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Ethereal Drawing: Architectural Drawing in other Domains

Abstract

Ethereal Drawing is a project in experimental architectural drawing. The research uses a multi-modal drawing technique to give insights into contemporary phenomena. Weather, seismic events, or miniature biological worlds are made spatially palpable through architectural drawings combining VR, sculptural space and soundscapes. This builds on earlier research by the authors in drawing ethereal presences. This paper sets parameters for the next phase of this drawing research and presents it for discussion.

The research has two aims. The first is to establish a robust technological platform for multi-modal, multi-sensory ideation that leverages traditional architectural drawing and exploits the affordance of VR and spatialized sound. While this has theoretically been possible for some time, the performance and availability of technology now enables designers to experiment with new forms of abstraction. Immersive, spatialized worlds offer audio-kinaesthetic experience that can extend architectural imagination, resulting in novel apprehensions of architectural space.

The second is to explore an expanded field of architectural practice. Where and how might the spatial acuity of the architect be deployed outside the domain of the built environment? The impact of the spatial turn within the sciences, and the capacity to model extremely large data-sets provide strategic opportunities for interdisciplinary collaboration. Space and place underpin understandings of contemporary phenomena. From the magnification of microscopic worlds, in such applications as materials and neuroscience, to the modelling of large scale planetary processes such as weather ocean ecosystems, there is potential for architectural sensibilities to give insight into these material, yet ethereal worlds.

We pursue a theoretical perspective informed by new materialism, post-human philosophies, digital creativity and spatial imagination, to propose the parameters and scope of a series of multi-modal drawing projects; spatialized installations draw creative potentials from contemporary phenomena and act as portals to their internal architecture.

Ethereal Drawing - Introduction

Ethereal Drawing is an ongoing interdisciplinary collaboration in experimental architectural drawing with researchers in architectural drawing, algorithmic design, virtual reality and spatial sound. The research uses a novel combination of virtual reality (VR), sculptural space and soundscapes to give spatial insights into other domains. It projects into worlds that are a complex mix of tangible and intangible characteristics, leveraging drawing's traditional openness to sketch impressions of contemporary phenomena through multi-modal, multi-sensory drawing installations.

This project is an extension of research begun in the *Canyon* project of 2018, a collaboration between this paper's authors. *Canyon* was an installation conceived as an 'inhabitable sketch' of a seismically active submarine canyon¹. The project explored intangible presences in a vast ocean seascape, distilling pressures, flows and material dynamics, as well as the submarine landscape's ominous potential for seismic rupture. Presences in the canyon were spatialized as an atmospheric sketch that could be experienced both virtually and bodily. The research prompted reflections on architectural drawing and how it might be extended through a combination of digital media, material space and soundscapes². The next stage of the research proposed to test this technique as a way of generating space, to "situate these experiments as a way to conceive built form that has a similar boundless, oscillating scalar resonance"³. *Ethereal Drawing* takes on this challenge through a series of experimental drawings. The drawings engage with new subject matter, natural phenomena with protean, irresolute characteristics, and attempt to distil their internal architecture as multi-sensorial installations. In doing so, the drawing technique is developed and its potential for design research and ideation explored further. This paper discusses the ideas and technology surrounding the *Ethereal Drawing* technique and parameters for a series of future drawing experiments.



Figure 1. *Canyon VR*, smudge zone of VR environment. Video still, 2018.

Extending the Architectural Sketch

Ethereal Drawing (ED) is premised on the idea that architectural drawing is a tool for imagination that can be extended to give insights into domains that are not generally considered architecture, or certainly, not buildings. Traditionally, an architectural sketch, such as a section through a landscape, captures its shape and form in a few rapidly drawn marks. It also captures intangible characteristics, such as its immense scale and materiality, often through heavily applied shading. The sublime characteristics of the landscape become part of the subject matter of the sketch, negotiated through body movement, densities of graphite and the spatial imagination of the sketch's author⁴. The traditional architectural sketch is simultaneously a representation, a material condition and a portal into the space being drawn. The *ED* project asks how this spatial acuity could be deployed as a portal, or lens, to other domains. How might a multi-modal, extended form of sketching draw tangible and intangible characteristics in natural or virtual phenomena? In doing so the intention is twofold: to prompt new understandings of phenomena - by way of a multi-modal architectural drawing lens - and to create new apprehensions of architecture, drawn in shared authorship between phenomena, drawing media and architect. The goal is for ethereal dynamics, present in drawing and the phenomenal subject matter, to emerge as possible architectures.

