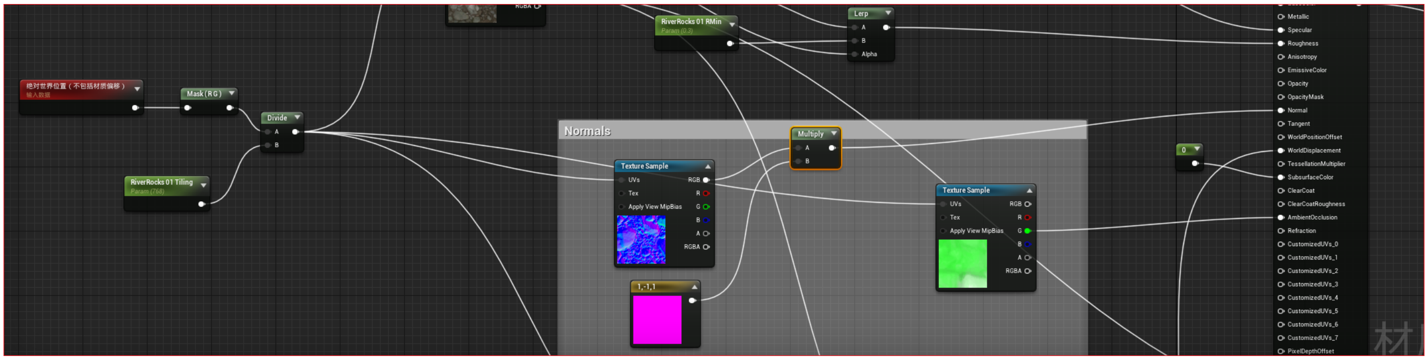
water shader 分析

demo 来源：UE 商城免费项目 A boy and his kite（放风筝的男孩）
water shader address:ABoyandHisKite\Content\KiteDemo\Environments\Materials\M_TilingDisplacementTest_01.uasset

