Connecting the AxF Format to the AxF Material Implementation in Unity

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At the moment, only the "SVBRDF" and "Car Paint" BRDF types are supported (not BTF nor layered then).

I will list below the variables expected by the AxF material to drive the AxF shader:

Textures

NOTE: The "_sRGB" suffixed textures are only here to specify that if the texture is created as an 8-bits fomat then it should be stored as sRGB. But the AxF files usually provide floating-point values so the floating-point RGBA16F or RGBA32F formats should be preferred/expected to be fed to the shader at all times. I specify the preferred format for each texture.

NOTE: When a vector/color is given as the default expected value for a texture, ideally the importer should create a small 4x4 texture with that uniform color, unless there is a flag to enable or disable the texture sampling (e.g. height map or clear coat map).

CAUTION! Some color textures have been found to contain negative values! Max to 0!

SVBRDF-Only Textures

- **_SVBRDF_DiffuseColorMap_sRGB** (AxF lowercase name: "**diffusecolor**")
  RGB Diffuse color.
  Usually always provided otherwise use (0,0,0,0) (black) as a default value.
  RGBA16F format is advised.

- **_SVBRDF_SpecularColorMap_sRGB** (AxF lowercase name: "**specularcolor**")
  RGB Specular color
  Usually always provided otherwise use (1,1,1,1) (white) as a default value.
  RGBA16F format is advised.

- **_SVBRDF_NormalMap** (AxF lowercase name: "**normal**")
  Tangent-Space Normal vector with offset
  Warning: The AxF format provides [-1,+1] vector values but the shader expects a classical normal with offset so you must apply the following re-ranging transform:
  targetNormal = 0.5 * (sourceNormal + 1).
  We should fix that and use the float values directly in the future but for the moment you can

create a **RGBA16_UNORM** texture.
Usually always provided otherwise use (0.5,0.5,1,1) (bump) as a default value.

- **_SVBRDF_SpecularLobeMap** (AxF lowercase name: "**specularlobe**")
  Specular lobe in [0,1]. Also known as "roughness".
  Either a scalar (**R16F**) if isotropic, or a float2 (**RG16F**) if anisotropic.
  Usually always provided otherwise use (1,1,1,1) (white) as a default value.

- **_SVBRDF_OpacityMap** (AxF lowercase name: "**opacity**")
  Alpha (scalar in [0,1])
  Never encountered.
  Use 1 as a default value.
  R8_UNORM format is advised.

- **_SVBRDF_FresnelMap_sRGB** (AxF lowercase name: "**fresnel**")
  RGB F0 value in [0,1].
  Usually always provided otherwise use (0,0,0,0) (black) as a default value.
  RGBA16F format is advised.

- **_SVBRDF_AnisotropicRotationAngleMap** (AxF lowercase name: "**anisorotation**")
  Anisotropy rotation angle.
  Warning: The AxF format provides values in [-π,+π] but the shader expects a [0,1] scale so you need to apply the following re-ranging transform:
  targetAngle = 0.5 * (1 + sourceAngle / PI)
  We should fix that and use the float values directly in the future but for the moment you can create a **RGBA16_UNORM** texture.

- **_SVBRDF_HeightMap** (AxF lowercase name: "**height**")
  Height map, should be in millimeters. Rescale accordingly.
  Never encountered.
  R16F format advised.

Car-Paint-Only Textures

- **_CarPaint_BRDFColorMap_sRGB** (AxF lowercase name: "**brdfcolors**")
  RGB BRDF color.
  Usually always provided otherwise use (1,1,1,1) (white) as a default value.
  RGBA16F format is advised.

- **_CarPaint_BTFFlakesMap_sRGB** (AxF lowercase name: "**btfflakes**")
  RGB Flakes color.
  Warning: This is a Texture2DArray where as many slices as the "depth" dimension indicates, also AxF provides all mip levels for the array, which must also be used otherwise very nasty aliasing would occur.
  RGBA16F format is advised.

If not provided then use (0,0,0,0) (black) as a default value.

- **_CarPaint_thetaFI_sliceLUTMap** (doesn't exist in AxF, must be created manually)
  This is a custom texture created from the TYPE_INT_ARRAY property named "**thetaFI_sliceLUT**".
  The texture is expected to be at least the amount of entries in the INT_ARRAY. The advised format is **R8_UNORM** and the values in the INT_ARRAY *must be divided by 255.0f*.
  In the future, we should create a **R8_UINT** texture directly to avoid the division by 255.

