

## Notes on performing with spatial sound – *o ire* and the Parat+ ambisonic controller Nick Fells, 2017

### Background

This short article describes an approach to designing and controlling spatial sound as an integral feature of improvised live electronic performance.

The approach is rooted in the author's experience as a laptop performer and stems specifically from a work that has been developing since 2015, *o ire*. This is a live laptop piece where pre-recorded sound materials are subject to combined spectral and spatial manipulations in an improvised way. The work was conceived for the ambisonic surround sound loudspeaker array at the Institut für Elektronische Musik und Akustik at the Universität für Musik und darstellende Kunst, Graz (IEM), and was first performed in the OpenCUBE series there. The IEM array comprises a hemispherical arrangement of loudspeakers around the audience. A key advantage of ambisonics over discrete-channel approaches to surround sound is that material can be adequately reproduced on a range of playback systems. In the case of *o ire*, a basic horizontal quad arrangement of four loudspeakers will suffice, so long as the performer is prepared to sacrifice the height dimension in a given performance. The piece also exists in a binaural format, designed for headphone listening, and can be realised that way (e.g. for practice or demonstration). The concepts and tools underpinning the approach to space used in the piece are outlined here, with the hope that these thoughts might be of use to others interested in performing with spatial sound.

Firstly, the approach considers the listener not in isolation but as a 'listener-in-place'. In other words, of prime importance is the experience of the listener in relation to their location – to the place of performance. By the 'place of performance', I mean not just the physical room, the performance space itself, but the combination of physical-acoustic space with the sense of place generated by the performance activity itself. Tuan (1977) described place as space imbued with value. If we consider performance as activity that adds value to space, that generates 'place-ness', then a listener's sense of place is determined at least partly by the nature of the performance and its sounds.

Secondly, it assumes that in *listener* we include *performer*. In the author's case, 'listener' embraces performer/composer and audience member. We assume audience, performer, and composer are together in the same space (not just physically, but also conceptually – 'in the zone', 'all in this together'), as a listening community; a community held together, albeit temporarily, by their listening. This idea is explored a little more below. We might think of performer/composer as a 'generative listener' – a listener who generates, who produces, through their activity.

Thirdly, the approach conceptualises the subdivision and manipulation of sonic space in broad experiential terms. Its aim is not the accurate reproduction of sound-fields – rather, the apparent source or location of sounds is regarded in a non-specific sense. It adopts broad spatial concepts such as 'over there', 'right here', 'behind me', 'somewhere above me', 'outside' ... in other words, the conception of sonic space is rooted in a generalised subjective sense of the qualitative nature of the space that sounds establish around us. Spatial dynamics are dealt with in a similar generalised way, where sounds might 'spread out', 'get bigger', 'surround', 'recede', 'fragment', or 'diverge'.

The approach is essentially a form of extended panning. When panning sounds the aim is generally to place point-sources at apparent locations in a stereo or 3D sound field. More sophisticated conceptions of space are found in the practice of acousmatic music and its realisation in concert situations. The approach under discussion here tries to balance the simplicity of a pan control with these more sophisticated acousmatic conceptions of space and a generalised treatment of spatial dynamics.

It considers live performance itself as *productive* of space – or more correctly, of *place*: of space imbued with value, through the shared perspectives of performer/composer and audience. It does this by enabling the creation of spatial perspective, depth and ordinality that can change dynamically in relation to the content of the source materials in the moment of performance. It requires the performer to respond in real time to spatial materials as they unfold. Practically, this requires the performer to be able to layer sound spaces, and to reconfigure and redistribute them ‘on the fly’ as a performed element of live mixing.

The approach draws on the personal performing experience of the author, and on existing discourses on space and sonic experience. Whilst by no means comprehensive, the following review may help provide some background.

### **Context**

In *Space-form and the acousmatic image* (2007), Denis Smalley generates a multitude of spatial-analytical concepts arising from his description of listening experience. One such concept is ‘perspectival space’, described as ‘the relations of spatial position, movement and scale... viewed from the listener’s vantage point’ (Smalley, p48). Perspectival space is key to the work under discussion here – the interplay of what Smalley calls ‘*prospective space, panoramic space and circumspace*’ – essentially the shift over time between different spatial perspectives. Smalley refers too to Edward Hall’s classification of distance in relation to the social situation – intimate, personal, social, public – and a dynamics of space operating through ‘expanding and contracting fields’ (Hall, 1966, cited in Smalley, p49). The approach to sound projection embodied in *o ire* is grounded in this idea of a dynamic socio-spatial perspective in listening.