This work is not intended to contribute to discourse on data visualisation, but aims to draw out intangible atmospheric potentials, allowing the invisible architecture of phenomena to become appreciable in a spatial way. The contribution of *ED* is hoped to be in providing

insights through spatialising characteristics that evade data representation. We also hope to contribute to the discourse on drawing. By intensifying architectural drawing's inherent capacities as an aesthetic lens, for capturing intangible characteristics in the space it draws, we hope to add to contemporary discussions about drawing's role in observation and ideation.

The drawing installations proposed for the *ED* project leverage drawing's ideational traditions. The creative power of drawing, particularly the sketch, is tied to its inherent openness, its capacity to be uncertain and irresolute through a co-agency of hand, graphite and imagination. This gestural and material feedback loop allows drawing to be the "opening of form", as commented on by Jean Luc Nancy.⁵ This tradition recognises the power of matter, or non-human participants, in creativity and can be seamlessly applied to the realm of digital or virtual materials. Betti Marenko & Philip van Allen describe digital creativity in this way, describing human to machine interaction as "capable of fostering affects, sensibilities and thoughts that capitalize on the uncertain, the unpredictable and the nonlinear, and their capacity to trigger creative pathways."⁶ This is a facet in the act of drawing as a mode of imaginative thought, in the creative observation of spatial phenomena or in the design of architectural space. The uncertain line or form that emerges from co-creation, combining the influence of physical or digital 'matter', has complicated ties to the subject matter of the drawing and how it is understood. The abstract and 'recalcitrant' smudges that James Elkins describes⁷ inevitably populate the traditional sketch, and its digital equivalent, and aid the drawer in imagining the space being drawn. The architectural sketch is a collection of rapid notations that pursue the form and atmosphere of the space they draw, capitalising on a creative uncertainty that Elizabeth Grosz describes as "the capacity to elaborate an innovative and unpredictable response to stimuli, to react or, rather, simply to act, to enfold matter into itself, to transform matter and life in unpredictable ways".⁸

The sketch is a terrain where the acuity of the architect is in concert with Grosz's 'enfolding of unpredictable subject matter' as well as uncertainties in the drawing medium itself. This dynamic of mark-making, thinking, material agency and representation is extended in *ED*. The marks become more than graphite on paper and are brought into dynamic virtual environments. Sonic marks are made and caused to interact with spatialized virtual marks forming three-dimensional worlds that merge real and virtual space. The virtual and sonic environments combine with sculptural aspects in the installations. Sculptural surfaces are constructed as hand-made three-dimensional sketches and these shape and define the material space of the installations. These three components: soundscapes, sculptural space and virtual space (VR) come together as a multi-platform environment that is able to be

experienced bodily. The combination of virtual, sound and sculptural material allows a drawer/ participant to engage in a multi-sensorial drawing environment, and its abstracted subject matter, in ways that go beyond conventions of representation. The parameters of these *Ethereal Drawing* installations are outlined below.

Multi-Modal, Multi-Sensory Ideation: Parameters of Hybrid, Interdisciplinary Practice

Parametric Design has been identified with a specific mode of digital technique in contemporary architecture and design, associated with the multi-curvilinear aesthetic of spline geometry, once novel but now ubiquitously available within contemporary design software. However, it has also been argued that parametric design is a tautology, as all design involves the manipulation of parameters. Common to both views on contemporary parametricism, is the emphasis on geometry albeit with some developing interest in the material and tectonic parameters. The approach outlined here, uses 'parameter' in a broader sense to capture the range of tools, techniques and material process that are at play within *ED*, as a hybrid interdisciplinary practice. The domains of sketch drawing, physical modelling by hand or machine, the production of immersive virtual reality, and the authoring of spatial sound environments provide a rich source of parameters including, but not restricted to geometry. Figure 2 provides an overview of these, which generate a network of possibility that can be traversed in a multitude of ways.

