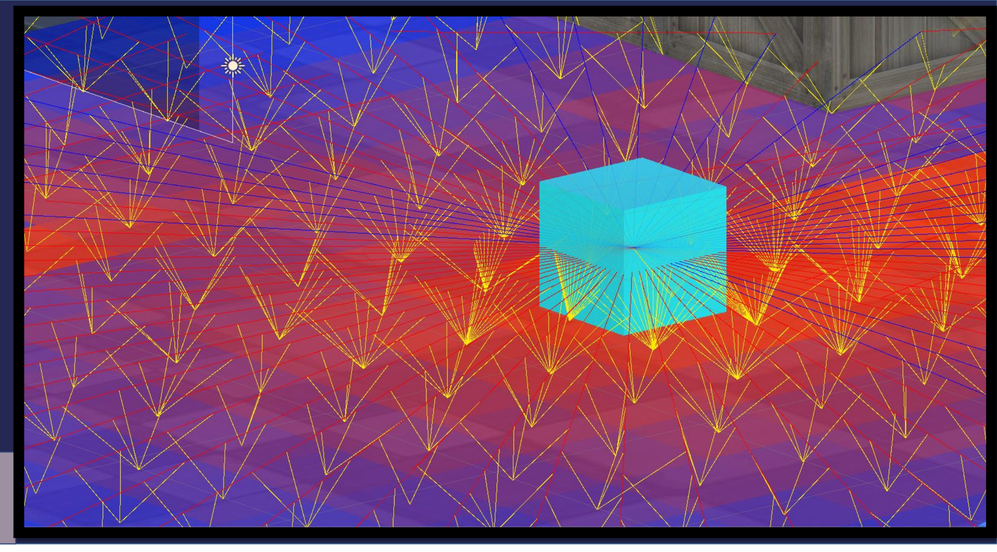
Modelling of Sound Propagation in Video Game



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Introduction

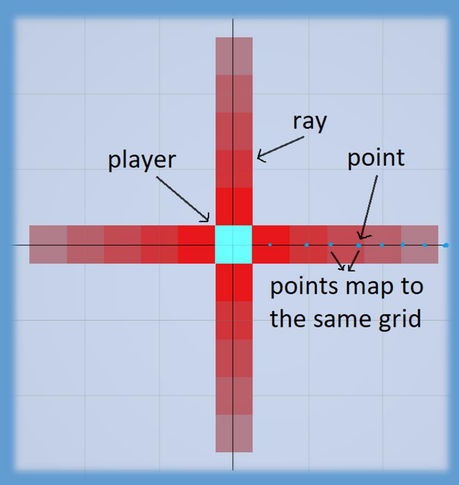
In some modern video games, players only rely on visual confirmations or use simple representation for the sound propagation, such as a circle area with a certain radius around the character.

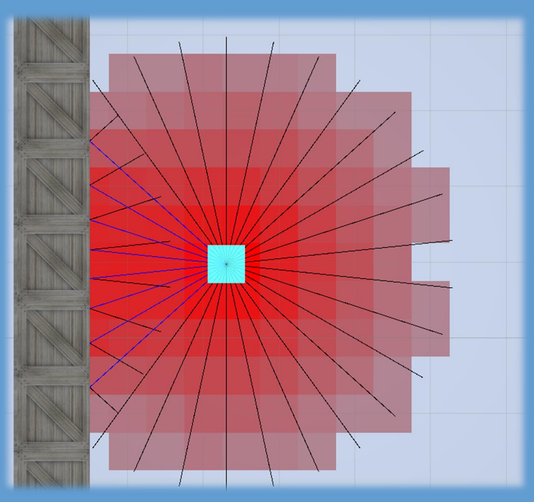
We want to design a sound system that:

- Propagate the sound accurately
- Has relatively cheap and fast computation
- Provide a way to identify source location by sound

Approach

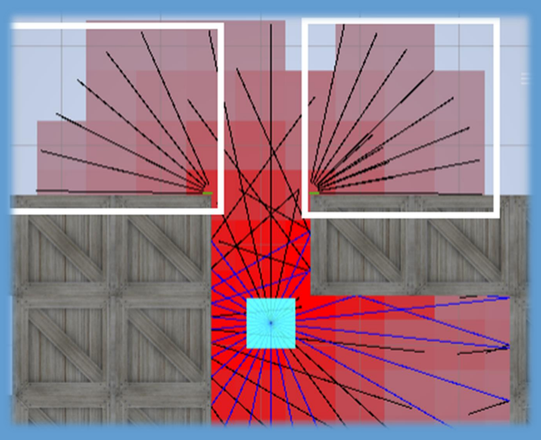
- Ray-cast based model
- Each ray is divided into several points that can be mapped onto the grid based on coordinates.
- Further the point is to the source, less intensity it has