Thinking through issues of sonic space and subjectivity led me to Martin Heidegger’s seminal work *Being and Time* (1927). The writing of course is complex and wide-ranging, concerned not with sound but with a re-evaluation of metaphysics through interrogating afresh the basic nature of ‘being’. Heidegger resists language that separates being into subject and object. In so doing he raises arguments that might relate to sonic-spatial experience. Commentator William Blattner, in his *Reader’s Guide* (2006), sets out the problem neatly: ‘If we begin with the assumption that we have subjective, representational or intentional states directed at a world, then the question naturally arises: How do we “transcend” the “subjective sphere” in order to grab hold of a world and understand it? Instead of talking about us being conscious of or intentionally directed at the world, Heidegger writes that the world is *disclosed* to us.’ (Blattner, p74)

In grappling with these questions, I turned to my eminent colleague Dr Martin Parker Dixon in order to avail myself of his extensive familiarity with Heidegger. Given the nuance of the discussion, it seems appropriate to simply reproduce the exchange here.

NF: Heidegger uses ‘disclose’ and ‘disclosedness’ in the sense of ‘to lay open’ or ‘the character of having been laid open’ (Being and Time, p105), suggesting a kind of dynamic process of being as a revealing that defies location entirely in subjective experience or the objective world of things. In his discussion, Heidegger brings to the fore *Dasein* (‘existence’, ‘presence’, ‘being’) in terms of its literal meaning, bringing to the fore the implicit ‘there’ (as in *Da-sein*, ‘there-being’).

MPD: This will come as no surprise, but the literal “translation” of *Dasein* into “there-being” might not be immediately helpful because the “there” of the *da* (otherwise a mere adverb) has to be heard in so many nuanced senses. *Dasein* names characteristics that are distinctive of human beings (and when they are being distinctively human and not dick heads): for *Dasein*, life (their ownmost being) is not merely given or instinctual, *Dasein* is concerned

with leading a life a certain way (with authenticity, freedom, decision). For *Dasein*, *being* (as such) is itself a question. *Dasein* is the human who is roused into a state of perplexity and anxiety about their own being, and being (or Being if you prefer). And following on from your first sentence above, *Dasein* is itself “open” to the existence of entities, *Dasein* is in the midst of things, it encounters them (in a primal, pre-theoretic sense) and it takes entities *as being such-and-such*. (One commentator thinks it helpful to translate “Da” as “open”. Yikes.)

But I might suggest that the spatial sense of “there” (there in a space) has a useful parallel in the exclamatory and revelatory sense of “There!” Oddly, I wonder if the sense of *Da* we need is a bit like the “dah” in the colloquial expression “ta-dah!”, the verbal imitation of a fanfare that heralds and reveals a significant appearance, a presence, *there*. *Dasein* is always *open to* the heralding of the presence of entities. When *Dasein* is concerned with itself, it steps into a hermeneutic circle whereby the being-that-thinks-Being, thinks-the-Being-of-beings. This circle is the peculiar way by which *Dasein* heralds itself by standing *outside* itself and tries to appear to itself in a more authentic way, “*there!* I am!” This heralding also has that negative moment of *angst* whereby nothing seems to mean anything (“There! I am nothing!”).

NF: In attending to the ‘there’, being becomes inherently spatial.

MPD: This is bit nerdy, but as it happens, Heidegger recommends that the stress comes on the second syllable, *Dasein*, it’s the being that matters. And I don’t think that the “there” in *Dasein* is the place to look for space. That’s elsewhere. As you say:

NF: Notions of ‘here’ and ‘yonder’ are laid open too as aspects of being. Heidegger talks about what is *in der Nähe*, what is close-by or ‘proximally ready-to-hand’ (Being and Time, p135).