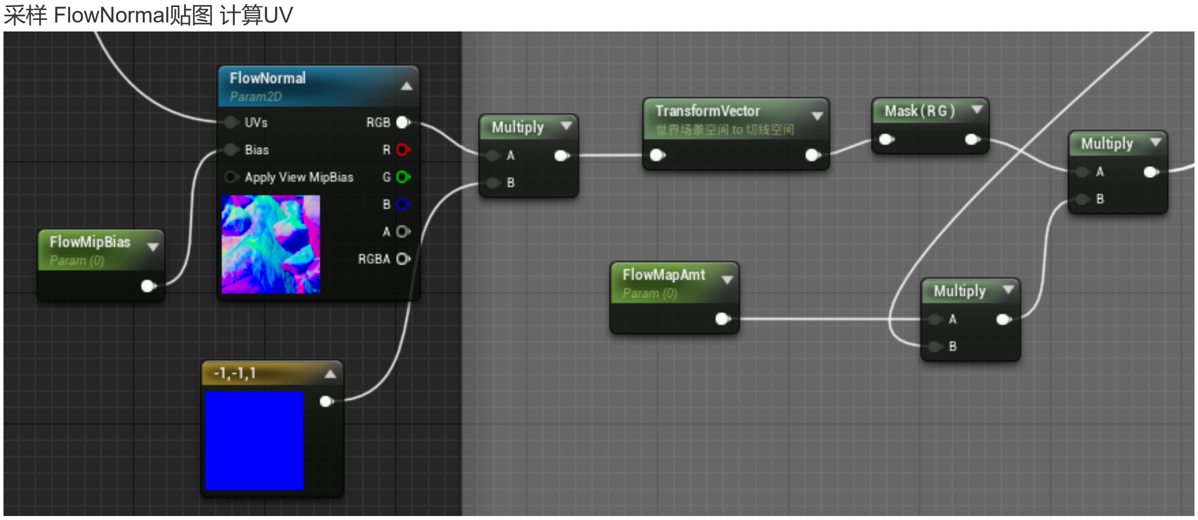
流程分析

normal

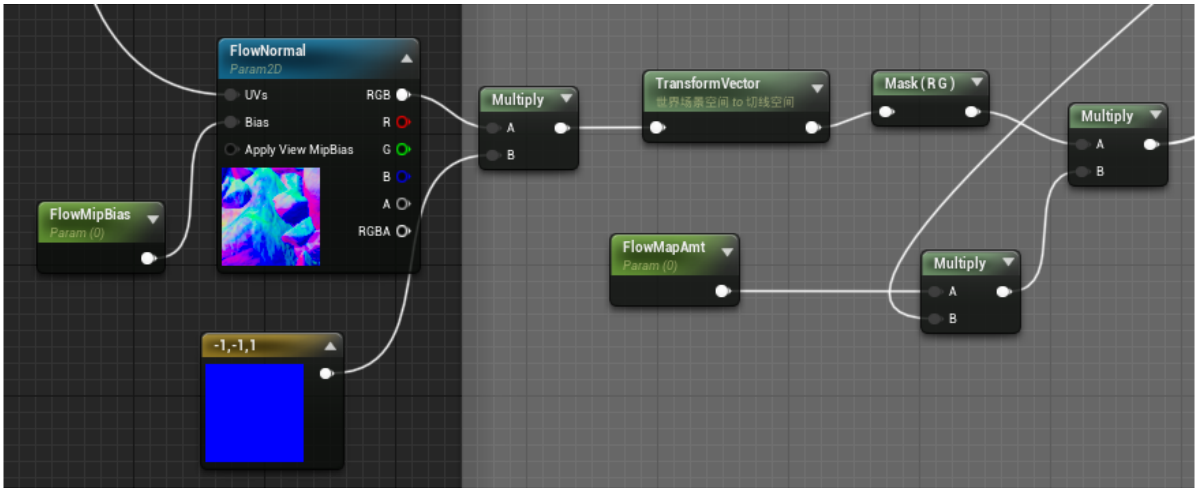
- 取水底的基础 normal ， 采样水底法线贴图 T_Tile_PebblyRiverbank_N



  `baseNormal = sample(T_Tile_PebblyRiverbank_N, screenUV /` **RiverRocks01Tiling** `) * const(1, 1, -1)`
  - T_Tile_PebblyRiverbank_N：提前准备好的水底法线贴图
  - **RiverRocks01Tiling**：水底法线采样缩放
- 采样高低频的默认水法线贴图，并进行混合
  - 采样 FlowNormal贴图 计算UV



    `flowNormalUV = sample(T_GDC_TilingRocks_02_N, screenUV +` **FlowMipBias** `) * const(-1, 1, -1)`
    `flowNormalUV = flowNormalUV * Clamp(height *` **FlowmapDepth** `) *` **FlowMapAmt**
    - T_GDC_TilingRocks_02_N：水流法线贴图 / 流速图
    - **FlowMipBias**：采样水流法线贴图的固定偏移
    - **FlowmapDepth**：水体深度的乘因子
    - **FlowMapAmt**：UV的乘因子
  - 根据 flowNormalUV 和高低频法线贴图的缩放值计算出采样UV