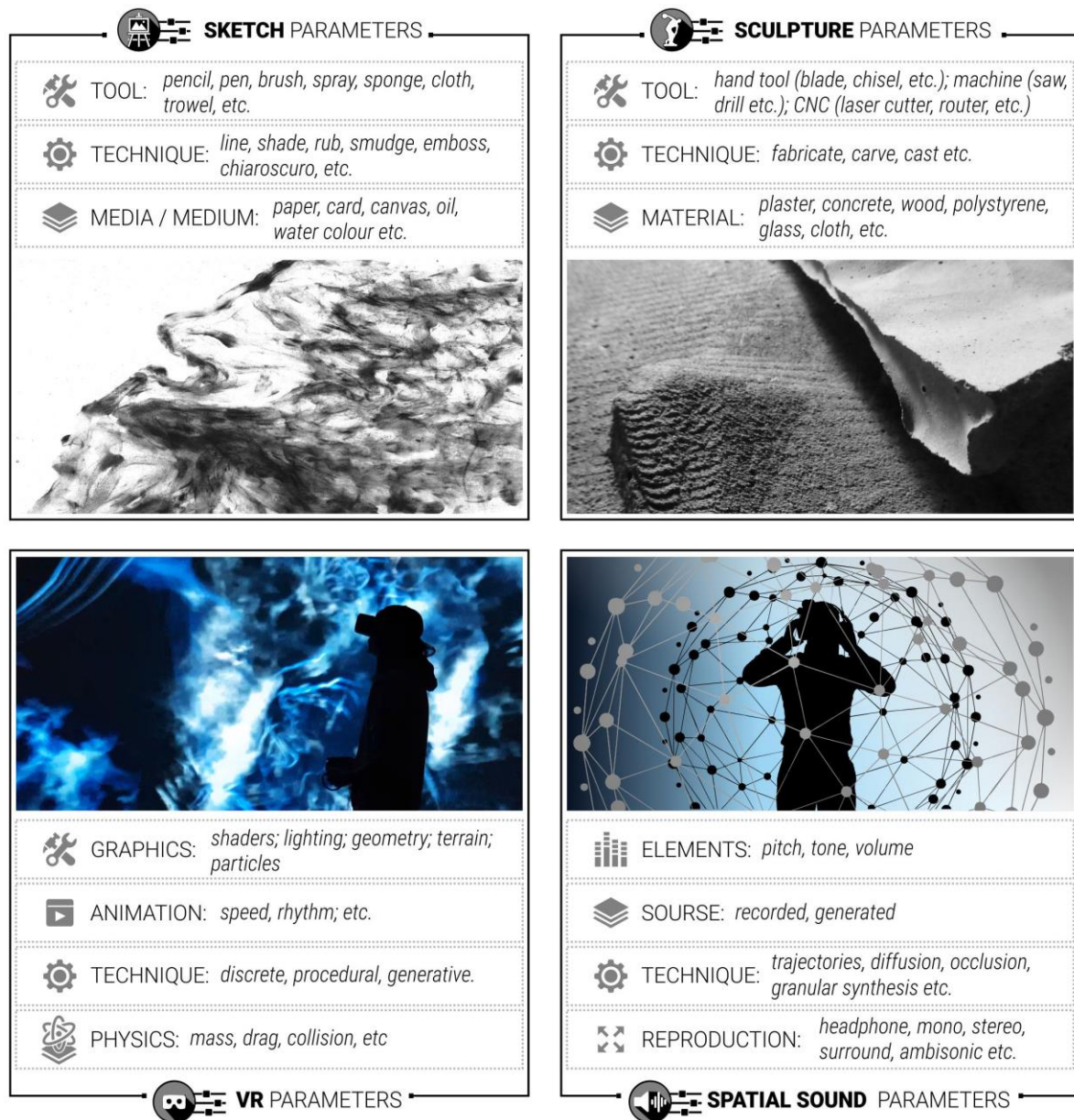


Figure 2. Parameters for Hybrid Drawing Practice

This approach to conceiving parameters aligns with the overall theme of the open drawing, where interplay across four domains enable a multiplicity of interpretations of the spatial phenomena and context being explored. There will be well travelled tropes that relate to the individual preferences of the design collaborators, and to some extent these have been revealed by the *Canyon* project. However, it is our expectation that habitual moves will be challenged by the range of natural phenomena being explored, and through deliberate experimentation with tools, techniques and material conditions - alternate and potentially novel spatial conditions will be revealed. Rather than describe Sketch, Sculpture, VR and

Spatial Sound as distinct activities, the sections below outline the parameters across domains through the distinction between tool, technique and material/ media/ medium.

Tools

“A tool is a moving entity whose use is initiated and actively guided by a human being, for whom it acts as an extension, towards a specific purpose”.⁹

The introduction of digital tools within design in the latter 20th century resurrected the issue of creativity and technology. In reaction to the dismissive line ‘the computer is just a tool’, Malcom McCullough unpicks at length the complex relationship between designer, tools, form and ideas. His approach provides a way to discuss the range of tools potentially at play within our hybrid practice. The designer guides or manipulates the ‘entity’ either in direct interaction such as a pencil or touch pad, and/or adjusts parameters in response to outcomes, such as sharpening the lead or adjusting the sensitivity of the device. However not all tools involved in our project are prosthetic, and the agenda goes beyond hand-eye coordination. McCullough was writing in the late 1990’s and the uptake of procedural computer modelling techniques and Computer Numeric Controlled (CNC) machines had not made their presence felt in mainstream design practice. The distinction between a discrete computer drawing / model where each part is fabricated ‘by hand’ and a procedural approach where the composition is coded as interrelated instructions (associative geometry) enables a mode of working in which the definition of ‘active’ guidance comes into question. The use of CNC machines also makes problematic the explicit form of interaction embedded in McCullough’s definition: rather than ‘guiding’ the tool, the mode of interaction when using such machines operates at a different duration; where the results are examined after execution; with parameters subsequently being adjusted.