Commmon Textures

Although ill-prefixed "SVBRDF", the clear coat textures are valid for both BRDF types…

- **_SVBRDF_ClearCoatColorMap_sRGB** (AxF lowercase name: "**clearcoatcolor**")
  RGB Clear coat color
  Usually provided if property "cc_no_refraction" is *not* found or set to 0, otherwise use (1,1,1,1) (white) as a default value.
  RGBA16F format is advised.

- **_SVBRDF_ClearCoatNormalMap** (AxF lowercase name: "**clearcoatnormal**")
  Tangent-Space clear coat Normal vector with offset
  Warning: The AxF format provides [-1,+1] vector values but the shader expects a classical normal with offset so you must apply the following re-ranging transform:
  targetNormal = 0.5 * (sourceNormal + 1).
  We should fix that and use the float values directly in the future but for the moment you can create a **RGBA16_UNORM** texture.
  Usually provided if property "cc_no_refraction" is *not* found or set to 0, otherwise use (0.5,0.5,1,1) (bump) as a default value.

- **_SVBRDF_ClearCoatIORMap_sRGB** (AxF lowercase name: "**clearcoatior**")
  Clear coat F0
  Warning: The AxF format provides the IOR (Index of Refraction) in [0,∞[range but since I only support [0,1] range, I converted the IOR into a Fresnel F0 value so at the moment you need to apply the following transform:

$$\mathrm{F}_0 = \left(\frac{IOR - 1}{IOR + 1}\right)^2$$

  R16F format is advised.
  Usually provided if property "cc_no_refraction" is *not* found or set to 0, otherwise use IOR=1.5 (F0 = 0.04)

Vector/Scalar Values

Unless explicitly written, no variable should be exposed to the user… (unlike the current state of AxFUI.cs where many variables are exposed but for debug purpose only)

Commmon Values

- (float) **_materialSizeU_mm**
  size of the U range, in millimeters (currently used as UV scale factor)
  ► **Should be exposed to the user.**
- (float) **_materialSizeV_mm**
  size of the V range, in millimeters (currently used as UV scale factor)
  ► **Should be exposed to the user.**

- (uint) **_flags**
  - Bit 0 = Anisotropic. If true, specular lobe map contains 2 channels and the _AnisotropicRotationAngleMap needs to be provided (used for **SVBRDF** only).
    Set to match "bIsAnisotropic" bit after calling axfGetSvbrdfSpecularModelVariant()

  - Bit 1 = HasClearCoat. If true, the clear coat must be applied. The _ClearCoatNormalMap must be valid and contain clear coat normal data.
    Set if any of the clear coat textures is present (color, normal or IOR)

  - Bit 2 = ClearCoatUseRefraction. If true, then _ClearCoatIORMap must be valid and contain clear coat IOR data.
    Set if property "cc_no_refraction" is *not* found or set to 0.

  - Bit 3 = useHeightMap. If true then displacement mapping is used and _HeightMap must contain valid data.
    Set if a height map is present.

SVBRDF-Only Values

- (uint) **_SVBRDF_BRDFType**
  - Bit 0 = Diffuse Type (**set to match axfGetSvbrdfDiffuseModelRepresentation**)
    - 0 = Lambert
    - 1 = Oren-Nayar (not supported at the moment) *(not encountered)*
  - Bit 1-3 = Specular Type (**set to match axfGetSvbrdfSpecularModelRepresentation**)
    - 0 = Ward
    - 1 = Blinn-Phong (not supported at the moment) *(not encountered)*
    - 2 = Cook-Torrance (not supported at the moment) *(not encountered)*
    - 3 = GGX (not supported at the moment) *(not encountered)*
    - 4 = Phong (not supported at the moment) *(not encountered)*

