3D Sound

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Outline

- Game Engine Implementations
- Physical Aspects
- Simulated 3d Sound
- FMOD Demo
- Enemy Listener Demo

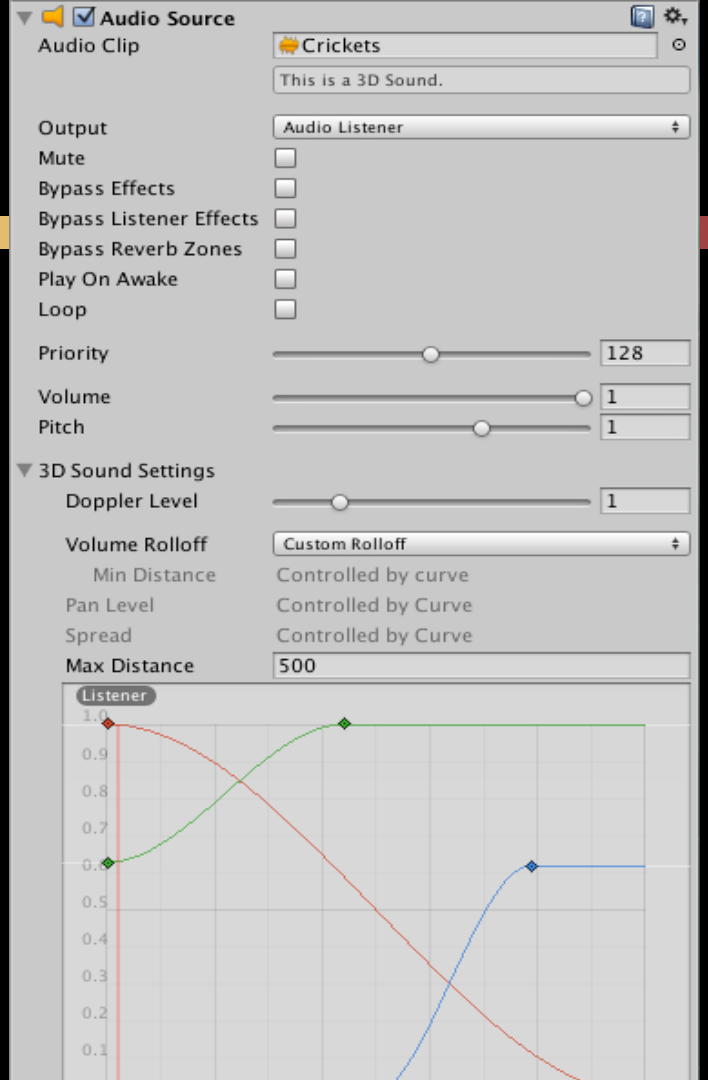
Why Sound is Important

- Ambience/Aesthetic: Sound design is critical to create a believable environment
- Sound can be used to evoke emotional responses
  - Part of the brain responsible for processing sound is also tied to memory.

