INTERNATIONAL JOURNAL OF CREATIVE MEDIA RESEARCH

Vol.11, April 2025

# *josef*: Spatiality as a Material Property of Audiovisual

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## Abstract

josef is an audiovisual performance piece composed specifically for an immersive surround sound environment. Throughout every stage of its creative development, spatiality was one of the principal materials used to shape this work's overall form and structure. As a result, spatiality came to encompass this work's sonic and visual composition, performative enaction, and its eventual studio production and release. Thematically, this work was largely influenced by Josef Albers' Interaction of Color, which contains a collection of ideas demonstrating that spatiality can be conveyed using colour. Sonically, we portrayed this visual notion using additive synthesis coupled with a chromatic spatialisation technique. In keeping with Albers' ideas surrounding colour interaction - his emphasis upon the way in which one's perceptive capabilities alter their experience of an artwork - this work utilises spatiality as a means of curating diverse and nuanced experiences, sympathetic to their environments and unique to their spectators.

Soundcloud links:
https://soundcloud.com/lewiswolstanholme/julia-set-josef?si=e90bafe3055b4c9280d7abc53db66daf&utm_source=clipboard&utm_medium=text&utm_campaign=social_sharing

Supplementary links to performances of 'Josef':
Iklectik 23/04/2022 https://soundcloud.com/lewiswolstanholme/julia-set-josef-live-at-iklectik-art-lab/s-jk7YuIJCvoH
EIS 16/06/2022 https://soundcloud.com/lewiswolstanholme/julia-set-josef-live-at-everyday-is-spatial/s-dvZZBYE2lTd

***josef* is an** audiovisual performance piece which primarily explores spatiality as a compositional material. Conceptually, we wanted to create a work that imbued a notion of spatiality within its sonic and visual content - a notion which is further emphasised through immersive multimedia performance. These formal ideas aimed to showcase spatiality through numerous interrelated means. Sonically, spatiality was explored through

a chromatic approach towards spatial audio, which has here been engendered through a complimentary use of additive synthesis. And visually, this work was influenced by, and named after, the works of Josef Albers (1972), who describes spatiality as a visual property which emerges from the interaction of colours. The result of these approaches is a work which both embodies its performative environment, and creates a unique perceptual reflection of spatiality for its spectators.

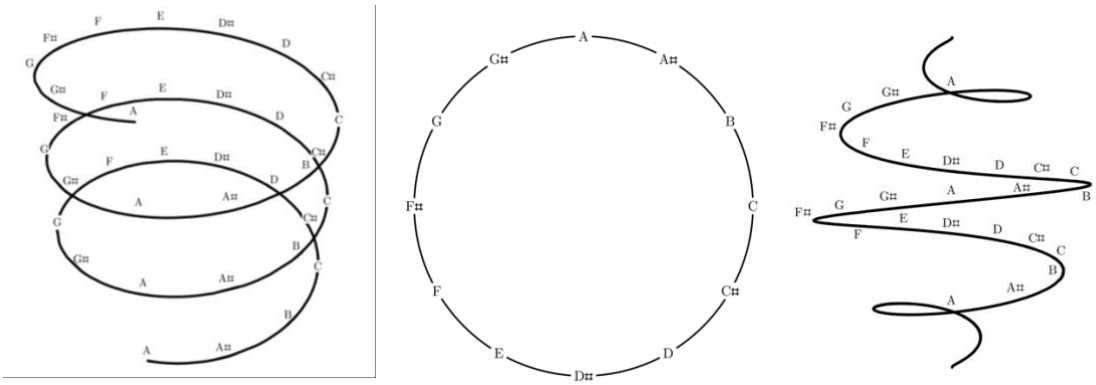
**Sound in Space**

When conceiving of spatiality as a sonic material, we focused our attention primarily on two opposing modes of listening. A sound can be heard from over there - in isolation, localised to a particular region. And a sound can be heard from everywhere, or nowhere in particular - concurrent and omnidirectional. In taking this duality as our basis, we devised a means of using additive synthesis to emphasise both of these approaches to listening within a spatial audio environment. By splitting a single sound into its component parts, its partial frequencies, and positioning each partial in a precise location within a space, it is possible to curate a sound that is perceivable as both a singularity and a plurality. The resultant sound envelops its spatial environment through its use of component positioning, and its collective timbre emerges from the interaction of these partial frequencies within the space.