Later in his book, McCullough observes that digital tools provide the means for “combining the skillful hand with the reasoning mind”.¹⁰ This partly captures the mode of interplay between designer and tools that we envisage, albeit that building on the tradition of drawing, we would place intuition alongside reason. Moreover, while we expect that the spatial conditions we intend to explore will become progressively definitive and refined, at the early stages the ‘specific purpose’ of our experimentation will be deliberately open ended. The choice of tool will afford or constrain outcomes, and while we can anticipate the appropriate choice at the outset, experimentation with alternate tools may stimulate alternate ideas. Clearly the granularity and substance of the phenomena we are drawing will trigger the initial choice of, for instance: charcoal over fine tip pen; particle system over mesh geometry; or

percussion over string instrument. But as has been well travelled within creative practice the strategic shift of tool set has the capacity to stimulate alternate ideation.

Technique

While tools are generally available to all, it is a technique that arguably produces distinctive outcomes, either through mastery or inventiveness. Historically this has been most evident in arts practice where a succession of techniques from chiaroscuro to projectile painting have evolved. Architecture has traditionally been reliant on projective sketch drawing via various techniques – lines, rubbing, shading etc. – alongside the range of physical modelling techniques such as folding or carving that have emerged more recently. These physical techniques have their correspondences within digital design software and in the use of CNC tools. For example, Lisa Iwamoto describes five techniques – sectioning, tessellating, folding, contouring and forming – that inventive designers have used to produce distinctive outcomes from standard CNC machines¹¹.

Digital sound production has also developed from physical process both in terms of replicating physical instruments and experimental analogue technique. Take for example, the technique of granular synthesis that has become reasonably common in contemporary electronic music. Iannis Xenakis pioneered the approach by splicing magnetic tape into very small segments, rearranging the components and then re-taping the segments together, resulting in a distinctive granular sound quality.¹² This arduous process can now be applied digitally through software techniques that provide a high degree of control over the parameters of the sound 'grains': position, speed, length, density, pitch and waveform shape.

