Our Proposal – Sound Nodes in X3D

Strategies to Improve X3D Sound Component – Add acoustical material descriptors

Absorption coefficient

- The Sound Absorption Coefficient (**α**) of a surface is the ratio of the sound intensity absorbed or otherwise not reflected by the surface o that of the Initial sound intensity
- Depends on **nature** and **thickness** of material
- Sound is absorbed when it encounters: fibrous or porous materials, panels that have some flexibility, volumes of air which resonate, openings in the room boundaries (eg doorway)
- Absorption of sound by a particular material/panel depends on the frequency and angle of incidence of the sound wave
- **Typical sound absorbers**: acoustic panels, membranes, drapes, foams, carpets
- $0<\alpha<1$
- Absorption coefficients are usually measured in reverberation chambers according to **DIN EN ISO standard 354**

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Scattering coefficient

- The Sound Scattering Coefficient (**s**) describes the degree of scattering due to the roughness or irregularity of a surface – the scattering due to diffraction from the edges is not included
- $0<s<1$
- The scattering coefficient is usually measured according to the **ISO standard 17497-1**, either under free-field or diffuse field conditions, but numerical solutions are also available for some types of corrugated surfaces

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Diffuse coefficient

- The Sound Diffusion Coefficient (**d**) aims to measure the degree of scattering produced on reflection
- It can be seen as a measure of the surface's ability to uniformly scatter in all directions
- The diffusion coefficient is measured in an anechoic chamber according to the **ISO standard 17497-2**

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Refraction coefficient

- The Sound Refraction Coefficient (**r**) of a medium determines the propagation speed of the wave
- For a wave travelling from medium 1 into medium 2, then the ratio of the refractive indices is equal to the inverse of the velocity ratios
- Sound waves are refracted when parts of a wave front travel at different speeds
- This happens in uneven winds or temperatures
- Sound waves tend to bend away from warm ground, since it travels faster in warmer air

Strategies to Improve X3D Sound Component – Structure (1)

- Add the new acoustical material descriptors to **Material** node of X3D

Material *: X3DMaterialNode {*

SFFloat [in,out] ambientIntensity 0.2 [0,1]

SFColor [in,out] diffuseColor 0.8 0.8 0.8 [0,1]

SFColor [in,out] emissiveColor 0 0 0 [0,1]

SFNode [in,out] metadata NULL [X3DMetadataObject]

SFFloat [in,out] shininess 0.2 [0,1]

SFColor [in,out] specularColor 0 0 0 [0,1]

SFFloat [in,out] transparency 0 [0,1]

}

Strategies to Improve X3D Sound Component – Proposal (1)

```
Material : X3DMaterialNode {
  SFFloat [in,out] ambientIntensity  0.2          [0,1]
  SFColor [in,out] diffuseColor      0.8 0.8 0.8  [0,1]
  SFColor [in,out] emissiveColor     0 0 0        [0,1]
  SFNode  [in,out] metadata          NULL         [X3DMetadataObject]
  SFFloat [in,out] shininess         0.2          [0,1]
  SFColor [in,out] specularColor     0 0 0        [0,1]
  SFFloat [in,out] transparency      0            [0,1]
  SFFloat [in,out] absorption        0    [0,1]
  SFFloat [in,out] scattering        0    [0,1]
  SFFloat [in,out] diffuse           0    [0,1]
  SFFloat [in,out] refraction        0    [0,1]
}
```

Strategies to Improve X3D Sound Component – Structure (2)

- Add the new acoustical material descriptors to **new acousticMaterial node within Shape node**

Shape *: X3DShapeNode {*

SFNode [in,out] appearance NULL [X3DAppearanceNode]

SFNode [in,out] geometry NULL [X3DGeometryNode]

SFNode [in,out] metadata NULL [X3DMetadataObject]

SFVec3f [] bboxCenter 0 0 0 (-∞,∞)

SFVec3f [] bboxSize -1 -1 -1 [0,∞) or −1 −1 −1

SFNode [in, out] acousticmaterial NULL [X3DAcousticMaterial]

}

Strategies to Improve X3D Sound Component – Proposal (2)

acousticmaterial : X3DAcousticMaterial {

SFNode [in,out] metadata NULL [X3DMetadataObject]

SFFloat [in,out] absorption 0 [0,1]

SFFloat [in,out] scattering 0 [0,1]

SFFloat [in,out] diffuse 0 [0,1]

SFFloat [in,out] refraction 0 [0,1]

SFString [in,out] name //Name (and only the name) of the material

SFString [in,out] description //Detailed description of the material

}