We developed this methodology primarily in response to the analogous work of William Sethares (2005, pp.25–27), who similarly makes a distinction between two opposed modes of listening. He terms his former modality *analytic listening*, hearing out the particular components of a sound, and the latter *holistic listening*, hearing a corpus of sounds as a single entity. Sethares describes these two modes of listening as being available to us at all times, with each modality requiring more or less cognitive focus depending on the context of the sound and the psychoacoustic phenomenon of *tonal fusion*. Tonal fusion describes the capacity for a sound to be perceived holistically, and is influenced by numerous sonic qualities such as “attack, envelope, vibrato, harmonicity” (Sethares, 2005, p.27). These sonic qualities became our principal concern when both controlling our synthesised sonic material and structuring the performance for this work, inspiring us to use these parameters to influence our spectators’ modes of listening. When applied to a spatial environment, this parametrisation translates to a curated sound that can be intentionally morphed between a singularity, a timbral mixture of colour, and a plurality, a collection of colours scattered throughout a space.

The sonic material for this work consisted of multiple additive synthesis models, with the entire composition centering around a constant and unarticulated presentation of sound which gradually changed over time. The main body of the piece was created using physical models of circular and rectangular membrane instruments, the simulations of which dictated the synthesised partial frequencies and their modal amplitudes relative to an imaginary percussive strike location (Asmar, 2004; Bilbao, 2009; Fletcher & Rossing, 1998). Throughout the piece, these modal amplitudes were continuously altered by exploratively changing this imaginary strike location, whilst the frequency content was altered by updating the fundamental frequency of the simulated membrane. To further explore Sethares' notion of tonal fusion, we employed both tremolo and vibrato effects throughout this work to influence the perception of our additive synthesis models. These perceptual effects were most notable when we employed a sound design technique which Jensen (2002) originally termed *shimmer*. The shimmer effect can be created by applying tremolo to individual partial frequencies, and setting each instance of this tremolo effect to its own unique rate. Upon increasing the presence of this shimmer effect, it is possible to morph from a perceptibly cohesive timbre to an intermittent collection of asynchronous oscillators. Overall, the compositional nuance of these approaches, particularly relating to the use of additive synthesis, have been further discussed in some of our previous works relating to the spatialisation of timbre (Wolstanholme et al., 2023).

When putting this concept into practice, we devised a coherent system of spatialisation in reference to another psychoacoustic theory regarding *tone chroma* and *tone height* (Bachem, 1950). This theory, which aims to analyse pitch perfectness, uses the term tone chroma to describe the colour or class of a pitch, its C-ness or D-ness for example, whilst it uses the term tone height to describe the various octave transpositions of these chromas. Diana Deutsch (2010) portrays this organisation of pitch using a helical structure, which can be seen in figure 1a. We used Deutsch's helical model to determine the position of our individual partial frequencies within a space, which can be seen in figures 1b and 1c. This precise use of spatialisation builds upon one of Wolstanholme's earlier compositional explorations (2019), during which he first experimented with this chromatic approach to the spatialisation of harmonic and inharmonic sounds.



(a) Deutsch model (b) Circular projection (c) Spherical projection

Figure 1: Tone chroma & tone height

**Colour in Space**

During our early ruminations for this work, we became heavily influenced by the artist Josef Albers and his abstract visual exploration of spatiality. Throughout his work, and especially in his book *Interaction of Color* (Albers, 1972), Albers has demonstrated that when mixing bodies of colour, one can create the impression of a perceived foreground and background relationship between them.

> "[C]olors are placed above or below each other, or in front of or behind each other. They are read as here and there, as over, and beyond there, and therefore in space." (Albers, 1972, p.31)

By orchestrating colours in this way, Albers' has highlighted a means of transforming a 2-dimensional visual artwork into one that conveys both spatiality and depth to its spectators. Such a method produces a subtle illusory effect, and can be expressed in differing quantities through varying approaches to contrasting and mixing colours. An example of this abstract representation of space can be seen in figure 2.

