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# Approaches to Immersion and Interaction in Virtual Procedural and Orchestrated Space

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## ABSTRACT

This paper outlines approaches to immersion and interaction in *w[i]nd* (Rawlinson, 2020), an audiovisual composition and installation in a first-person screen-based Virtual Environment (VE) for Mac and PC. Users explore a photorealistic space containing images, models and spatial audio through first person motion controlled by keyboard and mouse. Object position, movement, underlying algorithmic parameters and spatial triggers are used as a mechanic to influence the sonic density and character of the experience. Among other things, the work explores open sonic form, timbre and character in non-linear interactive experiences and contributes to research into the use of sound and sounding objects as an approach to presence and immersion, navigation and interaction in VEs.

## BACKGROUND

As a composition/installation art work, *w[i]nd* is informed and inspired by historical experimental spatial composition and open and mobile form works, and recent immersive sound and image installations. The work is a walking simulator built with Unity and Wwise game audio technologies.

Hybridised, abstracted, augmented and imperfect images of wind instruments were synthesized using StyleGAN (Karras et al., 2019) from a dataset of images of wind instruments held by the University of Edinburgh's musical instrument collection. Sounds were created using a range of physical modelling approaches as a sonic response to the generated images and consider their likely acoustic character as simulacra of woodwinds or brass instruments, and the impressionistic and distorted properties and features of the images. Other sounds in the work include natural and processed Creative Commons recordings of wind instruments.

Effort is required to navigate the work's fragmented audiovisual landscape as an act of 'ergodic musicking' (Oliva, 2019) in which the user plays a participative role in the construction of their experience of the work as they traverse space, blurring the role of composer and performer in the reconfiguration of soundscape.

In this VE users are involved and included in a mediated perceptual experience that aims to cause a subjective sense of presence as, and through, sensory immersion and transportation. Presence causing form variables in the work include: number, scale, dimensionality, resolution, colour and field of view of visual elements; number, spatial realism, frequency range and dynamic range of sonic elements (Lombard and Ditton, 1997); natural real-time interaction, consistency of multimodal information, scene realism, environmental richness, movement perception and degrees of control (Witmer and Singer, 1998).

## IMMERSION AND INTERACTION

The synthesised images are hung as photorealistic exhibits in a large, dark virtual exhibition space with an industrial character and a procedural distribution (using Perlin noise) of irregular open areas and smaller pockets of space. Each exhibit emits highly localized audio (best experienced via headphones) of varying stability of pitch, amplitude and timbre triggered by first-person proximity. The audiovisual exhibits are clustered, dispersed and rotated such that the visitor is granted multiple viewpoints and points of audition, and the exhibits often prevent the user from moving in a linear, straightforward way forcing spatial interaction. The user can restart the work should they become disorientated.

Three-dimensional models of wind instruments of partly-transparent, saturated character are hung overhead at significantly larger than life scale. These models regularly emit untreated sustained tones typical of these instrument. Density of audio events increases with proximity, and sounds travel across moderate distance in the VE, allowing users to orientate themselves and navigate by sound. The positioning of these models results in variation in timbre and register as a form of orchestration in space. Parameterised filtering and reverberation

effects extend perceptual spatial characteristics. Stochastic and aleatoric generation of audio events leads to clusters of extended harmony and ambiguous tonality.