Game Engine Implementations

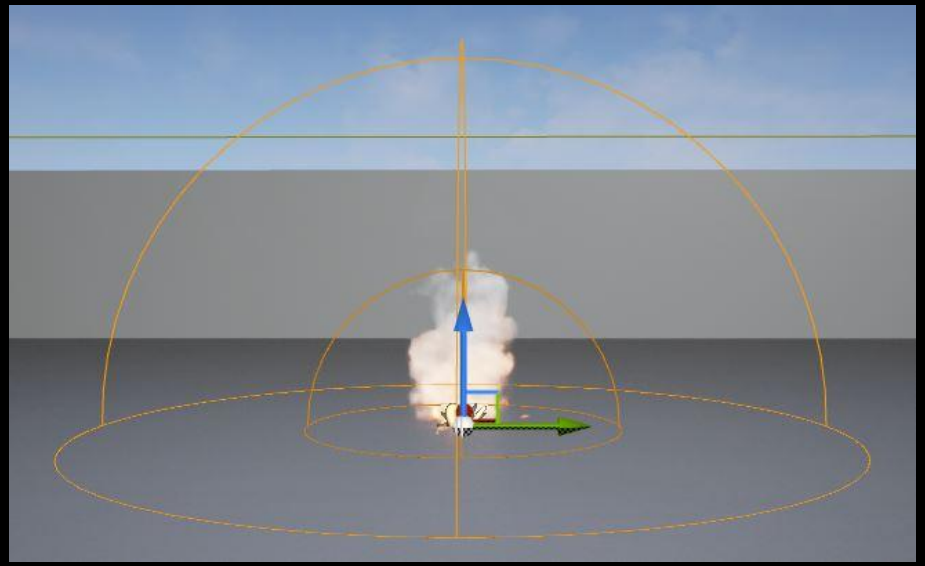
Unity

- Uses 2 object types: Audio Source and Audio Listener
- Emulate 3D sound by attenuating volume and panning across speakers
- Many controls to tweak sounds
- Works by simply calculating the source angle and distributing it across the channels
- See spread and pan in the unity documentation.



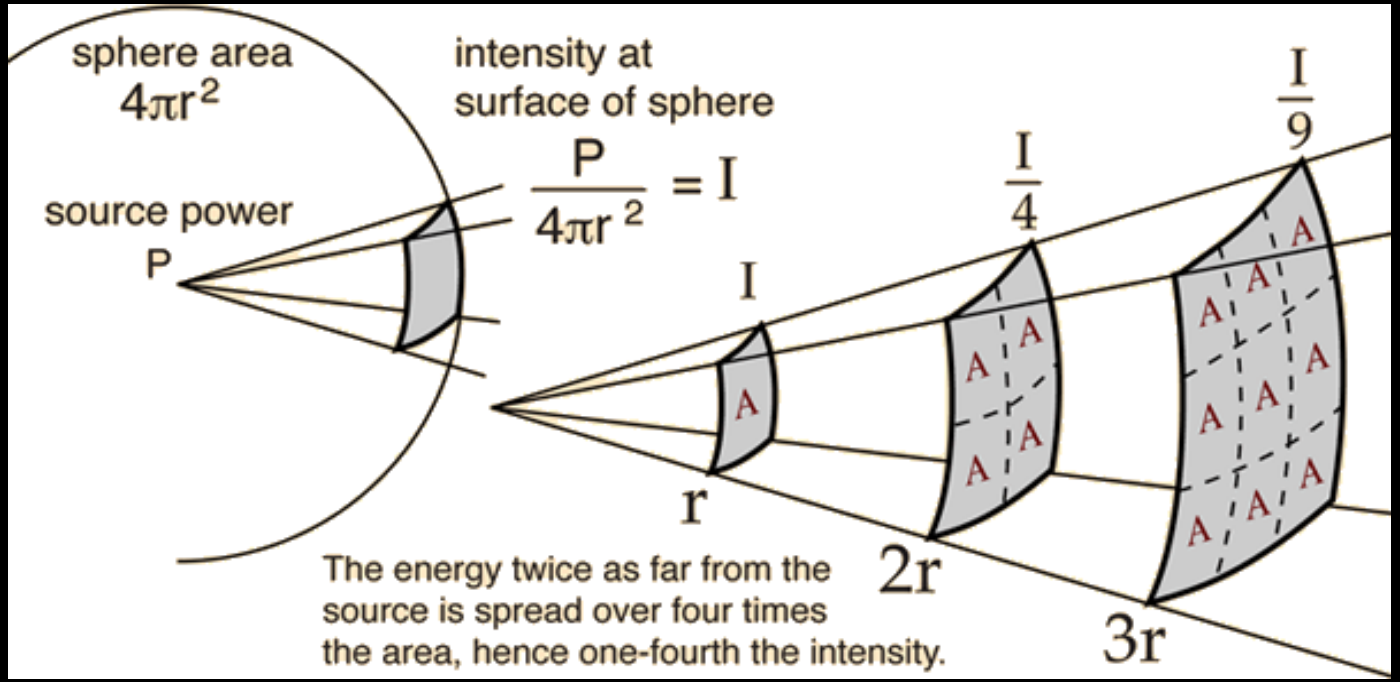
Unreal

- Distance Model Attenuation
- Reduces sound over a distance function to simulate 3D interaction.
- Can be implemented in various shapes