In a similar manner, lofting techniques from traditional boat building have been adapted as procedural techniques in 3D software, where the ease of parameter adjustment and the automatic generation of cutting patterns has enabled widespread experimentation of this approach within design disciplines. These examples highlight the degree of control and speed of application by which physical techniques can be deployed by software and CNC machines. Moreover, the speed of execution enables an iterative and reflective mode of interaction with parameters *while designing*, which is not feasible with physical manifestations of the technique.

Beyond the speeding and scaling up of physical process, what techniques are distinctive to digital modelling, virtual reality and sound production? For architecture, the availability of spline geometry is one clear example of a tool / technique that has enabled experimentation with geometry not possible with Platonic solids or Cartesian geometry. Spline geometry not

only results in continuously variable lines, but also subtly flexing spline surfaces and terrains. Splines are algorithmically defined procedures akin to applying force to a material with variable resistance. In a similar manner, VR environments enable adjustment of physical parameters of mass and drag, which enable experimentation with techniques that are not possible within real world gravitational fields. Another set of digital tools has evolved through computational models of fluids that enable experimentation with techniques of attraction and repulsion.

Other algorithmically derived techniques available in 3D modelling and VR software include a range of 'noise' algorithms and cellular automata techniques that have been inspired by natural phenomena, but with the capacity for the designer to manipulate parameters to produce novel outcomes. Similarly, there are animation procedures based on inverse kinematics inspired by skeletal and mechanical systems, but capable of behaving in ways not possible within the physical constraints of fauna or machines. Similar sets of algorithmic procedures are available for digital color, texture and lighting that make possible new techniques for designing virtual reality environments. Sound production with digital tools has followed a similar path, where initially the software replicated techniques developed with physical reverberation chambers, microphones and tape machines. As per the previous example of granular synthesis, the degree of control and speed of execution has led to experimentation with new techniques that go beyond that feasible with analogue equipment.

Material/ Media/ Medium

Tools and techniques for drawing and sculptural practice have typically evolved in relation to materials. In the physical domain, the irreversibility of many material operations has led to specific tool sets and carefully scripted sets of operations. While typically there is less at risk at the sketch design stage, techniques and materials are generally aligned. There are however multiple material parameters at play, which often have a direct and significant impact on possible outcomes. For example, identical moulds will produce similar overall casting outcomes, but with distinctive variation dependent on the texture and viscosity of the material used. In a similar manner when using a carving technique, similar techniques will have distinctive outcomes dependent on the granularity and hardness of the material. While more subtle in outcome, choice of drawing surface, for example watercolor over butter paper, affects the fluency and granularity of drawing outcomes.

Returning to McCullough's discussion of digital media and medium, he argues that similar interrelations between media/ medium and tool/ technique occur, albeit these are less obvious. He observes that differences are most clear when considering dimensionality, such

as that between a two-dimensional image made up of a grid of dots and a three-dimensional medium constructed from vector geometry.¹³ The temporal dimension provides another set of media affordances, in which motion and event timing can occur via linear or interactive scripts or generated computationally in 'real time'.

Some twenty years on from McCulloch's interrogation of digital design, contemporary VR and sound production brings together in one medium the affordances of two-dimensional graphics, materials based on shader technology, 3D vector geometry, particle and lighting systems that generate atmospheres, spatialized sound and interactive physics engines. The medium is experienced in a dynamic environment where graphics, geometry, lighting and physics can change over time, either pre-scripted or in response to interaction with the designer. The interaction capacity is continuing to evolve via in-world graphic interfaces, voice activation, haptic controllers, and eye tracking. The aural dimensions are also increasingly sophisticated with both interactive background sounds, and spatial emitters that generate radiating sound that are occluded by world objects and are responsive to material properties. Dependent on the processing power of the computer used, this evolving medium provides new opportunities for exploring spatial conditions that can supplement or extend the sketch drawing or physical study model.

