EXPLORING IMMERSIVE IMPACT THROUGH VERTICAL AND HORIZONTAL SOUND DESIGN IN HYBRID ORCHESTRAL COMPOSITION

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ABSTRACT

Immersive audio is an aspect of music production enabling sound to be positioned around a person, creating a more engaging listener experience. The increased accessibility to immersive audio technology has created a new paradigm for composers, delivering a new tool set of creative possibilities.

Creating immersive audio content requires a broad skillset encompassing technical sound production skills, an understanding of the implications and affordances on the compositional process, and the impact of immersive sound on the listener. Without an understanding of these areas, composers are not empowered to effectively engage with immersive audio early in the compositional process, rather placing an increased reliance on later production processes to position musical material in the audio environment.

This paper explores how knowledge of immersive audio can inform and influence music composition. It reports on a new creative work Immersio Overture, which applies immersive techniques in the context of hybrid orchestral music - combining traditional and electronic instruments such as synthesisers, guitars, and

percussion ensembles. Through a practice-based approach, the study addresses the question: How effectively can selected immersive audio techniques be applied to hybrid orchestral music through composition?

This project investigates the positioning of musical instruments on the vertical and horizontal axis, the use of room sounds and spatial placement, and the roles of additional supporting elements, in order to examine how these factors create sonic experiences distinct from stereo. It also reflects on the emotional impact that such techniques may invoke in listeners. Immersio Overture demonstrates, through the panning of instruments such as drums, how perspectives can be shifted, locations re-imagined, and ambiences or reverbs juxtaposed to shape perceptions of size, space, and ensemble configuration. The work also considers the technical and creative ramifications of distributing layers along the height axis,along the height axis, thereby providing greater clarity and divergence between instruments without creating an audible distraction.

The findings highlight the efficacy of several immersive audio characteristics that can enhance musical composition and provide additional expressive impact.

Link to creative work, Immersio Overture (2:22): https://www.dropbox.com/scl/fo/33ba8ay1hgcnsyh6w8pog/AB8AGAHZn1grSfbVTgFz 2I?rlkey=dnrofrpu3rktu2233n31vetk8&st=yn9tptoa&dl=0

1 INTRODUCTION

Music that uses immersive audio is produced using audio systems in which speakers are positioned around the listener in multiple layers. As these technologies become increasingly accessible, the field is attracting scholarly and industry attention, enabling innovative production techniques that can create unique experiences specific to the format.

This project explores immersive impact through vertical and horizontal sound design in hybrid orchestral composition. Hybrid orchestral music uses traditional orchestral instruments combined with electronic instruments such as synthesisers, guitars, non-rhythmic or non-tonal instruments and a variety of percussion ensembles. We explore production and composition approaches that are particularly relevant to immersive audio through a composition titled Immersio Overture. This research aims to address the question: How effectively can selected immersive impact techniques be applied to hybrid orchestral music through composition? The discussed music composition is available in multiple formats, including stereo, binaural and surround sound, plus immersive sound formats Dolby Atmos ADM and ambiX. It is recommended that a 7.1.4 listening environment is used to enable the full experience of the discussed techniques and concepts.

2 COMPOSITIONAL TECHNIQUES

This study focuses on four areas as applicable to the creative work: immersive impact, vertical axis separation, non-distractive height energy and microphone distance panning.

This approach facilitates an understanding of how these techniques are creatively applied and considers the roles the techniques play in creating immersive music from its foundation.

2.1 IMMERSIVE IMPACT

The immersive impact (the sudden shift of instruments positioning, as well as their volume, role or timbre to create the impression of sounds suddenly appearing around the listener) can be achieved with both instrumental and non-instrumental sources. In titled Immersio Overture, at 00:48, footsteps are automated across channels, moving around the listener to create a vivid sense of space. These footsteps act as a transitional cue, signalling a forthcoming change and the introduction of new musical elements and locations. The height speakers located above the listener, deliver the sound of rainfall, creating a sonic presence in the elevated space. To reinforce this spatial impression, a room reverb was added, giving the listener a perspective of size, location and room materials. At 00:57, a full drum circle commences, placing the listener at the centre of the performers. Each of the ear-level speakers features a direct percussion instrument across the horizontal plane, while the height speakers produce room and reverb sounds.