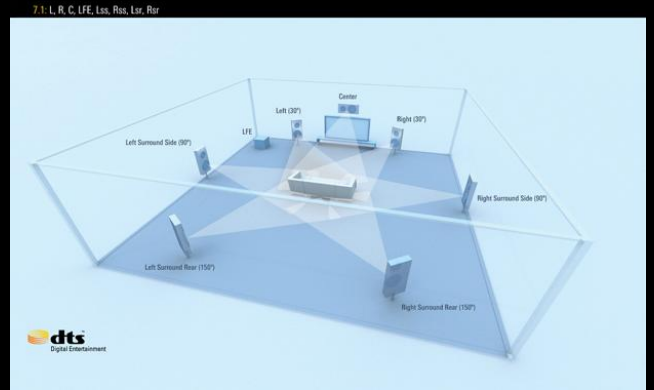
Inverse Square Law for Sound

Equation for determining sound drop-off



Limitations

- Stereo, 5.1, and 7.1 options still portray sound as a two-dimensional plane.
- Creates an audio-visual disconnect between what the player sees and hears.

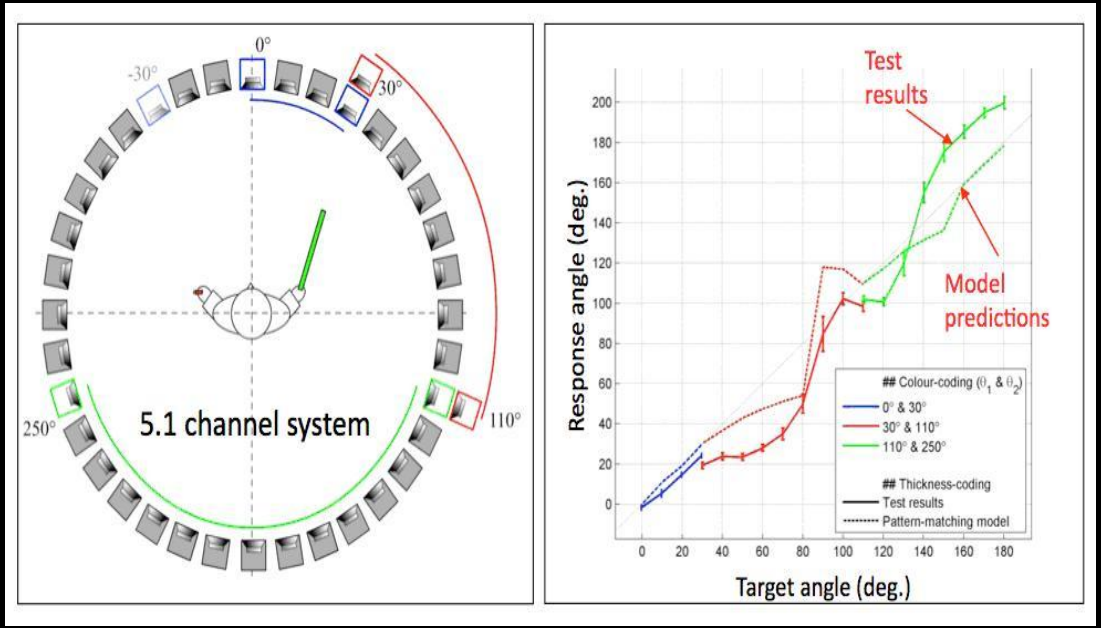


Physical Aspects

Stuff that is out of our control.

Optimal Source Distribution

- Positioning of audio sources reduce interference.



Environment

- Many things to consider when putting sound in your game.
  - How does sound interact with the game environment?
  - How will it interact with the players environment?
- We will expand on this in the demo

DISTANCE ATTENUATION	The attenuation of the sound signal with distance
ANGULAR ATTENUATION	The amount of attenuation relative to the angle of propagation
DOPPLER EFFECT	A variable delay as a function of distance
PROXIMITY EFFECT	A low-shelf filter for small distances (close proximity)
ABSORPTION FILTER	A low-pass filter simulating air absorption as a function of distance
INCIDENCE FILTER	A low-pass filter to simulate frequency-dependent attenuation with angle
REVERB	A filter with an impulse response representative of the current scene size

Simulated 3D Sound

Like, Woah.