MPD: So as I understand it, the ready-to-hand is what I am caught up with, concerned with, have an active use for. Arguably, the mobile phone is the most ready-to-hand thing in our world. Our concerns are wrapped up with it, it is a priority; it comes first amongst things. The mobile phone is proximal or near in the sense of being caught up in concerns and dealings and projects, not just because it is in one’s hand and is close in the sense of measurable distance. The “there” in the complaint “you weren’t *there* for me when I needed you!” means, “I did not feature in your concerns and priorities.” Likewise “you are not making enough *space* for me!” means, “*fit* me into your life, I need a *place* in your heart.” And “I need some space!” means, “I need freedom and *room* to discover and actualise my own desires.”

The critical force of what Heidegger is on about is to backtrack from the Cartesian sense of an abstract space to an analysis of Being-in-the-world whereby it is our *activities* and dealings that disclose spaces.

The English term “space” translates the German *Raum*. If one hears “room” in *Raum*, lots of powerful connotations are produced. Do sounds have *room*? (i.e., space – opportunity – to actualise, or *be* themselves? Cage’s time frames *give* sounds *room*.) For Heidegger (and this is the essence of the matter) abstract measurable distance is a notion that *comes some considerable time after* we have gotten used to this business of bringing things close, finding places, regions, “zones”, where aspects of our world become negotiable and meaningful. “Our problematic is merely designed to establish ontologically the phenomenal basis upon which one can take the discovery of pure space as a theme for investigation, and work it out.” (Being and Time, p147) I was struck by Heidegger’s example of the sun and our use of “sun rise” as a way of placing the sun in our world and making it ready-to-hand as “morning” (i.e., get up, go to work...). This is clearly not about “actual” physical, measurable, distances.

NF: He says: ““Here” and “yonder” are possible only in a “There” – that is to say, only if there is an entity which has made a disclosure of spatiality as the Being of the “There”... In the expression “There” we have in view this essential disclosedness. By reason of this disclosedness, this entity (Dasein), together with the being-there of the world, is ‘there’ for itself.’ (Being and Time, p171)

The reciprocity makes Heidegger’s formulation a complex one to grasp, but it might lead us to consider that in the notion of ‘there’, we have in view the essential disclosedness, or the character of having been laid open, of the phenomenon of being – that being and world are simultaneously and reciprocally ‘there’. Through his discussion, Heidegger presents spatiality and existence almost as two sides of the same coin.

MPD: I think you are on the money here. (BTW I think the best description of here, there and yonder is on pages 154 and 155.) I wonder, though, if reciprocity sets the right tone. *Being and Time* seems to want to work by analysing fundamental ontology and then pointing out that the things we believe to be “given” (like space and the extension of bodies) are actually preceded by a pre-theoretical being-in-the-world. The “There” of an entity is *prior* to our activity of sorting out where (in space) that entity “is”. In a sense, spatiality and existence cannot be separated, but, and by way of a titanic historical corrective, existence needs to be given interpretative priority.

NF: ‘Here’, ‘there’ and ‘yonder’ are explored in Being and Time in depth, not just through physical spatiality, but also the sense of location, place, and familiarity – as Blattner says, ‘My familiarity with my world is a familiarity with places: my home, my neighborhood, my place of work. These places are not objective phenomena, but rather existential locales. Our familiarity with place includes a sense of nearness and distance... The essential point for us here is that phenomenologically we are not located in space-time; rather, we are always somewhere with which we are more or less familiar.’ (Blattner, p75)

This might suggest a sense of space lies beyond any conceptual division of the phenomenon of existence into subjective and objective qualities – combining spatial location with familiarity, sense of place, and value.

MPD: Yes! Exactly! So – if I understand you – *sounds disclose spaces*. The knock on the door, *qua* sound, discloses the coming *close* of an other, it discloses an inside/outside, it produces the *zone* of my privacy (it makes my privacy appear at the very point it is about to be violated.) The interruption forces me to abandon and become *remote* from my project and concern (which was *near* to me) and take up the concerns of another. I hear a sound in the distance, a voice crying “Help me!” The distance (yonder) can be interpreted as the terrain I must traverse so as to lend assistance, (I want to be *ready-to-hand* for the stricken person) or the distance resonates with my incapacity to help. In the latter case, the “zones” between him and me take on a quality of deadliness and tragic inertia.

...