This immersive impact may be understood as an extension of the "drop" – an effect in electronic music whereby "following a build-up and often a break, there is a sudden rhythmic, timbral, and/or harmonic change that provides a moment of heightened energy and engagement" (Snoman, 2014). Here, the drop is spatialised: a sudden and dramatic shift occurs not only in tone but in the distribution

of sounds around and above the listener. Høier (2020) similarly observes that “the dynamic panning of sounds – especially sound effects – can further heighten the 'sonic velocity'” and present desirable qualities, highlighting how surround channels and immersive audio tools extend the possibilities of spatial manipulation.

The transition from automated footsteps with height-channel rain to the static panning of percussion around the ear-level plane creates a striking contrast. This shift delivers both a tonal change, from the calm ambience of environmental sounds to the energetic texture of percussion, and a physical reorientation, as instruments now surround the listener on all sides. These elements combine to reshape the perceived size and acoustics of the listening space in ways that stereo formats cannot achieve. As Nosenko (2024) describes, “spatial placement of musical elements and acoustic modelling serve to increase or decrease the apparent size and distance to performers and sounds”, demonstrating the creative and expressive potential of immersive tools.

Comparable strategies have recently appeared in film soundtracks. For example, Hans Zimmer’s *F1* (2025) places a bass synthesiser more prominently in the side channels than in the front, creating a subtle sense of wraparound immersion. Immersio Overture develops this technique further, intentionally distributing percussion across the side and rear speakers. Whereas F1 employs immersive mixing to simulate a singular, enclosed performance environment, Immersio Overture transforms the listener's spatial perspective throughout the piece, continually altering the perceived position, room, and ensemble in motion.

2.2 VERTICAL AXIS SEPARATION

Creating an effect without conveying aural distraction is an important consideration. Part of the mixing is “to blend the auditory environment of a show so that listeners can accurately process the location of sounds without distraction or confusion" (Keyes, 2021). Within *Immersio Overture*, sounds with important or lead roles are positioned closer to the front of the mix, unless used in a supporting or effect-based role. Alternatively, positioning sounds left/right and forward/back allows for more dramatic effects. As Ziemer (2019) describes, “music lives and unfolds its effects with the room in which it resounds”, showing the philosophy of the space in a spatial environment primarily containing the “room” replacements and “effects” within. The positioning of sounds at 00:57 combines percussion instruments placed at ear level around the listener with lead brass and synthesiser parts playing in the height channels above. As shown in Figure 1, important harmonic and melodic elements are placed towards the front of the space, whereas supporting roles are placed further back.

Although distinct sonic layers are separated, this technique is not distracting; rather, it provides a powerful, creative, and technically coherent approach. By distributing instruments along the vertical plane according to their roles, it achieves clarity that, in conventional stereo or surround mixing, would require frequency or dynamic separation. This approach allows different layers to remain perceptually distinct without displacing the listener’s focal attention. At the same time, it creates an additional creative opportunity: immersion is deepened by affording sonic agency