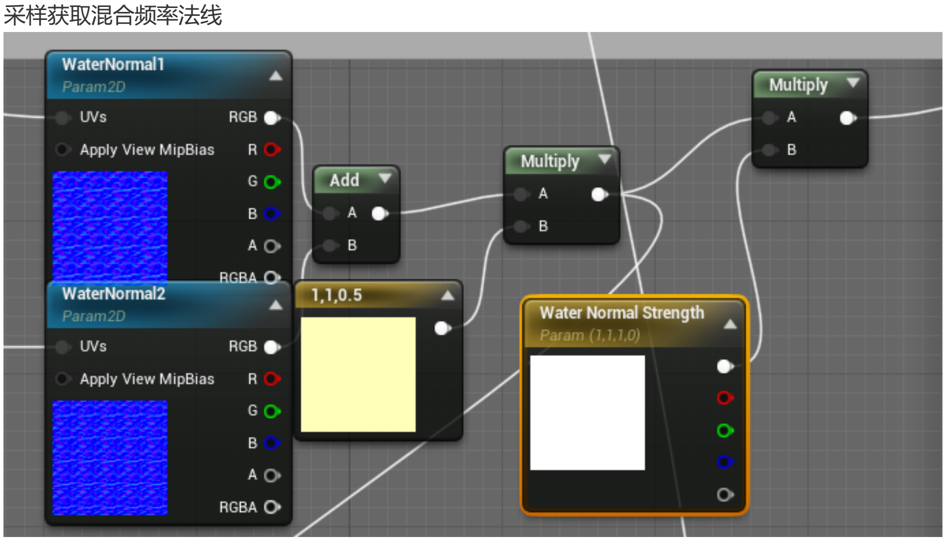

```
texCoordOffset = Vec2( WaterTiling , WaterTiling / WaterAspectRatio )

highFrequenceNormalUV = higFrequenceTexCoord * texCoordOffset
lowFrequenceNormalUV = higFrequenceTexCoord * texCoordOffset

highFrequenceSpeedUVOffset = speed * time * (PanDirection + const(-0.02, -0.02))
lowFrequenceSpeedUVOffset = speed * time * (PanDirection + const(0.02, 0.02))

highFrequenceNormalUV = highFrequenceNormalUV + flowNormalUV + highFrequenceSpeedUVOffset
lowFrequenceNormalUV = lowFrequenceNormalUV + flowNormalUV + lowFrequenceSpeedUVOffset
```

- 采样获取混合频率法线




```
highFrequenceNormal = sample(water_n, highFrequenceNormalUV)
lowFrequenceNormal = sample(T_Water_N, lowFrequenceNormalUV)
mixFrequenceNormal = (highFrequenceNormal + lowFrequenceNormal) * const(1, 0.5, 1)
mxiBaseNormal = mixFrequenceNormal * WaterNormalStrength
```

- 根据深度和边缘对法线进行混合

  `normal = lerp(baseNormal, mixBaseNormal, clamp(height *` **WaterMaskEdgeMultiply** `))`

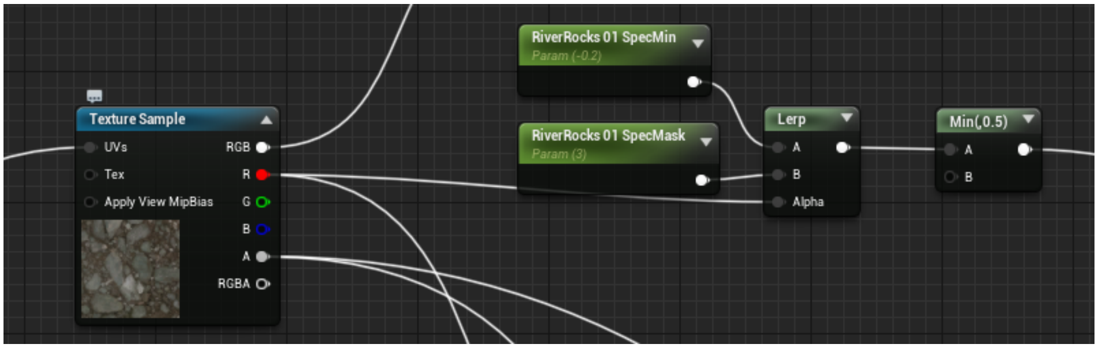
  - **WaterMaskEdgeMultiply**：水体边缘放大系数，用于处理边界

- 根据深度叠加一个额外的moss normal

  `normal = lerp(normal, mossNormal *` **MossNormalStrength** `, clamp(height))`

specular

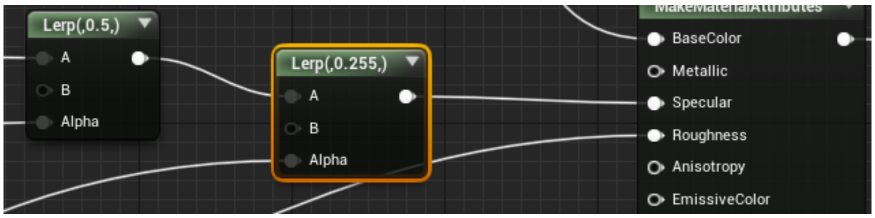
- 取水底的基础 diffuse ， 采样水底法线贴图 T_Tile_PebblyRiverbank_D ， 用 r 将预设的 specMin 和 specMax 混合



baseSpecular = lerp(**RiverRocks01SpecMin** , **RiverRocks01SpecMax** , sample(T_Tile_PebblyRiverbank_D, screenUV / **RiverRocks01Tiling**).r)

baseSpecular = min(baseSpecular, 0.5)