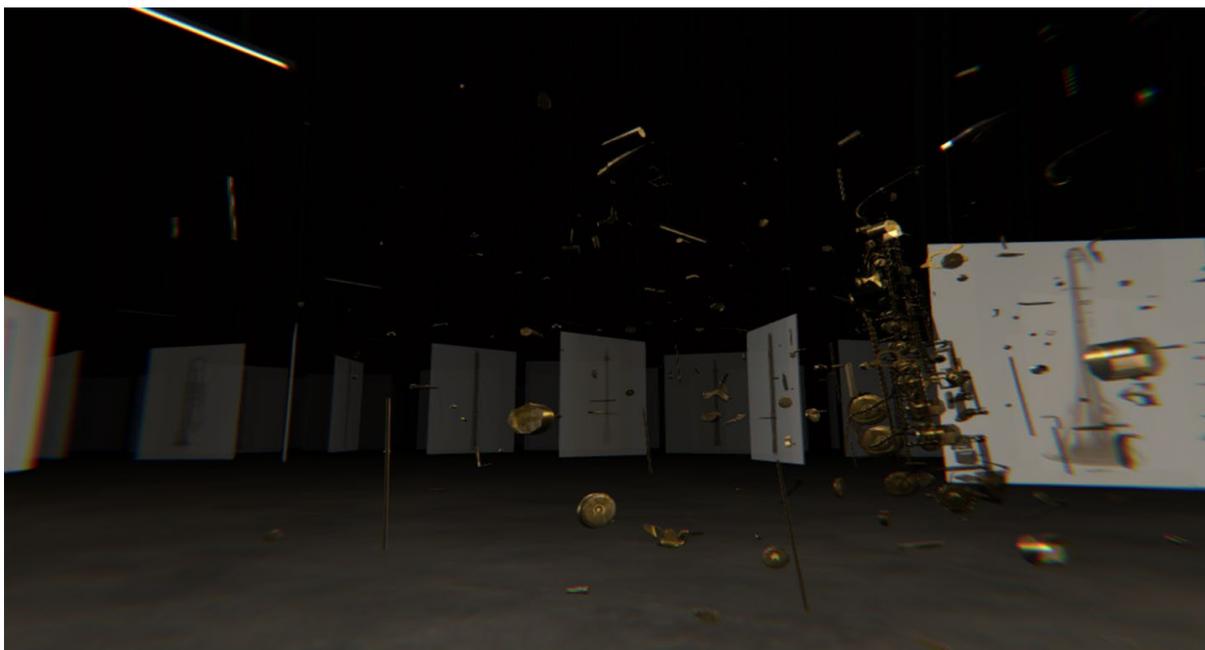


*Fig. 1. Screenshot of w[i]nd Virtual Environment – Audiovisual Exhibits.*

A smaller number of exhibits that are different in character to the main images, instruments and each other, are present in pockets of space. These exhibits are obscured and revealed by virtual visitor movement, and draw attention through contained active motion, staging and sound. Proximity triggers on these exhibits switch layers of audio on and off, extending indeterminate compositional scale and structure.

A final group of audio emitters playing constantly looping material of longer duration are randomly distributed throughout the space. The spatial experience of these emitters sits between the highly localised experience of the image exhibits and the more distant models, and the character is often highly unstable in terms of pitch, amplitude and timbre throughout the loop.

In addition to the emitter outputs, audio is fed into a low-level processing chain of doppler and granular effects. The depth and value of these effects are affected by real-time parameter control dependent on first-person location and motion.



*Fig. 2. Screenshot of w[i]nd Virtual Environment – Audiovisual Exhibit.*

## EVALUATION

The virtual character of the work allows for many more spatial sound sources than would generally be possible in real life, and a controlled experience. Through considered visual staging, fixed and aleatoric combination of sound, and motion and proximity-based mechanics and processes the scope, integration and resolution of the work is extended in terms of audiovisual impact and immersive effect. There's a blurred audiovisual diegesis through the juxtaposition of various orders of reality, simulacra and abstraction.

Anecdotal feedback from users has so far been positive including comments such as “ a convincing and coherent physical space with dynamic, fluid content that is responsive to gazing and micromovement”. One user said “there's a clear connection between space, motion and sonic output... a good range of musical events and gestures makes the environment come to life... it responds in surprising ways... there's always something new that makes you want to keep exploring and looking for surprises”. Another noted “the spatial arrangement of the visual and also auditory components was compelling, motivating me to spend more time within the installation that I might have done.”

## CONCLUSION

The research presented here combines natural and exploratory modes of interaction and degrees of control in a multimodal presentation offering movement perception, environmental richness and scene realism. The experience is dynamically configured in space and time. Open spaces and stable sounds act as connectors giving shape to the experience, while clustered and variable elements demand attention and focus or invite curiosity and may be seen as attractors and retainers through ‘perceptual opportunities’ (Fencott, 2005). Overall the approaches taken in developing the work have resulted in an immersive and engaging experience with characteristics of agency and presence.

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