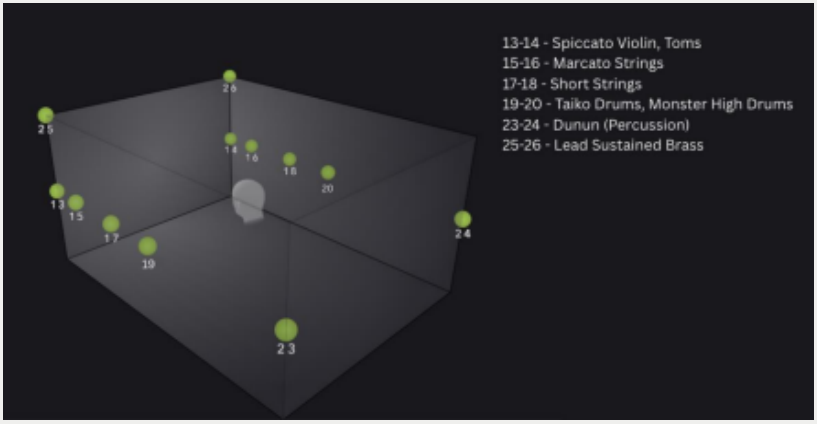

FIGURE 1. A VISUAL DIAGRAM OF THE CLIMAX AT 00:57 SHOWING THE PLACEMENT OF INSTRUMENTS WITHIN THE IMMERSIVE ENVIRONMENT

At the same time, it creates an additional creative opportunity: immersion is deepened by affording sonic agency across multiple horizontal positions, enriched by vertical differentiation. When the goal is to adjust density or to carve out ample space in the music without drawing focus away from key elements, vertical separation offers both technical and aesthetic advantages. Ziemer (2019) reflects on this in saying “Immersive audio compositions may use spatial sound to create the perception of expanding or contracting spaces, which can support narrative, emotional, or structural development within the piece". By providing controlled access to vertically panned sources, this technique enhances the detail of sonic positioning and opens a new dimension for composition. This is achieved not only through room recreation and emulation, but also by precisely affecting the direct sounds, thereby avoiding distractions for listeners.

2.3 NON-DISTRACTING HEIGHT ENERGY

At the beginning of the climax, at 00:57, harmonic instruments such as short and marcato strings, together with supporting synthesisers, are placed between the front and side planes at ear level. This placement is crucial for maintaining the listener's focus, as important and foundational elements remain directed towards the audience.

At 1:24, new harmonic material in the form of continuous semiquaver figures drives propulsion and builds texture across the immersive plane. These elements are placed in the height speakers to prevent distraction from the primary activity in the front left and right channels. Their presence enhances immersion by expanding the sonic field above and around the listener. A central pulse initially occupies the height plane before diverging into two distinct sounds that animate the front and rear height zones. Figure 2 details the placement of instruments during the climax and demonstrates how spatial separation of roles creates clarity. At the conclusion of this section, each sound is automated into a separate corner of the height field, resulting in four separate textures articulating the same part simultaneously. This technique contrasts with the percussion, which remains anchored in the lowest horizontal plane. As these sounds are based on short-attack synthesizers, they were used to fill the space with non-distracting elements rather than to increase the density of texture.

In the piece Can You Hear the Music (Göransson, 2023), rhythmic synthesisers develop suspense and motion. These sounds are placed primarily at the front of the immersive playback system, although the sides, rears, and

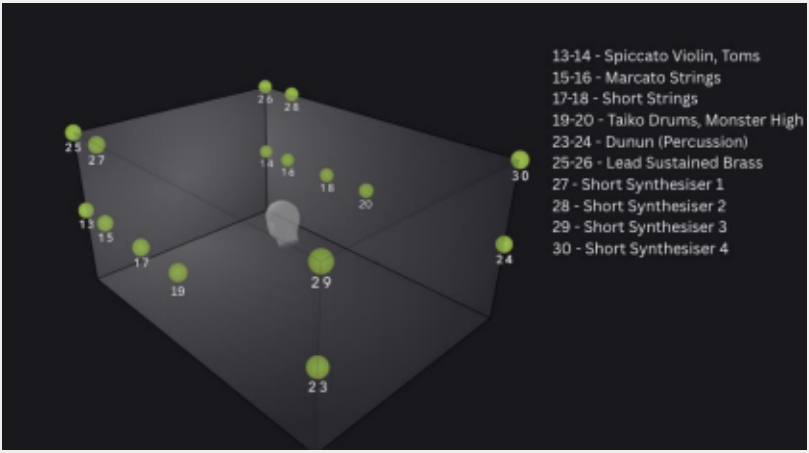

FIGURE 2. A VISUAL DIAGRAM OF THE CLIMAX FROM 1:24, SHOWING THE PLACEMENTS OF SYNTHESISERS

height channels also feature some of these elements. In Immersio Overture, this technique is extended by clearly defining instrumental parts and roles within the immersive system. The synthesisers are placed in the height channels to enhance clarity and avoid overlap with other elements. With subtle volume balancing, these sounds do not distract the listener but contribute additional energy. The purpose of this technique is to immerse the listener in new textures while providing non-intrusive rhythmic energy, adding depth without compromising focus.

Baxter (2022) observes that height channels "clearly contribute to the desired effect of total immersion". Immersio Overture enables this immersion and further develops the textural variation by placing four different in the height channels to occupy specific corners of the system. As Baxter also notes, "irrelevant and distracting sounds are not typically elements of an effective sound design" (2022), an issue avoided in this case through the careful deployment

of synthesiser timbres. Sounds with short attack times serve rhythmic functions; although more sustained than typical percussion, they provide both rhythmic and harmonic material. This enables individual parts and roles to remain clearly articulated, guiding the listener's attention toward the lead instruments.