- 根据水体边缘对高光进行两次衰减衰减



specular = lerp(baseSpecular, 0.5, clamp(height * **WaterMaskEdgeMultiply**))

specular = lerp(specular, 0.255, clamp(height * **WaterMaskEdgeMultiply**))

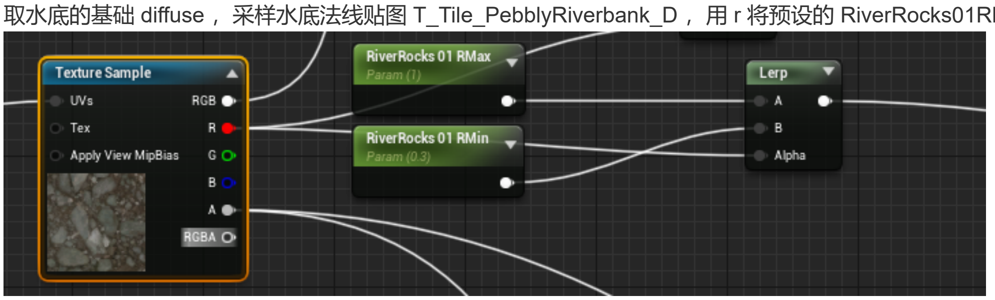
  - **WaterMaskEdgeMultiply**：水体边缘放大系数，用于处理边界

- 根据深度叠加一个额外的moss normal

specular = lerp(specular, **MossSpec** , clamp(height))

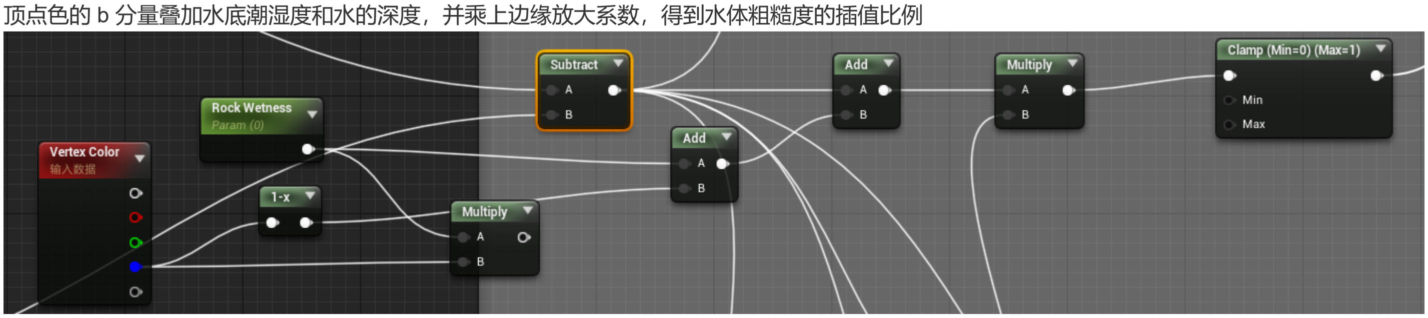
roughness

- 取水底的基础 diffuse ，采样水底法线贴图 T_Tile_PebblyRiverbank_D ，用 r 将预设的 RiverRocks01RMin 和 RiverRocks01RMax 混合



baseRoughness = lerp(**RiverRocks01RMin** , **RiverRocks01RMax** , sample(T_Tile_PebblyRiverbank_D, screenUV / **RiverRocks01Tiling**).r)