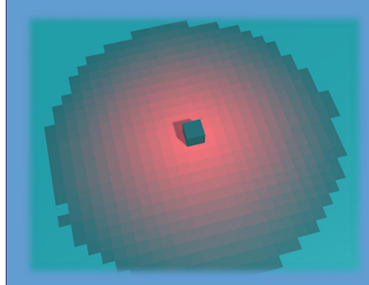




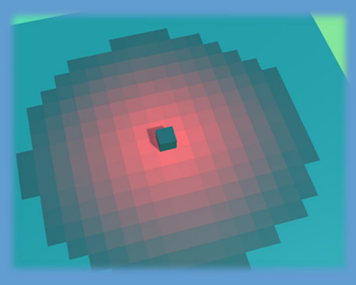
- If a ray hit a surface that belongs to the environment, it will be reflected.
- Reflected sound rays may cause constructive effect with other coming rays.
- Final resolution of sound intensity is stored back to the grid map, reflected by color.

- Diffraction occurs when any ray passes a **Diffraction point** located at the corner of an obstacle
- It takes the incident ray direction, using dot product with the edge vector to determine where rays will go





Scale at 1 of unit length

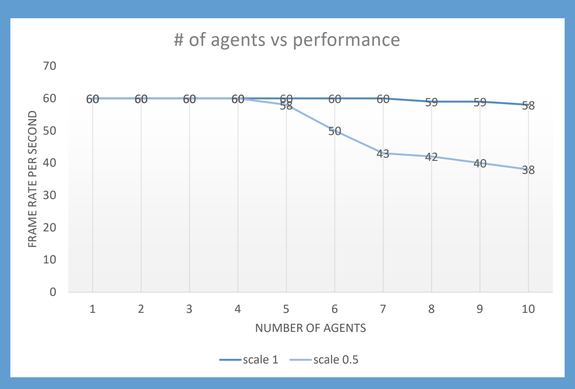


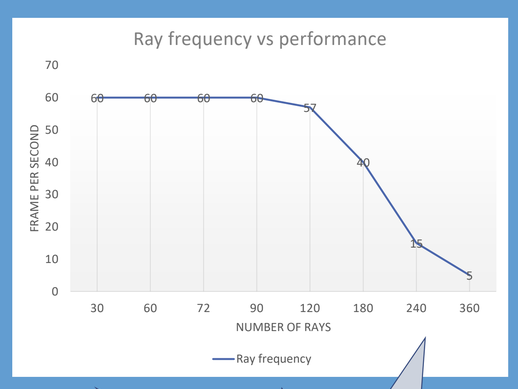
Scale at 0.5 of unit length

- Scale defines the size of each grid
- Smaller **scale** can hold more different intensity which leads more accurate propagation

Analysis

Under of the same complexity of environment, we measured the performance by changing **ray frequency** and **scale resolution at different number of agents**.

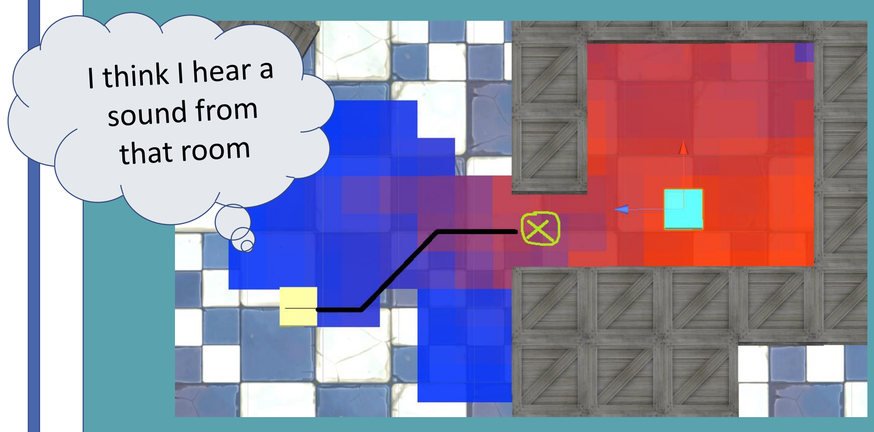




With smaller grids scale, FPS drops quickly with agents more than 5 in the scene

90 rays per agent seems like a good option

Even if someone hears it, can he find it?



With all the sound info stored in a grid map covering the level, character can identify the approximate location of the source.

It does not behave perfectly as sometimes a human being can only sense a general direction of where the sound comes from

Conclusion

- Sound propagation can be modelled accurately and efficiently at a “sweet spot” of parameter configuration
- Outside the screen, player can receive a better perception of how sound travels, predicting and identifying the sound.

Future Work

- Integrated into 3D space using Beam-tracing approach
- Visual rasterization and color interpolation
- Automated diffraction point population
- Sound validation with actual audio effect

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