2.4 MICROPHONE DISTANCE PANNING

In the final bars of *Immersio Overture*, at 01:50, a solo piano is heard. This part was deliberately shaped to emulate the impression of a distant piano, positioning the listener behind the performer. To achieve this effect, the Hans Zimmer Piano sample library from Spitfire Audio was used, which offers a range of microphone positions. Outriggers and surround microphones were selected to create a distant microphone signal and convey the impression that the audience's perspective was further away from the performers. Both signals were placed in the front left and right speakers and combined with additional reverberation routed to the surrounds and rear channels.

The reverb plugin Berlin Studio Professional was chosen for its flexible signal placement and the capacity to simulate traditional orchestral microphone arrays. In this configuration, the AB microphone signals were positioned to the sides, while the Surround signal was placed behind the listener, enhancing the impression of physical space and extending the distance from the piano sound. Figure 3 shows the microphone positions in Berlin Studio Professional relative to the piano, as well as available options such as the Decca tree, which was not employed in this project. The A-B

pair and surround microphones offered greater perceived distance than the Decca tree, aligning with the compositional aim of making the piano sound as remote as possible.

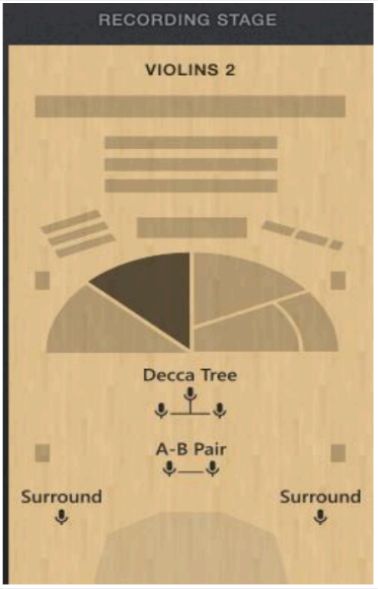

FIGURE 3. SCREENSHOT OF THE BERLIN STUDIO PROFESSIONAL PLUGIN BY SAMPLICITY, DISPLAYING A DIAGRAM OF A-B PAIR AND SURROUND SOUND MICROPHONE CONFIGURATIONS

The use of panning microphone signals has long been central to multi-channel formats such as 5.1 and 7.1.4. Haigh, Dunkerley, and Rogers (2020) describe how "left and right outriggers brought around the sides to a position about 30% of the way towards the rear speakers", illustrating one approach to distributing microphone signals in surround contexts. *Immersio Overture* builds on this tradition by experimenting with more extreme placements: for example, the piano's outriggers and surround microphones were panned to the front and then processed with convolution

reverb to create a heightened sense of space.

These practices can be understood in relation to other immersive audio research. The project Exploring the Cinematic Hemisphere for Orchestra (ECHO) (Lindberg et al., 2025) demonstrates a range of microphone capture strategies specifically designed for immersive playback and panning. Lindberg's 2L Prism (2025), for instance, employs seven microphones at ear height and four height microphones, each spaced 100 cm apart, with the plan to route each signal to a corresponding speaker in a seven-channel ear-height array. In contrast, Willsher's P3H Anamorphic array pans the furthest signal back only 50%, limiting the use of the rear channels.

By comparison, Immersio Overture adopts a more expansive approach: reverb signals were placed across both the side and rear channels, drawing inspiration from projects such as 2L Prism while diverging from more conservative strategies like the P3H Anamorphic array. This decision was guided by the compositional objective of maximising the available speaker field to create a strong sense of space, distance, and clarity, while offering the listener as much unique spatial information as possible.

3 DISCUSSION

Research into immersive audio has frequently focused on the characteristics of acoustic spaces and the recreation of room environments, particularly in relation to how spatial design influences the listener's perception of immersion. For example, Ohgi, Miyazaki, Kim and Uhm examined Yamaha's REV system, which utilised 53 speakers to alter

the "primary auditory characteristics of room acoustics" (Hiromu et al., 2023) in a performance space. Their study explored both the diffusion of sound through loudspeakers and the use of multiple microphone arrays. Four microphones were positioned close to each instrument of a string quartet (the In-line method), while twelve additional microphones were placed above the stage and in the audience area. This configuration enabled real-time manipulation of reverberation and sound-image control, allowing the acoustic environment to be adapted according to the demands of the performance.