This ‘valued’ sense of space, in terms of zones, or territories, is examined by Yi Fu Tuan (1977) in his book *Space and Place: The Perspective of Experience*. He suggests that ‘In experience, the meaning of space often merges with that of place’, but that ““Space” is more abstract than “place”” (Tuan, p6). In the opening pages he recounts an experience of theologian Paul Tillich, who describes growing up by the Baltic Sea, and how the sea generates a sense of *spaciousness*. Tillich compares this with trips to Berlin, the big city, pointing out that these too invoked a sense of unrestricted

space that reminded him of the sea (ibid., p4), leading him to question the experience and qualities of space and spaciousness.

He goes on to describe *place* – ‘what begins as undifferentiated space becomes place as we get to know it better and endow it with value’ (ibid., p6) – likening this to non-human animals marking off territory: ‘Places are centres of felt value where biological needs, such as those for food, water, rest and procreation, are satisfied’. But he also points out that people respond to space and place in complex ways: ‘how can the Baltic Sea and Berlin both evoke a sense of openness and infinitude?’ (ibid., p4). He raises the question of the sonic experience of space, asking ‘Is a sense of distance and of space created out of the ability to hear?’ (ibid., p14), and suggesting that ‘sound dramatizes spatial experience’ (ibid., p16). Tuan’s work on place suggests the entwining of space and listening are key in our sense of being and world.

Such an entwining is described by Salomé Voegelin, in her 2010 book *Listening to Noise and Silence: Towards a philosophy of Sound Art*, in which she posits the notion of ‘sonic sensibility’. Her starting point is a personal experience of listening to a set of radio broadcasts made by Maurice Merleau-Ponty in 1948. At one point he describes the unity of perception in terms of the stickiness of honey; Voegelin expands on Merleau-Ponty’s image, suggesting that she feels the honey through her *own* stickiness, that the honey ‘cannot be grasped as a remote object’ – she describes Merleau-Ponty’s voice as ‘the honey that drips into my ears and engages me without taking certain shape’ (Voegelin, p9). For Voegelin, this is ‘not an act of interpretation as much as the fantasy of my audition: it is not the... golden honey but his voice, his body in his mouth meeting mine in my ears, that shapes the perceived in the sensory-motor action of my perception’ (ibid., p10). She describes listening in terms of a meeting point of our bodies with the world – a kind of spatiality that has to do with an entwined proximity or inseparability.

Like Voegelin, David Morris in his book *The Sense of Space* (2004) builds on Maurice Merleau-Ponty’s work on spatial experience. He contends that ‘the sense of space is the basis of all social experience and of perceptual experience in general’ (Morris, vii). Morris’s wide-ranging analysis has direct relevance for music making, since it is concerned above all with the moving body, central to the act of performance. Morris is concerned not with measured, objective, or geometric space, but rather with ‘perceived space as we experience it before objectifying it’, echoing Heidegger and Tuan. This he calls ‘lived space’ (ibid.).

One of the key innovations in Morris’s work is a crossing of body and world through movement. To introduce this idea, Morris outlines the problem of depth perception. He couches depth not in terms of distance, but in terms of our sense of volume: ‘we can treat depth as an objective dimension interchangeable with height and width. But before that we must have a more basic perceptual experience of voluminous things, and that is our focus: how do we first of all perceive things and ourselves as standing out in depth?’ (ibid., p2). Morris describes his experience of sitting on a bench outside Toronto city hall: ‘I would seem to be part of the depths that I perceive. There is a problem though. I perceive things in depth as here or there, as near or far, in front or behind. But I do not perceive myself in this way’ (ibid.). He distinguishes between the *ordinary* depth observed in the environment, by which he means the ordering of parts of the environment by depth (in other words, we observe things as in front of or behind other things), versus the *extra-ordinary* depth we perceive of the body, which seems not to be subject to that kind of ordering. With ‘ordinary’, he invokes an ordinal structure – first, second, third. But the sense of one’s own body parts does not seem ordered in that way. For instance, we do not generally describe our left hand as distanced to the left of our body – rather, our left hand partly *defines* our sensation of leftness, even when it is not positioned to the left. Morris’s *crossing* refers to this interaction of our body with the world. He goes further, proposing that such a phrase as ‘interaction of our body with the world’ presumes these already to