Towards an Expanded Field of Architectural Practice

The subject matter for these drawings is still in development, but a spectrum of phenomena is being considered. The key is to test things that have a mix of identifiable aspects - that can be described through data - and intangible or 'unseen' aspects, such as apparent limitlessness or a capacity for unpredictable change. The idea is for this interplay between known and unknown, or empirical and spatially qualitative characteristics, to become captured in an architectural sketch that engages the multiple affordances and resistances of virtual, real and embodied space. Our understanding of architectural drawing is that it is a complex interplay of conceptual and sensorial, spatial and material conditions, so is an ideal mechanism to prompt new insights into phenomena normally considered beyond architecture's domain. The *ED* project aims to intensify this capacity through a multi-modal drawing technique, pointing to an expanded field of architectural practice.

There has been a long and influential precedent for architecture inspired by natural phenomena. From the platonic tradition to modernist crystalline forms, to contemporary biophilia - metaphoric, literal and systemic interpretations of natural form and process are omnipresent. The reverse trajectory, where the spatialized nuance of design research influences the natural sciences has been minimal. Translation between design and science

was at a zenith during the time of Leonardo da Vinci, given the virtuosity of the Renaissance figure to be simultaneously architect, engineer and natural philosopher. With the onset of modern science, the disciplinary specificity of deductive / inductive methods has typically precluded transfers from design to science. One significant crossover of the 20th century occurred with translations between architecture and computer science. The need for three dimensional representations within architecture, provided an early driver for the development of computer graphics with key research at MIT, Georgia Tech and other design-based labs at the forefront of computer graphics. In a mutually beneficial interaction Christopher Alexander, influenced by early Cybernetics conceived his pattern language approach, which has been acknowledged as triggering the important concept of object orientated programming that underpins most software today¹⁴.

Within contemporary inter-disciplinary practice there has been recognition that the abductive reasoning of design process has application areas within science domains. The scale and complexity of contemporary research contexts provide open-ended wicked problems, where the iteration – reflection loops of design process can complement inductive and deductive methodologies. Moreover, the recent availability of large sets of spatialized data enable the expertise of 3D design disciplines (from product to landscape), to be leveraged in new domains. As an example, members of our team have explored a new approach to data visualization. At present visual analysis primarily depends on static and reductive 2D representations. Building on the precedent of 3D scatter plots, we have developed a mimetic approach to data mapping that merges spatial, aural and kinaesthetic attributes with VR abstractions of natural environments. While it would seem counter intuitive, information-dense virtual environments are theoretically easier to process than simplified graphic encoding - if there is alignment with human ecological perception of natural environments. This example, which was published in a leading journal within the information sciences¹⁵, is indicative of the potential for the spatial expertise of the design disciplines to add new insight to research within science domains.

The scope of potential applications for our multi-modal ephemeral drawing agenda is large, but to provide some focus to the project we are examining two areas in relation to geo-spatial data. The first is the burgeoning amount of social media information, alongside the spatial modelling of synthetic process such as economic systems and human demographics. The second, and the set that we will use the next series of projects, is the spatial representation of natural phenomena. As illustrated in Figure 3, the six domains of research activity provide a rich palette of contexts, where the nuance and openness of drawing can be applied and developed. This range of natural phenomena act as a prompt for exploring alternate tools,

techniques and material/ media/ mediums. Initially these will be produced as installations within exhibition venues, but these also act as pilot studies that develop working methods and illustrate potential for applications to interdisciplinary architecture/ science/ art projects.