- 顶点色的 b 分量叠加水底潮湿度和水的深度，并乘上边缘放大系数，得到水体粗糙度的插值比例



wetnessAlpha = ((1 - VertexColor.b) + **RockWetness** + height) * **WaterMaskEdgeMultiply**

wetnessAlpha = clamp(0, 1, wetnessAlpha)

- 将预设的 WetRoughness 和 baseRoughness 进行叠乘

roughness = baseRoughness * lerp(1, **WetRoughness** , wetnessAlpha)

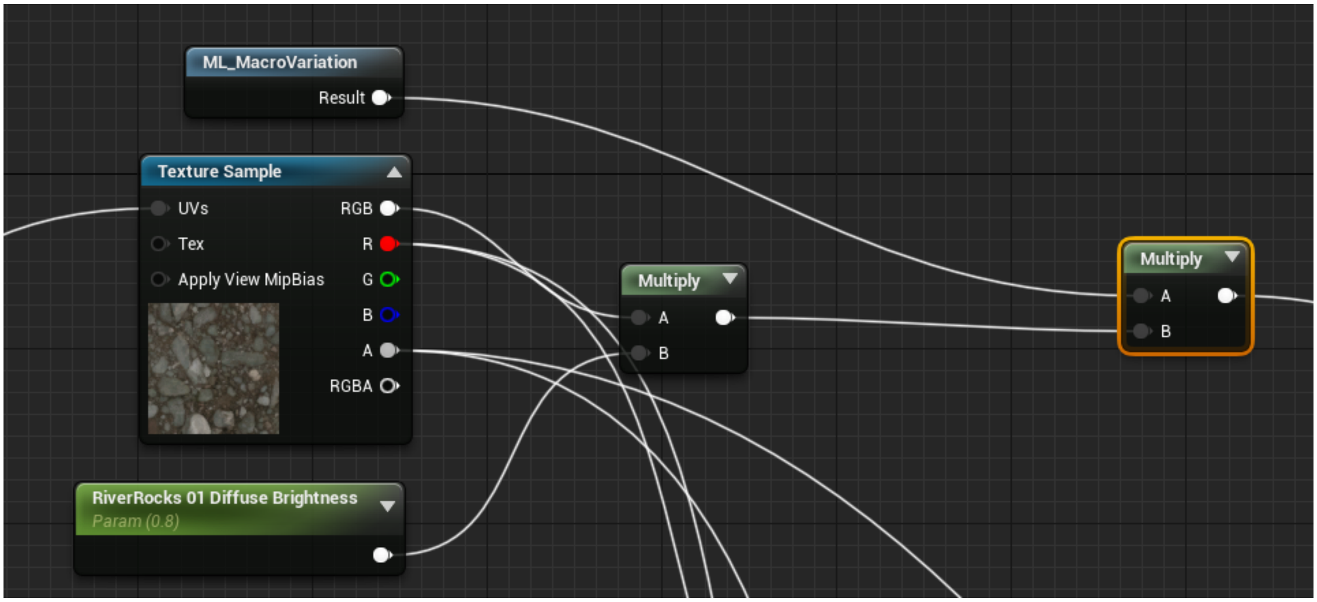
- 根据 moss 的 diffuse.r 插值出 MossR ，根据 height 将 MossR 与 roughness 混合

roughness = lerp(roughness, lerp(MossRMin, MossRMax, sample(T_ground_Moss_D, screenUV).r), clamp(height))