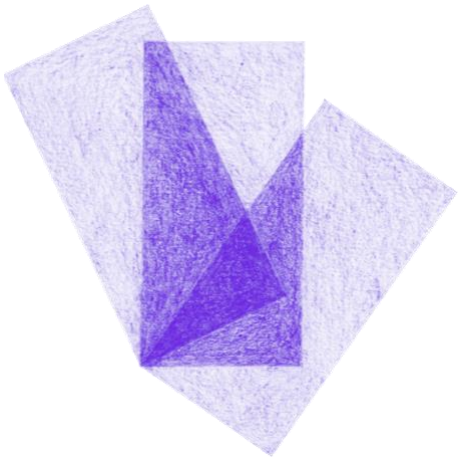


Figure 2: Josef Albers' cover image for the book *Interaction of Color*

In response to Albers' work, we composed our visual representation of space using a collection of rotating and overlapping shapes. Each shape had a distinct colour, and, upon interacting, these colours were blended together using a selection of the digital colour blending techniques described by Porter & Duff (1984). These various technical approaches towards the blending and mixing of colours allowed us to curate an additional representation of perceptive singularity and plurality. In some cases, a figure would appear as a continuity of undulating colours, whereas in other cases the distinction between each individual coloured shape was predominantly apparent.

Through further extrapolation of these themes and motifs, we came to consider our use of colour and the materiality of space as intimately linked. To exhibit this relationship, we parametrised our use of colour in relation to the tone chromas and tone heights of our sonic materials, such that each coloured shape corresponded to a specific partial frequency. Throughout audiovisual practice, many practitioners have developed numerous sophisticated mappings between sound and colour (Caivano, 1994). We felt, however, that a simple HSL representation of sound was the most suitable means for our concept, aligning hue with the position of each tone chroma, saturation with tone height and luminosity with loudness. In effect, this mapping of colour to sound curated a direct link between the visual aspect of this work and the way in which the sonic material was spatialised. As each partial frequency moved throughout the space, so too did its colour change to match its location. And similarly, as each sound changed in dynamic, its individual impact on the overall blended colour reflected this phenomenon.

**Subject in Space**

A large part of the conceptual process underpinning this work was influenced by our interpretation of the spectator's spatial perspective. In practice, many of our material incorporations of spatiality were entirely dependent upon, not only one's perceptive capability (Albers, 1972; Sethares, 2005), but also their perceptive location. The resultant intensities of both timbral and visual colours, in singularity or plurality, are an intrinsic property of any given spatial perspective. As one moves through the space, or the artwork is moved around them, so too does their perception of it differ. When presented within an immersive performance environment, these interwoven subjectivities serve as a thematic extension of this work's spatial materiality.

This immersive ideal is intrinsically sympathetic towards a given site of performance. After composing this work, we were given the opportunity to present it at two spatial audio performance spaces, and have also since released a recording of the work online. These various exhibitions each afforded their own curatorial nuances, whose effects were to either subdue or emphasise certain spatial qualities during each performance. This work was originally premiered at Iklectik Art Lab in London, which at the time housed a 13.2 speaker system arranged in a hemisphere and a large cinematic screen for the visuals. Following this, the work was presented at the University of Gloucestershire, using an 18.2 speaker system arranged in a circle and a dual monitor display for the visuals. In each setting, the audio was spatialised using vector base amplitude panning (Pulkki, 1997), as this method allowed us to discretely position each partial frequency within the space. For the second performance at the University of Gloucestershire we used the 2-dimensional spatialisation model shown in figure 1b, and for the premier performance at Iklectik Art Lab we used the 3-dimensional spatialisation model shown in figure 1c. Similarly, when the work was recorded, we also used the 3-dimensional spatialisation model, however, when it came to mastering the audio, we rendered the work in binaural using Dolby Atmos. The differences between each performative environment or playback system has, at every opportunity, defined the effectiveness of our conceptual approach towards spatialisation. For not only does an individual's perceptive location play an active role in this artwork, so too does each listening environment serve as an extension of this work's spatial material.

## Conclusion

*josef* is a work which aims to explicitly exhibit spatiality through a reflective and imitative approach to audiovisual performance. Influenced by the ideas of Josef Albers, spatiality has here been explored using a chromatic approach to sound and visuals. Building upon both a spectator's subjectivity and the performative environment itself, spatiality has been portrayed using a perceptive dialectic between singularity and plurality. At every stage during this work's creation, spatiality has served as the defining material characteristic underpinning this work's conceptualisation and formal composition.

## Acknowledgements

This work is supported by the Centre for Doctoral Training in Artificial Intelligence and Music at Queen Mary University of London, funded by UK Research and Innovation (UKRI) under EPSRC grant EP/S022694/1.

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