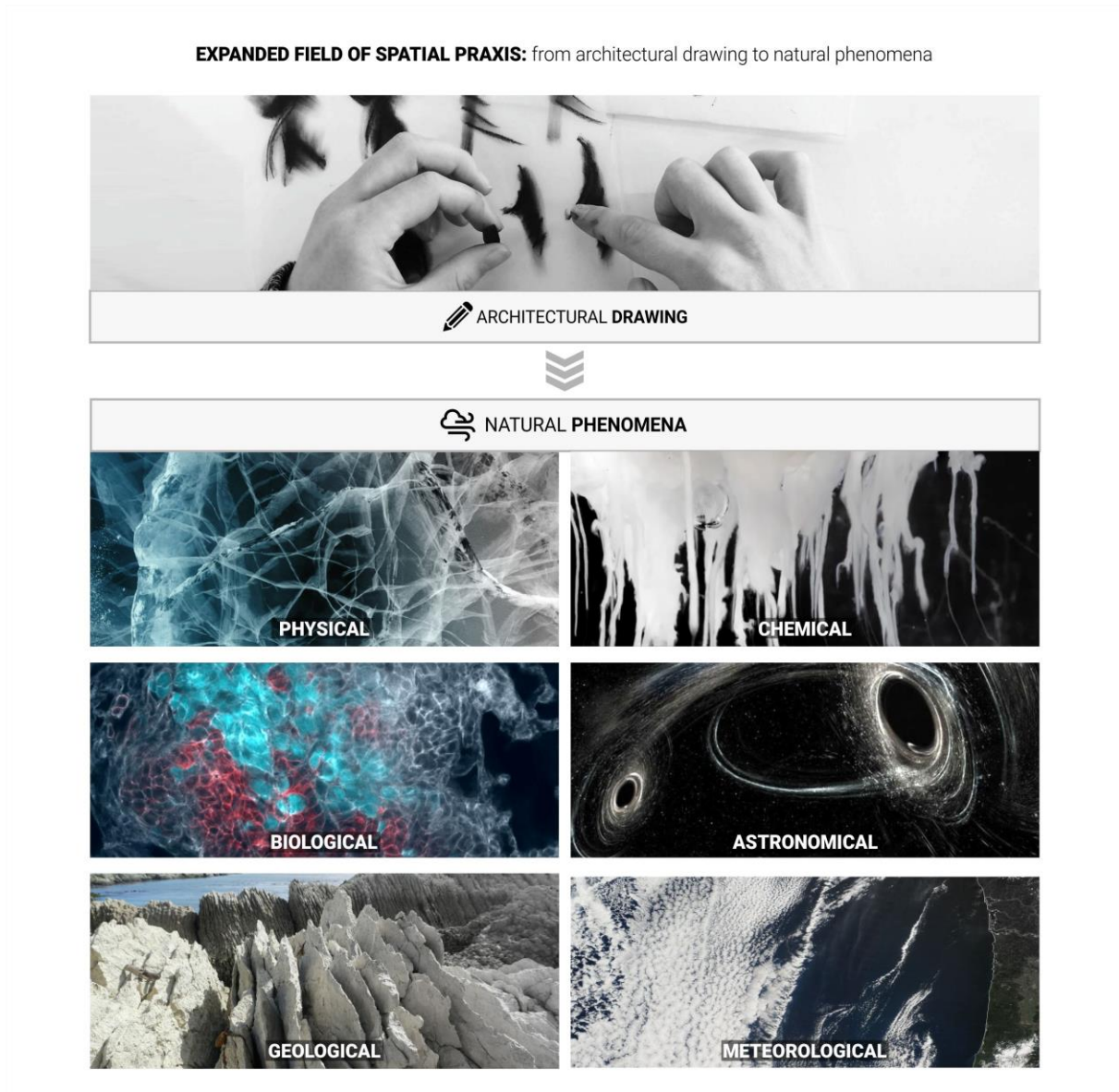


Figure 3. Expanded Field of Spatial Praxis, 2019.

***Ethereal Drawing* Research Threads**

This *ED* research is within a contemporary research context that spans new materialism, post-human philosophies, digital creativity and spatial imagination. These discourses provide creative friction and impetus to the *ED* installations and are possible areas in which they might contribute – through *ED* being an expansion of architectural acuity into other domains. The drawing experiments aim to extend or intensify architectural drawing, paying attention to externalised knowledge, feedback, and performative agencies. The *ED* project also supports

research into design research methodologies, particularly in the area of digital process. It connects to Peter Downton's thoughts on drawing as an experimental searching for limits, a "knowing in doing" used to find "both new knowing and new knowledge"¹⁶. It is also tied to Leon Van Schaiks work on the power of spatial imagination¹⁷ and to arguments surrounding art practice research methodologies, which hinge on maintaining creative uncertainty and contingency.¹⁸ Each of these research threads triggers a substantial body of literature and design research case studies, and the *ED* experiments aim to contribute to these discussions. However due to the scope of this paper only one area is briefly sketched below, expanding on object relations in multi-modal drawing.