Displacement

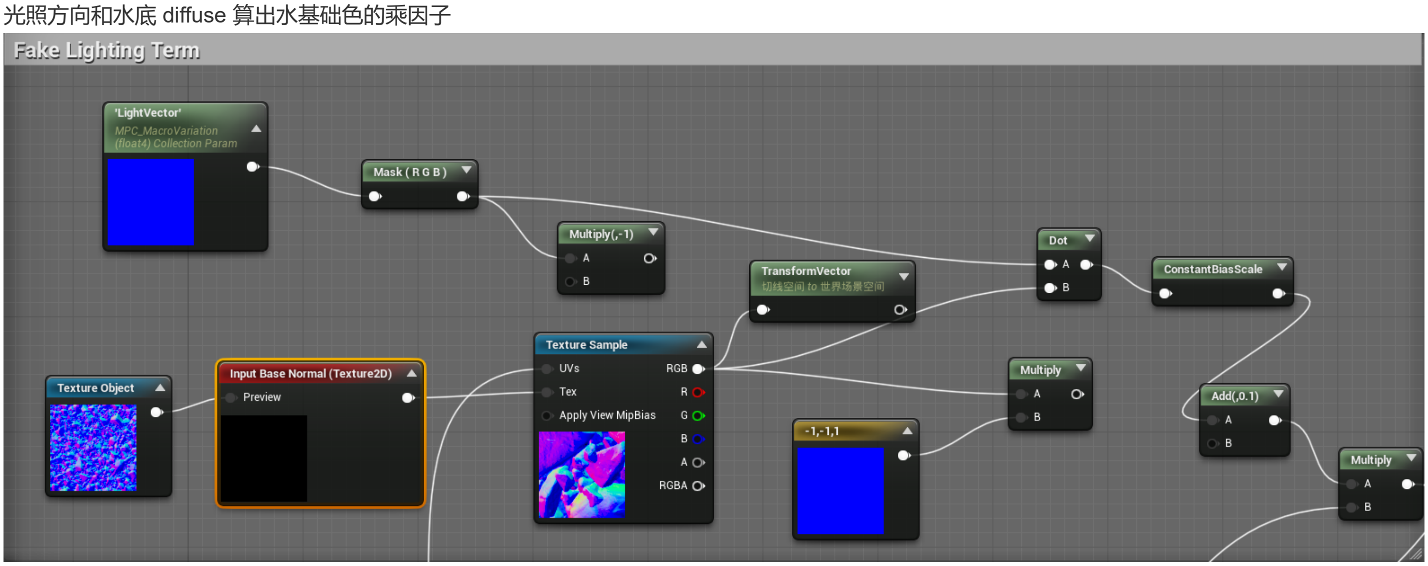
basecolor

- 取水底的基础 diffuse ， 采样水底法线贴图 T_Tile_PebblyRiverbank_D



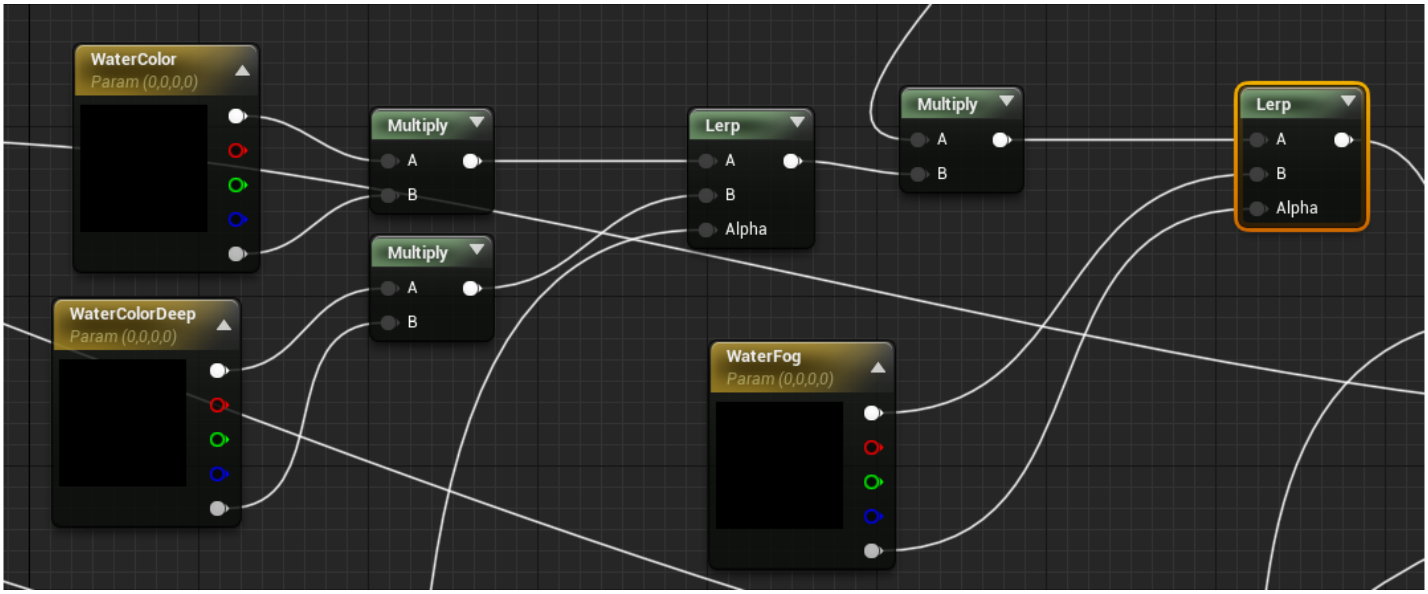
`basecolor = sample(T_Tile_PebblyRiverbank_D, screenUV /` **RiverRocks01Tiling** `).rgb *` **RiverRocks01DifffuseBrightness**