be two independent separate things that only subsequently interact. Rather, 'crossing' implies that the two are *mixed* – at once interdependent, arranged in a flowing threshold. Body and world cross one another. The body is not a separate sensing machine 'within which signs of depth are decoded' – rather it is 'in the depths of the world ... through a flowing threshold that overlaps both body and world' (ibid., p5). He reaffirms the point: 'our sense of space is not constituted by cognitive or neurobiological structures that are merely on our side of things; our sense of space is enfolded in an outside, in a world that crosses our body' (ibid., p6). These ideas are developed later in the book, in relation to *envelopment*, drawing again on Merleau-Ponty, and the social and ethical dimensions of movement.

That our sense of space arises from a continuous, enfolding flow of body with world resonates with music making. Combining Morris's enfolding with Voegelin's 'being honeyed' (Voegelin, p6), the notion of touching sound with our ears, we might think of ourselves as sounding, listening, practicing bodies unbounded, interconnected through sound as a community of listeners. The relationship between performer, performance, space, and audience becomes continuous, reciprocal.

### **Application**

The approach to sound spatialisation described here draws variously on these reflections, investigating some of the implications through the practice of performance itself. It is realised in a way that aims to reconcile the simplicity required of a performance controller with the complex, continuous, iterative relationship between listener/performer, sound material, space and place.

It assumes the listener/performer is located in amongst the community of other listeners, in the middle of the performance space, and in the middle of a multi-channel loudspeaker array suitable for ambisonic reproduction.

The approach is embodied in the design of a touchscreen performance controller which was developed in collaboration with Incalcando (<http://incalcando.com>) as part of their *Parat+* fader box app for iOS (<http://apps.incalcando.com>). The controller, called the 'ambisonic layer' within *Parat+*, communicates spatial information via OSC messages to host software (such as Max, Supercollider or a DAW). Use of the controller requires the host application to interpret and manage the spatial information in a meaningful way.

The controller gives the performer access to multiple spatial parameters simultaneously across layers in the mix. Each layer is controlled by its own 'polar panner' that appears on the touchscreen surface, and each panner comprises an overlay of rotary and linear faders that together provide multidimensional control of spatial attributes, manipulable by between one and three fingers:

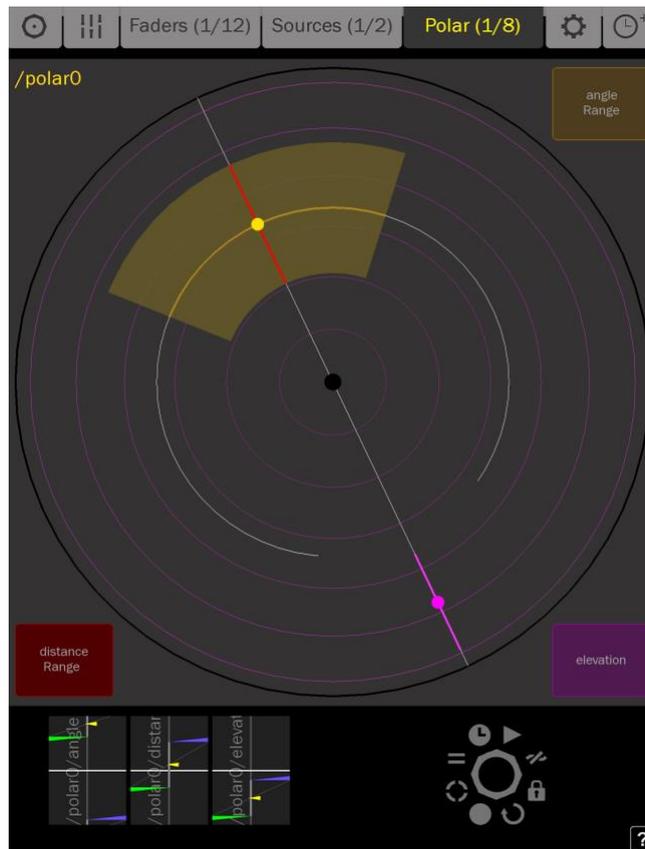


Figure 1: Polar panner in Parat+ ambisonic layer

A video outlining the use of the controller can be found [here](#), and more context can be found at Incalcando's YouTube channel [here](#).