- (uint) **_SVBRDF_BRDFVariants**
    - Bit 0-1 = Fresnel Variant.
        - 0 = No Fresnel ← **axfGetSvbrdfSpecularModelVariant returns a flag "bHasFresnel" that can be used to set this value**
        - 1 = Dielectric (Cook-Torrance 1981) *(not encountered)*
        - 2 = Schlick (1994)
    - Bit 2-3 = Ward NDF Variant (**set to match axfGetSvbrdfSpecularModelVariant**)
        - 0 = Moroder (2010)
        - 1 = Dur (2006) (supported but *not encountered)*
        - 2 = Ward (1992) (supported but *not encountered)*
    - Bit 4-5 = Blinn-Phong Variant (**set to match axfGetSvbrdfSpecularModelVariant**)
        - 0 = Ashikmin-Shirley (2000) (not supported at the moment) *(not encountered)*
        - 1 = Blinn (1977) (not supported at the moment) *(not encountered)*
        - 2 = V-Ray (not supported at the moment) *(not encountered)*
        - 3 = Lewis (1993) (not supported at the moment) *(not encountered)*

- (float) **_SVBRDF_heightMapMax_mm**
  Maximum height map displacement, in millimeters
  If you can provide the height maps as a **R16F or R32F** format, then this is useless and can be set to 1

Car-Paint-Only Values

- (float) **_CarPaint_CT_diffuse**
  Diffuse factor, directly set from property "**CT_diffuse**".

- (float) **_CarPaint_IOR**
  Clear coat IOR, directly set from property "**IOR**"

- (float) **_CarPaint_BRDFColorMap_Scale**
  Optional scale factor to the BRDFColor map.
  If you can provide the texture "**_CarPaint_BRDFColorMap_sRGB**" as a **R16F or R32F** format, then this is useless and can be set to 1

- (float) **_CarPaint_BTFFlakesMap_Scale**
  Optional scale factor to the BTFFlakes map.
  If you can provide the texture "**_CarPaint_BTFFlakesMap_sRGB**" as a **R16F or R32F** format, then this is useless and can be set to 1

Cook-Torrance Lobes Descriptors

- (uint) **_CarPaint_lobesCount**
  Amount of valid components in the vectors below.
  You can set it from the length of the FLOAT_ARRAY properties listed below but it's generally

always set to 3, up to 4 lobes supported.

- (float4) **_CarPaint_CT_F0s**
  Description of multi-lobes F0 values, directly set from property "**CT_F0s**"
- (float4) **_CarPaint_CT_coeffs**
  Description of multi-lobes coefficients values, directly set from property "**CT_coeffs**"
- (float4) **_CarPaint_CT_spreads**
  Description of multi-lobes spread values, directly set from property "**CT_spreads**"

Flakes Descriptors

- (float) **_CarPaint_FlakesTiling**
  Tiling factor for flakes, *NOT* an AxF property, default value is 10.
  ► **Should be exposed to the user.**

- (uint) **_CarPaint_maxThetaI**
  Maximum thetaI index, directly set from property "**max_thetaI**"