- 光照方向和水底 diffuse 算出水基础色的乘因子




```
UVOffset = mixNormal * **Distortion** * lerp(1, FarDistBoost, (PixelDepth - FadeOffset) / FadeLength)
offset = height * **RiverBumpOffset** + screenUV * UVOffset
watercolorMultiply = 0.1 + 0.5 *  (lightVector dot sample(T_ground_Moss_D, screenUV + offset).rgb)
watercolorMultiply = watercolorMultiply * (sample(T_ground_Moss_D, screenUV + offset).rgb * sample(T_ground_Moss_D, screenUV + offset).rgb)
```

- WaterColor 和 WaterColorDeep 混合水基础色



`waterColor = lerp(` **WaterColor.rgb** `*` **WaterColor.a** `,` **WaterColorDeep.rgb** `*` **WaterColorDeep.a** `, clamp(height * **WaterMaskEdgeMultiply**))`

- 水基础色乘以乘因子后和水雾色插值

  `waterColor = lerp(waterColor * watercolorMultiply,` **WaterFog.rgb** `,` **WaterFog.a** `)`

  `factor = ExponentialDensity(clamp(hight *` **WaterColorGradientDepth** `),` **WaterColorDensity** `)`

  `waterColor = lerp(waterColor, watercolorMultiply *` **RiverRocksUnderwaterDiffuseDarking** `, factor)`

- 水底基础色和水面基础色插值

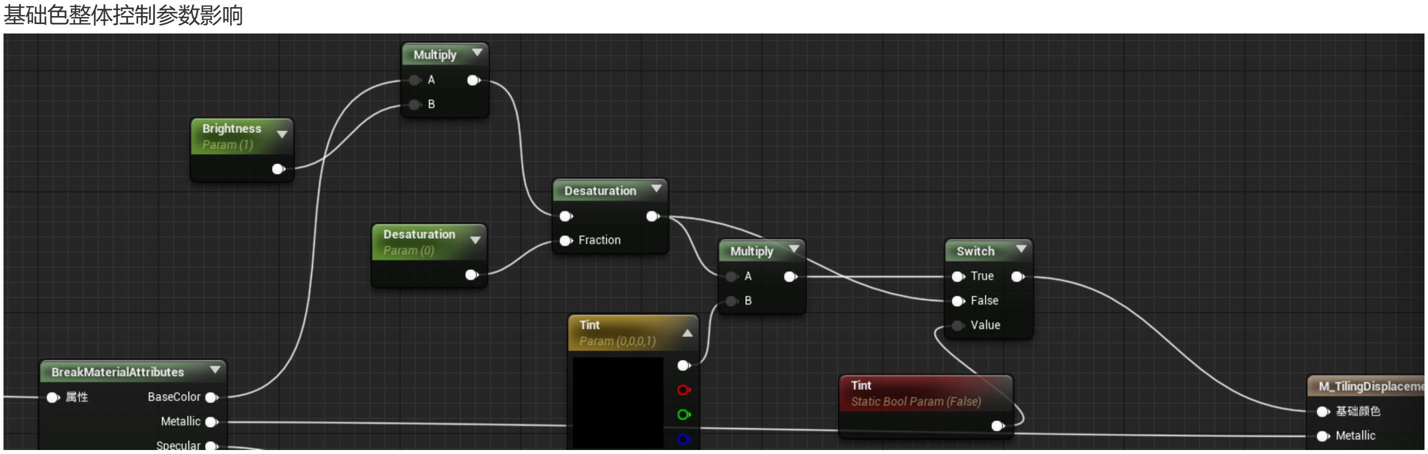
  `BaseColor = lerp(basecolor, waterColor, clamp(height * WaterMaskEdgeMultiply))`