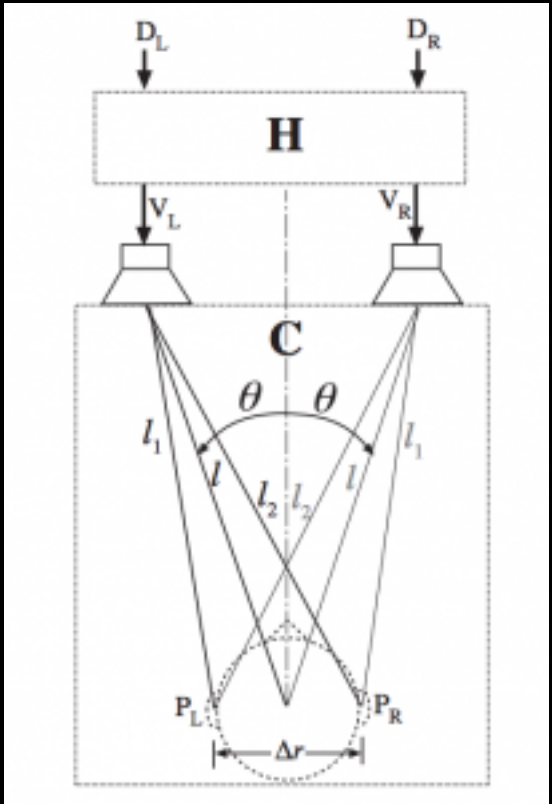
Immersive Audio

- Sound Field: Desired environment that sound will be interpreted as.
- Synthesis dependent on the Huygens-Fresnel Principle
  - Any wave front can be interpreted as a superposition of spherical waves.

$$\widetilde{\Delta I_m}(u,v) \approx -2I_i R(\omega_m)\exp(-2A_b)\times\left\{(1+jb_m u)\tilde{A}_d(u,v)+j\frac{u}{2R(\omega_m)}\frac{dR(u)}{du}\Big|_{u=\omega_m}\tilde{\varphi}_d(u,v)\right\}$$

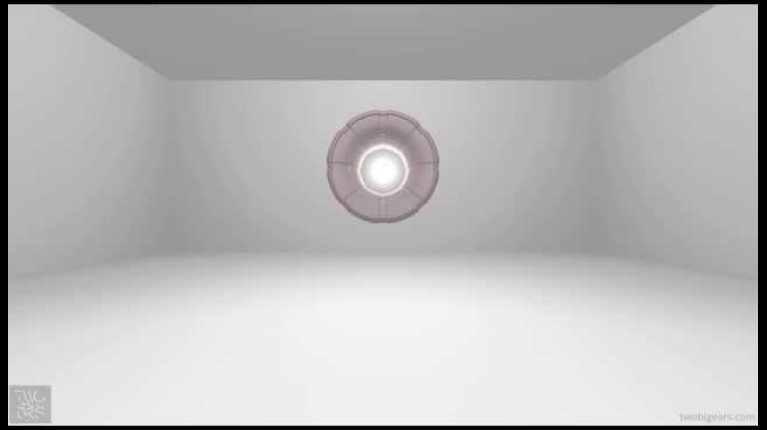
Simulated 3D sound

- BACCH 3D sound filters.
- Creates surround sound using 2 primary speakers
- Speakers produce sound waves that interfere with each other
  - Example



Simulated 3D sound

- Binaural Audio.
  - Method of creating 3D audio by recording using 2 microphones
- 3DCeption
  - Available for free for non commercial use
- Designed to create full immersion using headphones



Haas Effect and the First Wave

- Explains how brain locates sounds
- Based on volume, time, and frequency
- Hard to demonstrate without headphones

Beyond Binaural: Cetera Algorithm

- Algorithm developed for hearing aids
- “makes the hearing aid ‘invisible’ to the brain”
- Virtual Haircut

FMOD Demo

This is cool.

Installing FMOD

FMOD Studio

FMOD Studio is the professional audio content creation tool, for creating interactive sound and music for games and other types of applications. Changelogs – Click here for 1.05 changes.

Platform		Version 1.05.14
	Windows	Download
	Macintosh	Download
	To browse previous versions of FMOD Studio click here	

FMOD Studio Unity Integration

FMOD Studio Unity integration. For console (Xbox One, PS4, Wii U) integrations contact support

Platform		Version 1.05.14
unity	Unity Integration for Windows/Mac/Linux/iOS/Android/WinPhone	Download
unity	Unity Integration Documentation	Download
	To browse previous versions of FMOD Studio Unity Integration click here	

Enemy Listener Demo

Questions?

Speak up! (Get it?)

Sources

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