NANOVIBRANCY: AN AUDITORY PERFORMANCE OF NANOSCALE RESONANCE

Joel Ong

Nanovibrancy explores nanoscale activity by amplifying the oscilations at the surface of a model tympanic membrane in real time.The project repurposes the AFM by extending its reach into the creation of abstract, subjective and ephermeral sound.It shifts the observation of the miniscule from scientific eye to artistic ear, amplifying the resonance of reality and imagination through a confluence of nano and human scale listening.

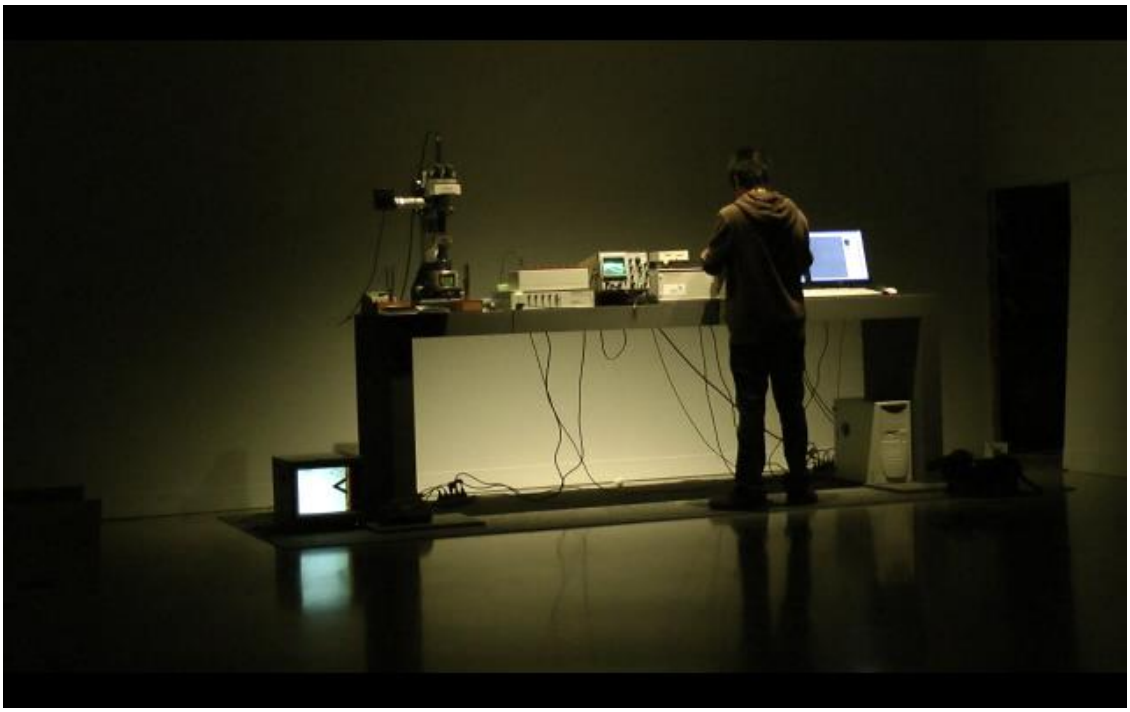

Figure 1: Screen shot of Nanovibrancy test run at the John Curtin Gallery, Perth. 2011. Image credit: Joel Ong.

Figure 2: Eardrum Man (2011). What would the eardrum sound like if we were small enough to stand on it? Image Credit: Joel Ong.

Introduction

This paper describes key concepts and processes behind Nanovibrancy, a sound performance installation that utilizes the atomic force microscope (AFM) as a listening device to record and amplify vibrations on the surface of a membrane. It rests the probe in the centre of a silk membrane that functions as a model for tympanic listening. In so doing, the AFM does not deliver a visual representation of the membrane insofar as it is tasked to provide an image of it; but more to determine its process over time and stretch the image into an evolving and ephemeral soundscape.

The project aims to subvert the premise of visual imagery in the current climate of nano-scientific observation through audile, subjective and ephemeral data derived from the AFM scans in real time. It is also site-specific in that it creates an immersive sonic environment fusing the nano-scale resonance of vibratory matter and the human-scale acoustical environment of the gallery space.Nanovibrancy was presented as a durational performance-installation at the John Curtin Gallery in July 2011. (Figure 1)

While the AFM is still an image-creating machine (albeit through complex but arbitrary algorithms), it removes the distance required by the focusing lenses of light-based microscopes and actually contacts the sample's surface as a way to gain atomic resolution. This emphasis on touch as the operant sense for nanoscale perception therefore allows a reordering of the scientific observation strategies commonly associated with microscopy. In addition, it also offers the chance for an artistic, poetic representation of the nanoscale environment. Since the sample's vibrations are highly influenced by environmental factors like ambient noise, air flow, temperature and humidity, this process reflects a vibrancy and agency that is not only centered on the sample, but also in its dynamic position within the environment.

