Spatial Audio Designer
Nicholas F. Polys, Noam Bendelac

Big Props to Sarah Jane Lynch and Bob Monroe

Web3D 2022
Target Users

- Digital music creators
- Digital audiovisual 3D artists
- Physical audiovisual installation artists who wish to develop ideas in a virtual space
  - Inspired by the student’s experience working with installation artists on a piece with limited time in a physical space
User Interviews and Requirements

Interviews with professors and practitioners in audio design provided requirements for the application

- Users can control movement of their virtual camera in the 3D space
- Users can hear the spatialized audio change due to their position in real-time
- Users can translate, rotate, and change the shape of the spatial sound field of sound sources
- The application should make it easy for non-technical artists to learn the tool and share their results
Web Audio API

- **PannerNode** (sound source)
  - Position
  - Orientation
  - Attenuation distance factor
  - Directionality (angles)
  - Outer angle gain

- **AudioListener** (microphone)
Web Audio API

距离系数：
$$distanceCoeff = \frac{refDist}{refDist + rolloffFactor \cdot (\max(r, refDist) - refDist)}$$

角度系数：
$$angularCoeff = \text{mix}(1.0, coneOuterGain, \text{clamp}(\text{lerp}(innerAngle, outerAngle, \theta), 0.0, 1.0))$$
Design Challenges

● Parameter manipulation
  ○ Position, orientation
  ○ "Sound field":
    ■ Inner and outer angle
    ■ Attenuation distance factor

● Situated 3D handles

● vs. 2D sliders
Design Challenges

● Visualization of audio
  ○ Sound source’s reach in space
  ○ Sound levels and mixing combinations

● Transparent cones
  ○ Show boundaries well, but don’t show sound combinations well

● Heatmap
  ○ Sources are color coded, brightness shows loudness
  ○ Shows relative loudness and sound mixing well
  ○ Impedes seeing the actual scene
Implementation Challenges

Learning curves

- Three.js
  - Shaders
  - 6DOF manipulators
- Web Audio
- React
- Typescript