Malyshev (2018) proposed a different perspective, recording full-band performances for 360-degree audiovisual presentation. His approach emphasised the importance of reproducing live environments, including their reflective properties: "We are reproducing a live environment that consists of reflections. Thus, it is important to recreate the room and its behaviour". The goal was to provide listeners with a stronger sense of presence within the VR environment through multichannel recording techniques, though the focus remained on accurate acoustic reproduction rather than extending or creatively manipulating the captured space.

Beyond these strategies of simulating realistic performance spaces, contemporary immersive loudspeaker systems also open possibilities for novel compositional and production approaches. In particular, the relationship between vertical and horizontal panning of direct instruments offers music producers new possibilities for shaping emotional impact and supporting the expressive goals of a composition, approaches that move beyond acoustic replication into explicitly creative spatial design.

Research on feature film music in 5.1 format shares common elements with hybrid orchestral practices. Holman (2002) distinguishes between a direct/ambient approach, where sounds "come from the front, and the surrounds are used for ambience", and complete surround, which is "akin to placing the listener on stage or inside the world of the film". While both approaches remain influential, they are primarily concerned with realism and cinematic convention. They do not typically account for hybrid or non-realistic strategies. In Immersio Overture, spatial placements are deliberately shifted: at times emulating a concert-like stage arrangement, and at others adopting more imaginative configurations, such as during the climax. These strategies suggest that immersive audio can move fluidly between representational and non representational modes, offering aesthetic possibilities that extend beyond filmic precedent.

Direct sound placement not only expands creative options but also delivers technical advantages. The techniques developed for Immersio Overture highlight how immersive audio can produce a clearer soundstage, increased dynamic variation, and improved frequency and dynamic separation, benefits less readily available in stereo. Rumsey (2016) notes that "upmixing two channel content for surround and immersive reproduction formats is therefore an attractive proposition if it can be made to deliver a convincing

experience", expressing a desire for improved experiences for the listener. Our work addresses this by positioning the listener within a drummer's circle, while assigning lead instruments to the height channels and situating an aggressive, sawtooth wave synthesiser at the centre of the listening space. This spatial arrangement generates horizontal variety while simultaneously maintaining vertical separation. In this sense, Immersio Overture demonstrates how immersive tools can be used not only to enhance realism, but to articulate musical structure in ways that stereo or conventional surround cannot.

Although research into height channel usage remains limited, some insights point to their creative potential. Baxter (2022) argues that "height speakers give greater resolution and creative possibilities in audio reproduction", while Keränen and Hongisto (2010) emphasise the practical advantages of "allocating sounds like ambience, reverbs, or certain instrument stems [e.g., strings or synths] to the height channels, so composers and engineers can avoid overcrowding the horizontal plane". Immersio Overture takes these perspectives further by using height channels not only for ambience or spill, but for clearly defined instrumental roles. This approach illustrates how the vertical dimension can be treated as an active compositional resource rather than a supplementary extension of the horizontal plane. In doing so, it contributes to ongoing discussions about how immersive audio may evolve from reproducing space to actively shaping musical experience.

4 CONCLUSION

Immersio Overture demonstrates how horizontal and

vertical placements of direct sounds, when combined with distant microphone positioning and reverberation, can be used to construct spatial depth and shape musical perspectives. These techniques provide creative and technical benefits, such as enhanced layer separation and reduced reliance on intensive dynamic or frequency-based processing. Direct panning of instruments within the sound field allowed the composition to evoke the impression of a reconfigured ensemble in physical space. Additional strategies, including room reverb variation and the deployment of height channels, contributed to a more immersive environment than stereo, while horizontal distribution of contrasting elements facilitated clarity and prevented masking.