In the implementation within *o ire*, each panner controls a *stream* of sound, altering the way that stream is diffused across the loudspeaker array. A stream is essentially a mix stem generated 'on the fly' during the performance. It might comprise the simple looping playback of a sample; it might be a sample with time-varying micro-loops, with the loop length and position controlled by other physical controllers (in the case of *o ire*, these include foot-pedals and a small custom-made theremin-style controller, called the *iski*, based on an Arduino and light dependent resistors); or it might be a stream of grains, generated by a granulation algorithm or by the rapid intercutting of different samples. It might also be a mix of these things, or the output of some other processor such as a filter, delay, or phase vocoder.

These streams can be considered akin to tracks in a DAW – each can be muted, rebalanced, or panned differently in the mix. In *o ire*, and using the Parat+ ambisonic controller, 'panning' means placing the sound stream in relation to a virtual hemispherical surface above and around the listeners in the performance space:

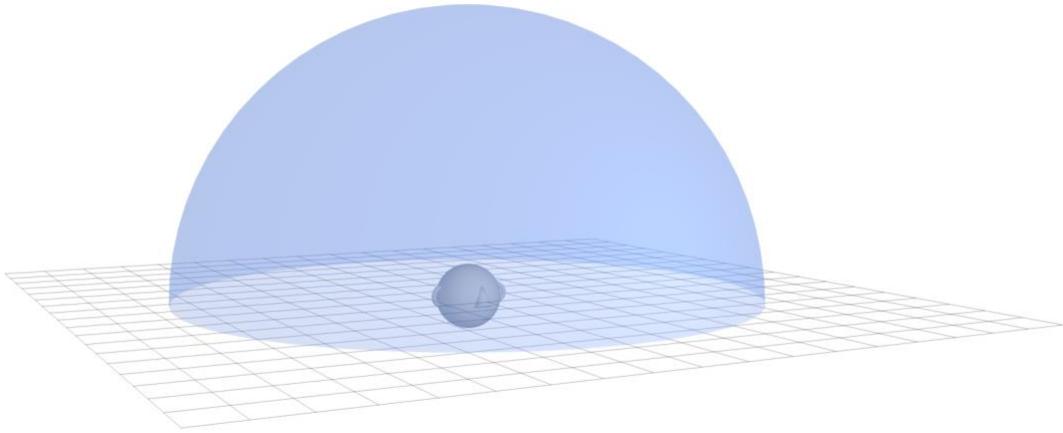


Figure 2: virtual hemispherical surface surrounding listeners

Each stream forms, or is bounded within, a notional truncated cone relative to the surface:

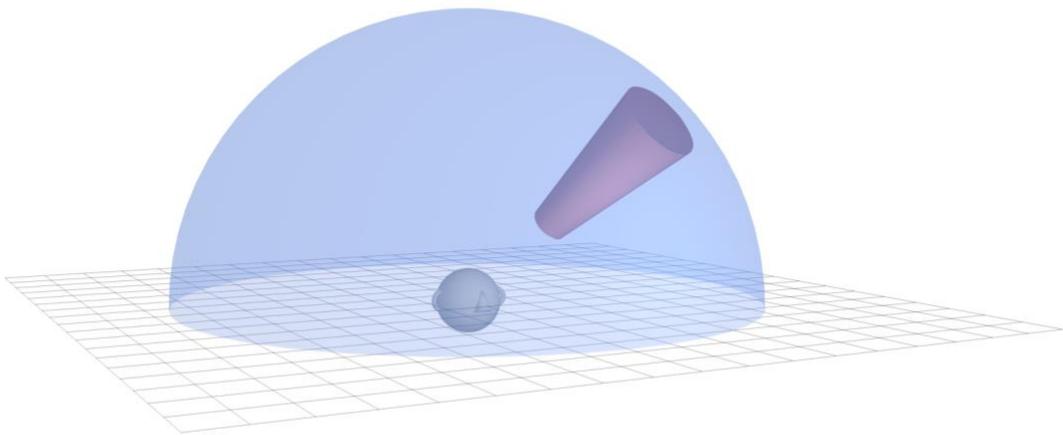


Figure 3: Parat+ spatial sound controller 'truncated cone' conception of panning

The cone's dimensions can be manipulated using the Parat+ controller, which gives access to the following parameters: horizontal position; horizontal range or 'spread'; distance outwards from the centre of the space; distance range or spread; elevation; and elevation range.