In terms of *ED*'s relation to objects, the research intersects with N Kathryn Hayles' notion of Object Oriented Inquiry.¹⁹ This is a twist on Graham Harman's Object Oriented Ontologies (OOO)²⁰ which Hayles directs to a more inquisitorial approach to the agency of non-human agents, where human and non-human entities participate in a shared aesthetic through loops of inquiry and reaction. In *Speculative Aesthetics and OOI*, Hayles questions the centrality of human sense experience in aesthetics. She asks: "what would it mean, then, to imagine an aesthetics in which the human is decentred and inanimate objects, incapable of sense perceptions as we understand them, are included in the aesthetic experience?"²¹ She cites Pickering's Mangle of Practice²² and his loop-of-resistance - of objects throwing up resistances to humans' inquiry that alter the line of inquiry, forcing different questions to be asked. The non-human participants in the production of a shared aesthetic also impact on one another, as Jane Bennet notes: "it is through relations that one object senses the specific parts of another object's "appeal" germane for the first object's purposes and benefits".²³

These explorations into the aesthetic agency of non-human objects relate directly to the traditions of architectural drawing, in terms of feedback from the drawing medium, and from the non-human subject matter, and are intensified in the *ED* drawing project. *ED* attempts to augment the aesthetic influence of non-human entities, both in the phenomenal subject matter of the drawings, and in the real, digital and sensorial facets of their drawing.

Contingent Conclusion

In this paper we have outlined the background, methodology and scope of a collaborative project, *Ethereal Drawing*, which brings together design researchers with expertise in architectural drawing, algorithmic design, virtual reality and spatial sound. The primary theme that informs the collaboration is drawing as an imaginative spatial acuity, where creative uncertainty and contingency are to the forefront. The theme of the open drawing is expanded

to include sculptural practice, spatial sound composition and immersive virtual environments. To articulate a working methodology for the collaboration, the interplay between tool, technique and material/ media / medium is used to map out a range of design parameters. These parameters offer a terrain of possibilities and through deliberate experimentation with tools, techniques and material conditions, we anticipate alternate and potentially novel drawing methods to evolve.

As well as extending drawing beyond the confines of graphite, we have outlined an expanded field of spatial practice. Our premise is that the spatial acuity of the architect can productively engage with spatial representations of complex process, be they synthetic or natural phenomena. The aim of the research is for drawing experiments to distil ethereal architectures within contemporary phenomena and, in doing so, discover new ways in which they might be understood. The anticipated knowledge generation is thus twofold: an expanded field of drawing provides new methods that can inform architectural ideation; while the application of the experimental methods to complex spatial phenomena provide pilot studies for productive collaboration between architecture and other domains.

Endnotes

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² SimonTwose, Jules Moloney, Lawrence Harvey, 'Canyon: Experiments in Drawing through Analogue Sketching, Sound and Virtual Reality', in *ADR18 Annual Design Research Conference*, Sydney, 2018 (Sydney: University of Sydney, 2018), 179-194.

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⁴ Leon Van Schaik, *Spatial intelligence: New Futures for Architecture* (Chichester: Hoboken, NJ: Wiley, 2008).

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¹⁰ McCullough, *Abstracting Craft: The Practiced Digital Hand*, 81.

¹¹ Lisa Iwamoto, *Immaterial/Ultramaterial: Architecture, Design and Materials* (New York: George Braziller, 2002).

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²⁰ Graham Harman, *Tool-Being: Heidegger and the Metaphysics of Objects*, (New York: Open Court, 2002).

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²³ Jane Bennett, *Vibrant Matter: A Political Ecology of Things* (Durham, Duke University Press, 2010).