In response to the guiding question, "How effectively can selected immersive audio techniques be applied to hybrid orchestral music through composition?", the four techniques considered (immersive impact, vertical axis separation, non-distractive height energy and microphone distance panning) each proved effective in ways that cannot be replicated in a 2.0 (stereo) environment. For instance, panning elements on the horizontal axis provided shifts in perspective, height placement enabled separation of parts and clear emphasis of lead elements; and microphone distance panning expanded the sense of depth. Collectively, these methods contributed to enhanced clarity, spatial interest, and new textural possibilities without introducing distraction.

It should be noted that many immersive works in hybrid orchestral genres, particularly those developed for streaming, tend to adopt film music conventions, prioritising room capture and realism over experimental spatial design. By contrast, Immersio Overture emphasised the

compositional applications of immersive audio, moving beyond the replication of real-world acoustics towards creative manipulation of direct sounds. While a grounding sense of place was retained, the focus remained on exploring the potential of immersive audio as a compositional and production tool in its own right.

REFERENCES

Baxter, D. (2022). “Immersive Sound Production”. CRC Press. Available at: https://www.taylorfrancis.com/books/edit/10.4324/9781003052876/immersive-sound production-dennis-baxter [Accessed 25 Jul. 2025].

Bernschütz, B. (2016). “Microphone Arrays and Sound Field Decomposition for Dynamic Binaural Recording” (Doctoral dissertation, Technische Universität Berlin).

Brian, F.G.K., Poirier-Quinot, D. and Lyzwa, J.-M. (2021). La Vierge 2020: “Reconstructing a Virtual Concert Performance Through Historic Auralisation of Notre-Dame Cathedral”. IEEE Xplore.

Cunningham, S. (2018). “Proceedings of the Audio Mostly 2018 on Sound in Immersion and Emotion”. Audio Mostly.

Göransson, L. (2023). “Can You Hear the Music”. [Streaming] Apple Music. Haigh, C., Dunkerley, J. and Rogers, M. (2020). “Classical Recording”. CRC Press.

Hiromu, O., Hideo, M., Sungyoung, K. and Sihyun, U. (2023). “Transcending boundaries: Unleashing Musical Expression through Immersive Sound Image and Reverberation Control System”. [online] Journal of the Audio Engineering Society, pp.134–141. Available at: https://aes2.org/publications/elibrary-page/?id=22288 [Accessed 5 Sep. 2025].

Høier, S. (2020). “Surrounded by Ear Candy?” Nordicom Review, 35(s1), p.251–262.

Holman, T. (2002). “Sound for Film and Television”. [online] Boston: Focal Pr. Available at: https://www-taylorfrancis-com.ezproxy.newcastle.edu.au/reader/download/9bd7b10e829f-4bd2-9b0d-8e261801ece2/book/pdf?context=ubx [Accessed 7 Aug. 2025].

Keränen, J. and Hongisto, V. (2010). “Comparison of Simple Room Acoustic Models Used for Industrial Spaces”. Acta Acustica united with Acustica, 96(1), p.179–194.

Keyes, K. (2021). “Using Localization Cues in Immersive Mixing”. [Online] SoundGirls.org. Available at: https://soundgirls.org/using-localization-cues-in-immersive-mixing/ [Accessed 14 Apr. 2025].

Lee, H. (2019). “Psychoacoustics of 3D Sound Recording and Reproduction”. Zenodo, p.538– 551.

Lindberg, M., Wollage, N., Willsher, M., Lee, H., Ratcliff, S., Caruso, A. and Boynton, K. (2025). “ECHO Project”. [online] APL. Available at: https://apl-hud.com/echo/ [Accessed 27 Aug. 2025].

Malyshev, M. (2018). “Sound Production for 360 Videos in a Live Music Performance Case Study” . [Thesis] Available at: https://www.theseus.fi/handle/10024/150460 [Accessed 5 Sep. 2025].

Nosenko, O. (2024). “Immersive technologies in the Formation of Musical Audio Space”. Collection of scientific works ‘Notes on Art Criticism’, 24(1), p.23–32.

Rumsey, F. (2016). “Immersive Audio: Objects, Mixing, and Rendering”. Journal of the Audio Engineering Society, 64(7/8), p.584–588.

Snoman, R. (2014). “The Dance Music Manual: Tools, Toys, and Techniques”. New York, NY; London Focal Press.

Ziemer, T. (2019). “Psychoacoustic Music Sound Field Synthesis”. Springer. Zimmer, H. (2025). “F1”. [Streaming] Apple Music.