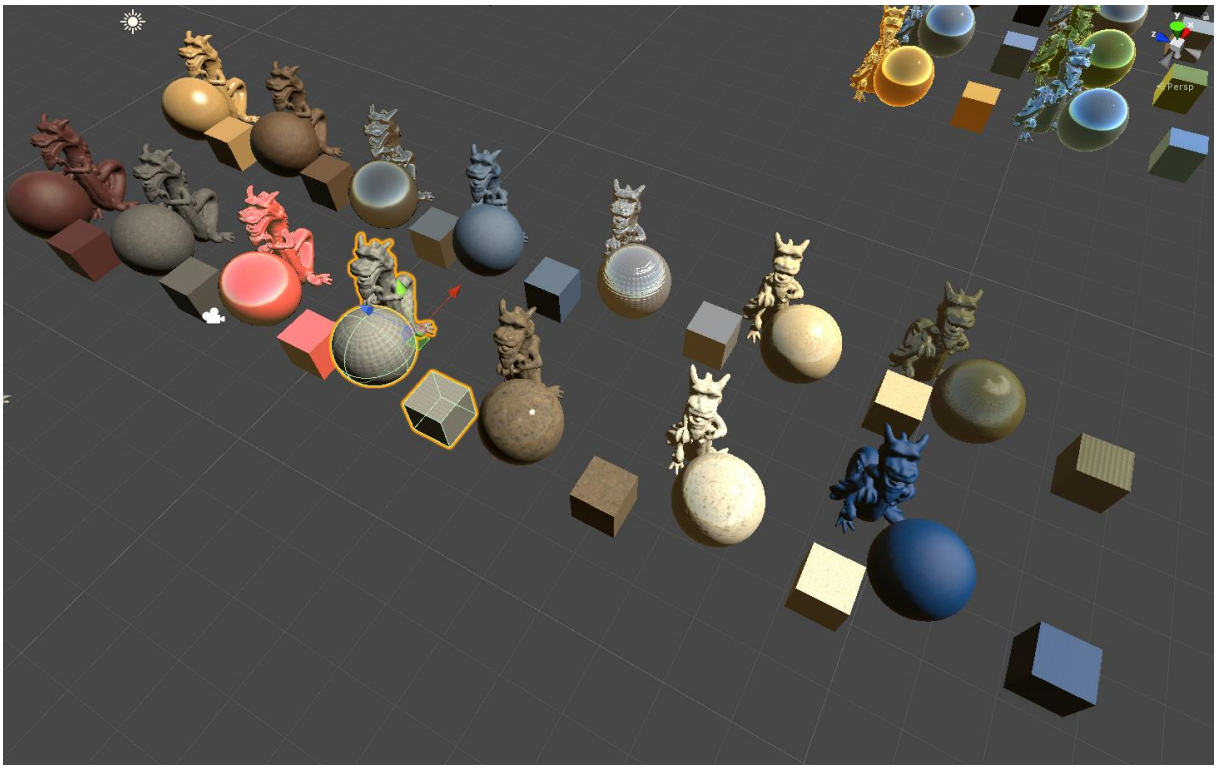
- (uint) **_CarPaint_numThetaF**
  Amount of thetaF entries, directly set from property "**num_thetaF**"

- (uint) **_CarPaint_numThetaI**
  Amount of thetaI entries, directly set from property "**num_thetaI**"

