



ZIRENE® 3D

Positional Audio

OVERVIEW

ZIRENE® 3D by AM3D provides 3D audio by positioning and separating an unlimited number of dynamic sound sources to create a true and natural 3D sound universe. The solution is purely software-based and is easily integrated into existing software platforms.

Audio content is usually mono, stereo or surround and played back on headphones or loudspeakers. This means that the sound experience is limited by the way content is generated and how it is played back. Furthermore, the sound experience is restricted to a horizontal plane since it can only be heard in the physical units or perceived in the area between them.

ZIRENE® 3D overcomes these limitations and takes the sound experience into a new dimension. By synthesizing the two signals to the ears that would have been present if the listener had been present in the synthesized environment, a natural 3D audio environment is encoded into the two-channel-signal. With ZIRENE® 3D the playback system is only used to reproduce the synthesized signals in each ear. This means that a multiple loudspeaker setup is not needed and as a result, dynamic sound events can be synthesized in any acoustic environment to create a true real-life sound experience.

The highly sophisticated software engine of ZIRENE® 3D creates binaural synthesis using head-related transfer functions (HRTF). It is based on AM3D's research and patented technology, and generates an unsurpassed 3D audio quality.

The engine is capable of rendering 3D audio with multiple sound sources on resource constrained devices. It produces natural 3D audio with smooth and artefact free transitions of dynamic sources - even at fast movements. Static sources can be spatially separated to make the human brain able to distinguish them. To synthesize different acoustic environments a high-quality reverberation is used. ZIRENE® 3D produces a dynamic and true life experience with impressive spaciousness – this takes the overall experience to a new level.

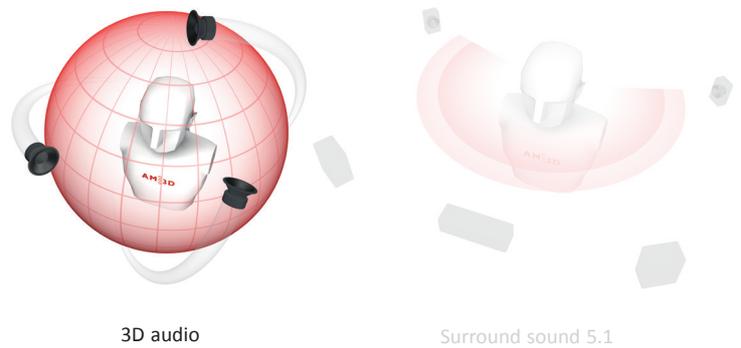
ZIRENE® 3D is generic and configurable. The software does not depend on any external libraries, and is developed in ANSI C using optimized code for the resource intense parts that are targeted at various platforms.

ABOUT AM3D

AM3D provides world-class audio technology. The company delivers software solutions for the consumer electronics industry such as smartphones, tablets, TVs, Bluetooth devices and automotive systems. AM3D holds several patents on audio enhancement and 3D audio technologies.

3D AUDIO VS. SURROUND SOUND

3D audio includes dynamic source and listener positions, real time dynamic rendering and reverberation generating ambient environment, whereas surround sound only operates with static sources.



ZIRENE® 3D

ZIRENE® 3D includes:

- **Sources and listener:** The location and orientation is set for all sources and the listener. For each sound source the directivity and distance attenuation can be specified, and play controls are available.
- **Effects:** Reverberation for room simulation, and Virtualizer for music enhancement. Obstruction, occlusion, doppler, pitch and chorus for realistic gaming.
- **Playback:** Support for playback through headphones and narrow-spaced stereo loudspeakers.

Please find more details on the other side of this hand-out.

AM3D has offices in Denmark, Japan and South Korea. AM3D A/S was established in 1997 as a commercial offspring of research activities at Aalborg University in Denmark and is owned by Dynaudio, which is part of GoerTek Inc.

ZIRENE[®] 3D IN DETAIL

PROCESSING OVERVIEW

The processing flow of the 3D audio engine is depicted in the figure below. Upper path is the 3D sound sources, while the lower path is music and other stereo content. Both paths are blended with the reverb and processed for playback.

SOURCES AND LISTENER

Sources cover sound sources that can be active (playing) in the 3D audio space. Multiple sources can be defined and processed simultaneously even with different input sample rates.

Location The location of each 3D sound source and the listener can be specified in Cartesian and Spherical coordinates. It works with four different coordinate system conventions for easy integration. Location is set relative or as world absolute coordinates. Relative defines the 3D sound source location changed relative to the listener location and orientation, while absolute defines a location in relation to a fixed listener location and orientation.

Orientation The listener and 3D sound sources orientation are a rotation from their default orientation by three coordinate axes being tilt, elevation and azimuth. The orientation is controlled using Euler angles or an orientation vector.

Distance Attenuation Each 3D sound source level can be attenuated with its distance to the listener. Different attenuation models are supported within a minimum and maximum distance. A roll-off factor determines the source attenuation. An optional mute at max functionality causes the 3D sound source to be muted when the maximum distance is reached.

Directivity An individual directivity pattern can be applied to each 3D sound source. It is controlled by a sound cone, radiating outwards from the sound source location. When the listener is inside the cone, the full sound source level is perceived and while outside the sound is attenuated. A transition zone can be specified in which the level is interpolated between two levels specified for an inner and outer cone.

Playback Controls Start, stop, pause and volume controls are available for each sound source.

PLAYBACK

The output of the 3D audio engine is a two-channel binaural signal. To obtain the 3D audio effect, the left and right binaural signal parts must be reproduced in the left and right ear, respectively. Playback is available using headphones or narrow-spaced stereo loudspeakers. The latter uses cross-talk cancellation.

EFFECTS

Effects cover features that create a natural and 3D realistic sound environment.

Reverb For truthful 3D audio reproduction, an environmental reverb is an essential element. Therefore, a high-quality reverberation for simulation of various environments is supported. It replicates the listener being in a given listening environment e.g. small/large room or hall, which creates a compelling feeling of spaciousness. The environments are defined as pre-sets, which are selectable and tuneable using reverberation time and reverberation level.

Pitch Each sound source can be pitched individually, facilitating interesting dynamic effects such as changing the pitch of a car engine sound during acceleration.

Doppler It implements the Doppler effect from the physical world, simulating pitch change according to listener and 3D sound source velocities in air. This is important within scenarios for simulating cars driving by, bullets flying by etc.

Obstruction and Occlusion Physical objects and structures like walls may block the sound path between the 3D sound source and the listener. Obstruction and occlusion blocking methods are supported. The obstruction method muffles only the direct sound, while the occlusion method also muffles the reverberation. Occlusion occurs when e.g. the sound source is outside the room of the listener. Different obstruction materials can be simulated by adjusting a parameter set (level and cut-off frequency).

Chorus The chorus effect simulates a choir with multiple voices singing in unison, producing a richer sound. The effect is fundamentally a slowly modulated short-time delay, giving a small variation in pitch which, when mixed with the direct sound, enables the effect. The effect can be controlled by selecting a pre-set or by individually controlling its parameters. The settings can range from gentle, musical chorusing, to extreme special effects, flanger, etc.

Virtualiser The Virtualiser effect widens stereo sound sources like background music. For normal headphone playback the sound is often perceived as in the head, however the effect provides an "out of head" sound experience. For narrow-spaced stereo loudspeaker playback, the sound will be perceived as extending beyond the physical device.

