal to Speed Tree where back and front faces just share the same normal. In case you want to soften the lighting i recommend values between 0.35 and 0.45. Such normals will always produce false specular highlights tho.

Backface Smoothness lets you reduce smoothness on back faces (to fight false specular highlights or just because you want it). If set to 0.0 Unity fill fall back to pure lambert lighting – which usually you do not want.

Translucency Strength acts as factor which gets multiplied with the translucency value sampled from the "AO (G) Translucency (b) Smoothness (A)" map and lets you fine adjust final translucency.

View Dependency determines when the translucent lighting effect will kick in depending on the view angle: Lower values will make translucent lighting appear already at rather flat viewing angles while high values will make it appear only if you look directly towards the sun. Values between 0.7 – 0.8 should be fine in case you want some kind of traditional thin layer translucency.

Ambient Scattering The amount of scattered ambient lighting.

Fade out Translucency Lets you fade out translucency (and smoothness) over distance as trees beyond the real time shadow distance tend to look a bit weird. If checked the leaf shader expects some global shader variables to be set as fade distance and fade range. You may set these manually from any script or use the provided `CTI.CTI_Utils.SetTranslucentLightingFade` function to so.

Wind

Wind Multipliers (XYZ) Multipliers for the baked bending strengths.

- **X** main bending
- **Y** secondary or branch bending
- **Z** edge flutter

Please note that these multipliers have to be synced across bark and leaf material as otherwise leaves will lose their connection.

Tumble Strength defines the strength of the tumbling animation.

Tumble Frequency lets you adjust the frequency of the tumbling.

Time Offset lets you shift the tumble animation in time so it comes slightly after the main wind animation.

Enable Leaf Turbulence You have to check this to enable leaf turbulence.

Leaf Turbulence lets you adjust the strength of the turbulence.

Edge Flutter Influence lets you adjust the strength of the edge flutter (stored in vertex color green) affecting the leaf turbulence. Using edge flutter influence values above 0.0 will most likely add some distortion to the leaf meshes – which in fact looks really nice.

Use Wind from Script In case you place your LOD trees using the terrain engine you have to check this in order to make the trees receive at least proper directional wind.

Enable normal rotation Checking this will make the vertex shader rotate the vertex normal according to tumbling. This is a bit more expensive but will improve lighting tremendously.

Fade out wind In case your billboards do not use wind you may create an extra material just for the *last LOD* using mesh trees, assign it to the corresponding LOD and check this feature. Doing so will make the final transition between the mesh tree and the billboard a little bit smoother.

CTI/LOD Billboard shader

Shader inputs

Color Variation (RGB) Strength (A) Make sure that the color fits the one you have added to the mesh trees.

Albedo (RGB) Alpha/Occlusion (A) This slot should contain the provided albedo texture atlas.

Alpha Cutoff If the alpha channel of the Base texture contains different shades of gray instead of just black and white, you can manually determine the cutoff point by adjusting the slider. A value of 0.45 should just be fine.

Alpha Leak Suppression: As the alpha channel of the Albedo textures stores both: *Alpha* and *Occlusion* dark pixels from the alpha mask might leak into the occlusion texture (caused by bilinear filtering) which would end up in full occlusion at the outer parts of the billboard. But if you set it about 0.6 all pixels darker than that will be set to white so you will get simply no occlusion on outer pixels – which in fact makes much more sense.

Normal (AG) Translucency (R) Smoothness (B) This slot should contain the created texture atlas.

Normal Scale Lets you scale the normal.

Specular Specular Color as simple solid color which you most likely should set to the default value of dielectric materials which is RGB = 51,51,51.

Translucency Strength might be a bit different from the one set in the leaf shader as the billboard's translucency map contains some kind of depth map in order to reduce artefacts due to missing self shadowing.

View Dependency determines when the translucent lighting effect will kick in depending on the view angle: Lower values will make translucent lighting appear already at rather flat viewing angles while high values will make it appear only if you look directly towards the sun. The value here should match your settings in the LOD leaves shader.

Ambient Scatter The amount of scattered ambient lighting.

Tree Height Limit (legacy) lets you optimize fill rate in case the used billboard asset does not fit the actual shape of your tree.

Enable Wind lets you enable or disable wind animations on billboards.
Please note: Only Wind from script is supported.

Wind Strength As Billboards do not have any baked wind information you may use this parameter to make the bending of the billboard better match the bending of the mesh tree.