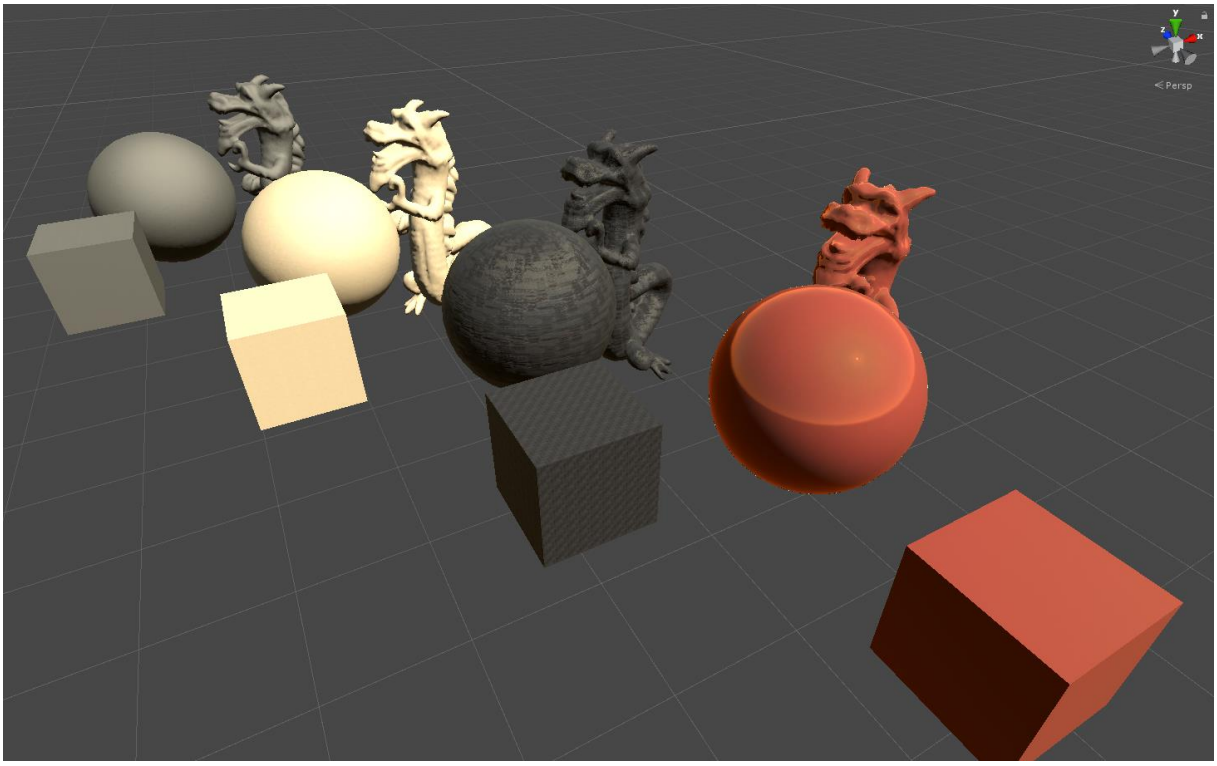
Tested packages

The following packages have been successfully exported and tested in Unity:

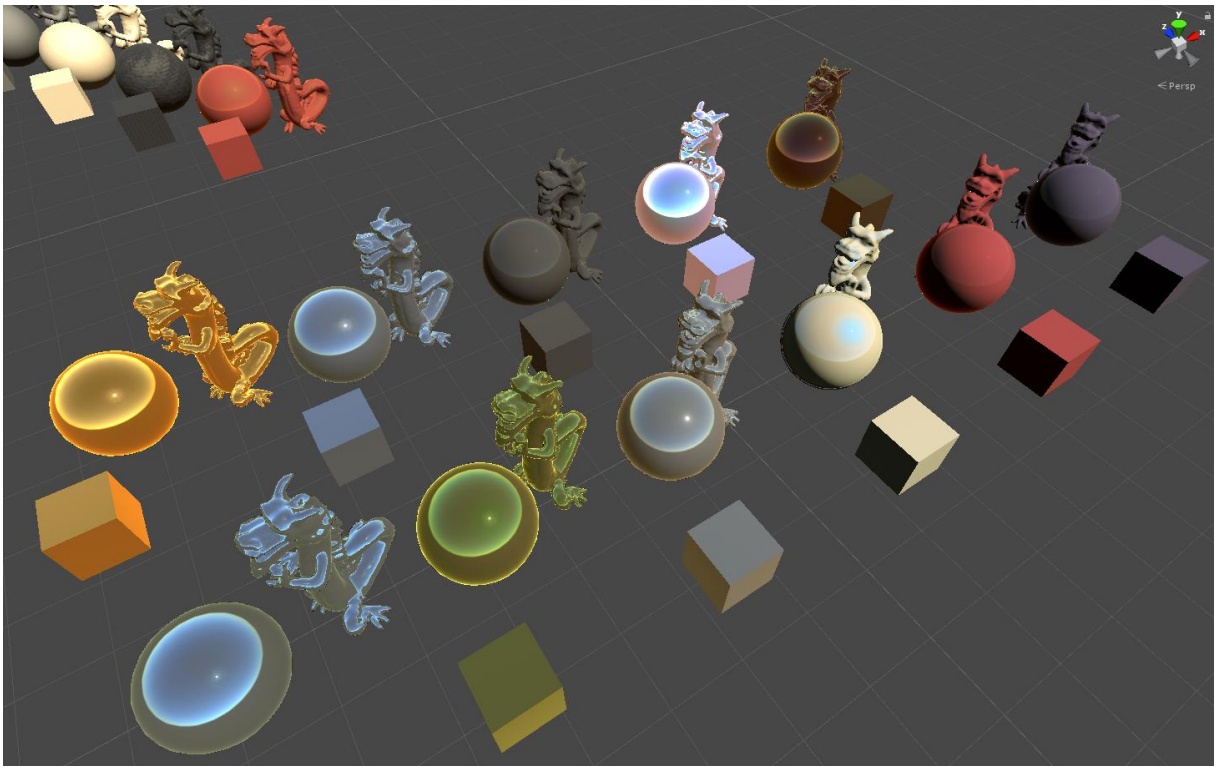
- **AxFSvbrdf_1_0_Dir, AxFSvbrdf_1_1_Dir, AxFSvbrdfNoRefract_1_3_Dir**, containing only SVBRDF materials.



- **Volkswagen**, containing 3 SVBRDF materials + 1 car paint material



- **AxFCarPaintRefract_1_2_Dir**, containing only car paint materials


Persp