- 根据 moss 的 DiffuseColor 和 FresnelColor 对 BaseColor 进行插值

  `mossColor = lerp(MossDiffuseColor, MossFresnelColor, Fresnel) * sample(T_ground_Moss_D, screenUV + offset).rgb`

  `BaseColor = lerp(BaseColor, mossColor, clamp(height))`

- 基础色整体控制参数影响



`BaseColor = BaseColor *` **Brightness** `* other`

新版水体着色流程

WaterColor / BaseColor

```
waterColor = waterColor.rgb * waterColor.a * clamp(height)
bankColor = bankColor.rgb * bankColor.a * clamp(height)
baseColor = lerp(waterColor.rgb, frameBuffer * bankColor.rgb, clamp(height) * mixFactor)
```

- waterColor：基础水色，固定颜色，根据深度调节局部的水色透明度
- bankColor：基础水底色，固定颜色，根据深度给frameBuffer中水底的颜色进行叠乘
- mixFactor：用于调节整体水色和水底色混合的比例，这个比例要受到深度影响

normal

- UVTexCoord

  `texCoordMultiply = vec2(WaterTiling, WaterTiling / WaterAspecRatio)`

  `highFrequenceTexCoord = highFrequenceTexCoord * texCoordMultiply`

  `lowFrequenceTexCoord = lowFrequenceTexCoord * texCoordMultiply`
  - TexCoord 是采样缩放比例，用来控制每个法线贴图的缩放
- UVOffset

  `highFrequenceUVOffset = speed * time * (PanDirection + const(-0.02, -0.02))`

  `lowFrequenceUVOffset = speed * time * (PanDirection + const(0.02, 0.02))`

  ``
- 高频混合

  `highFrequenceNormal0 = sample(highFrequenceNormalMap, highFrequenceTexCoord0 * (screenUV + highFrequenceUVOffset0))`

  `highFrequenceNormal1 = sample(highFrequenceNormalMap, highFrequenceTexCoord1 * (screenUV + highFrequenceUVOffset1))`

  `highFrequenceNormal = lerp(highFrequenceNormal0, highFrequenceNormal1, highFrequenceMixFactor)`
  - 不同比例的UV采样同一张高频法线，然后根据 highFrequenceMixFactor 进行混合
- 低频法线

  `lowFrequenceNormal = sample(lowFrequenceNormalMap, lowFrequenceTexCoord * (screenUV + lowFrequenceUVOffset))`
- 根据深度对高低频和顶点法线进行混合（水中心到岸边[1-0]）
  - 边缘(0.05-0)：顶点法线高权重
  - 岸边(0.3-0.05)：低频权重高
  - 深度水(1-0.3)：高低频混合权重高，提升高频权重
  - 根据深度判断是边缘还是岸边还是深度水

specular

固定高光度，可调整高光颜色

```
specularColor = specular * SpecularColor.rgb * SpecularColor.a
```

- specular 先暂定为固定值（0.02 / 0.04）
- SpecularColor：面板控制的高光基础色

wave

foam

临时记录

UE4 SingleLayerWater（文中简称水材质） 学习
UE4风格化水体制作
UE4简单水体使用记录
UE4基于物理的着色(二) 菲涅尔反射
Adreno Profiler分析任意安卓游戏特效+抓取资源
Android抓帧
如何查看安卓真机的渲染数据以及抓帧分析
UE5RayTracing篇(1)——NSight Graphics
test