These parameters are suitable for translation into azimuth, elevation, and distance (aed) polar coordinates for ambisonic encoding (e.g. using the ICST ambisonic tools for Max).

If the horizontal, distance and elevation 'range' parameters are set to zero, then the stream is panned to a point at a particular distance, horizontal angle (from straight ahead), and elevation above the horizon:

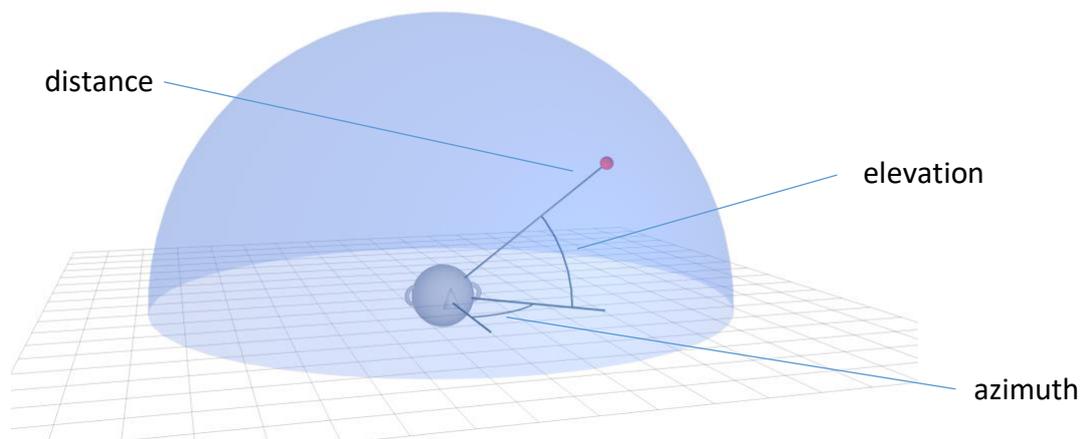


Figure 4: azimuth, elevation and distance – ranges set to zero

If the 'range' controls are used, then streams can be spread out, either horizontally, or vertically in terms of their elevation above the horizon, or in terms of distance, forming the truncated cone:

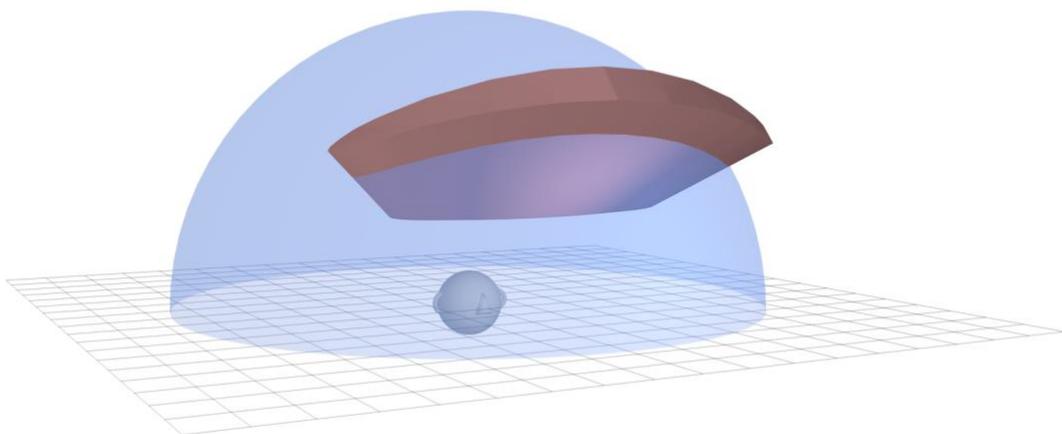


Figure 5: horizontal and distance ranges set

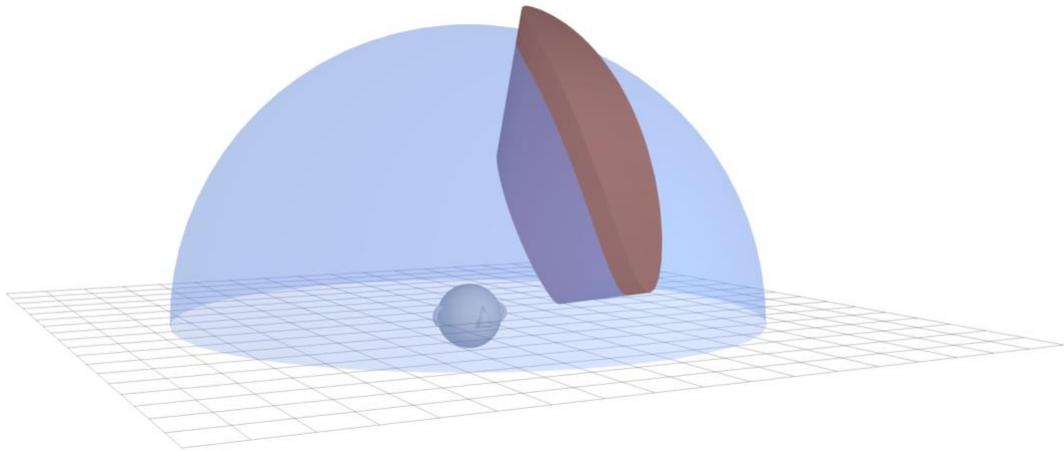


Figure 6: elevation and distance ranges set

When treated in this way, the cone can be used to define limits for the spread of discrete elements of sound within the stream; so if a stream is created by a granulator, for instance, the resulting grains can be distributed randomly within the volume defined by the cone. Alternatively, if a stream is generated by a multichannel sound source, such as a filter or phase vocoder that outputs multiple spectral bands, then these can be distributed inside the cone's limits:

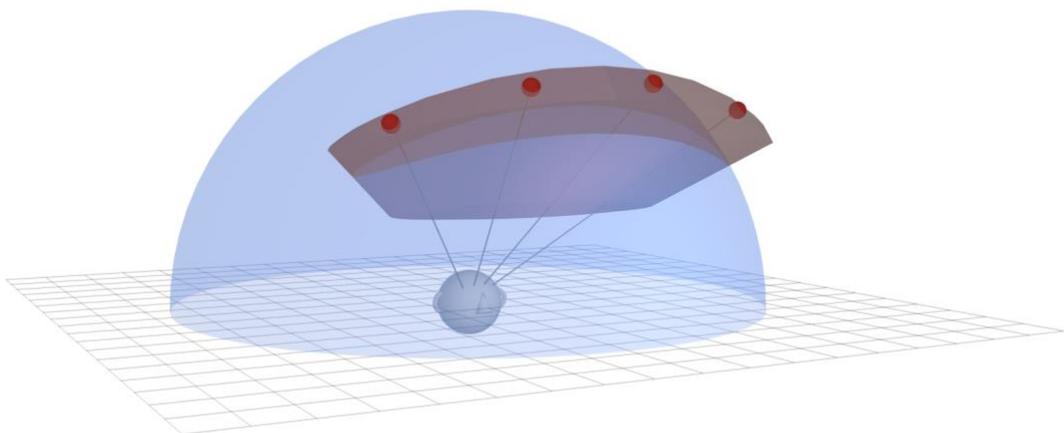


Figure 7: four channel signal evenly distributed within horizontal range limits

When repeated for multiple sound streams, the use of the controller enables each stream to have its own spatial characteristics. Given that the Parat+ controller framework provides the possibility of

recording and replaying finger movements either as one-shot gestures or loops, this enables the performer to build-up spatial patterns stream by stream, layer by layer, as the performance progresses.

In conclusion, this approach to surround panning enables an integrated performance style within *o ire* where the processing and sculpting of sound in the temporal and spectral domain goes hand-in-hand with shaping in the spatial domain. The combination of the ambisonic controller with the automation design of Parat+ enables the performer to shift focus continuously between domains, allowing numerous sonic parameters to be managed in real time in response to the unfolding aural experience.

Parat+ is available from Apple's App Store; the ambisonic layer is available via in-app purchase. The collaborative development with Incalcando was supported by the University of Glasgow Knowledge Exchange Fund.

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