Sidelining Occularity

The invention of the Scanning Probe Microscope (SPM) and its offshoots the Scanning Tunneling Microscope in 1982 and the AFM in 1986 by Gerd Binnig and Heini Rohrer (Binnig and Rohrer, 1986) revealed that to image high-resolution samples at the smallest scale possible, light had become obsolete.

While conventional optical approaches reflected light off the sample through a series of lenses, these devices worked by directly interacting with and touching its surface. The resolution possible was now beyond the effective wavelength of light, inaugurating a range of microscopes that could see into the nanoscale, but ironically were 'blind'.

This invention of the SPM technique signaled a paradigm shift that Peter Galison (2006) refers to as replacing visual ontology with an action or intervention. In so doing, the visual output of the microscope becomes connected to this ability to contact and change, becoming sidelined as a sensory accomplice in the creation and manipulation of nanostructures. Thus the image ceases to be an end in itself - even more than just highly publicized and highly seductive icons of a new science, they implicate the objects they depict as malleable and kinetic.

In Michel Certeau's 'Walking in the City', he describes the vertiginous experience of one observing the street from the top of the World Trade Centre as being created in distance and removal from the "grasp of the city", and later the collective experience at street-level of pedestrians as a "swarming mass (that) is an innumerable collection of singularities" (Certeau, p155). He describes the way in which sight functions as a voyeuristic activity that immobilizes the mass of individuals from a distanced perspective. To

walk the streets of the city therefore warrants an Icarian fall - to place oneself under the threshold of visibility 'down below' and to be immersed as a walker, a Wandersmänner, charting the trajectories of movements as a subjective and durational activity.

Salome Vogelin adds that the 'godlike' view from the tower results in total, objective knowledge whereas the activity of the man on the street is not receptive, but exploratory:

"De Certeau's city on the ground level is created by these blind practitioners, who by association hear rather than see its text, 'make use of space that cannot be seen' and produce with their footsteps the city as a heard phenomenon." (Vogelin 2010, p92; Certeau quoted in Vogelin 2010)

In the same way optical methods of observation and image creation that rely on focal distance are sidelined in favour of the physical exploration of the cantilever on and in the membrane. Nanovibrancy relies on this performativity of the membrane as process, replacing the static visual ontology of the sample with an auditory documentation of its material agency. The position of the listener in this case is explored between his/her bodily presence within the soundscape and the perspectival distance arising from the representation and mediation of nanoscale audition.

Leaning on the surface of a Membrane

Nanovibrancy is as much a performance as it is a passive observation. Any sound that is heard relies on the inherent agency of the membrane, rather than on a form of composed or pre-determined activity. This inclination to inflict and impose oneself on the activity of the membrane is both an artistic and scientific tension. Since nanotechnology offer the capabilities to manipulate atomic particles, the impetus to 'do' something rather than just passively observe matches the expectations of sub-molecular rearrangements, attaching and removing individual atoms, or even leaving marks on the surface as experimentally useful procedures.

The sounding of a membrane that 'amplifies' rather than 'affects' it emphasizes the sounds that are already present in it. Jane Bennett refers to the "capacity of things . . . not only to impede or block the will and designs of humans but also to act as quasi agents or forces with trajectories, propensities, or tendancies of their own" (Bennett 2010, viii), echoing Bruno Latour's definition of the "actant" which is a source of action which has an individual efficacy and the ability to modify another entity. The membrane is seen, and heard, as an actant, with its own agency and efficacy.

But as a membrane - a flap of freely suspended 'skin'; it is implicated as an active listener of its environment, extending the repository of internal sound to include its acoustic environment. Scanning the membrane reveals its internal structural mechanisms and the inter-atomic foces at its surface; it also reveals its exteriority within the medium of air and the vibrations it experiences as a result of gaseous atomic activity. The membrane thus becomes a dynamic actant whose agency is reflected in a state of becoming within its external acoustic milieu. Gaston Bachelard argues:

In its energetic folding the atom is becoming as much as it is being, motion as much as it is object (Bachelard quoted in Andrews 1992)

Similarly, the membrane as dynamic process literally and metaphorically usurps a visualist definition of the 'object' - it does not offer a static depiction of the sample. Instead, it stretches the effective image

into the observation of a process – of the object as a vibrant participant within its environment occupying a transitory middle ground "between potential and actual" (Andrews 1992).

In Nanovibrancy, the listener is brought into the space of the nano-cosm through a sharing of the acoustic environment of the membrane. Listening to the membrane thus creates a dynamic continuum that connects the listener and the object in an ensuing relationship within these energetic oscillations. The perception of sound is determined by the physicality of all the components that conduct it. Therefore, the physiological hearing activity, its model through the silk membrane and AFM assembly in Nanovibrancyexplore their "energetic unfolding" within the acoustic environment, becoming indicative of the continuum of vibrations through the membrane, air and listening bodies. As Salome Vogelin describes:

Listening produces me as a dynamic subjectivity intertwined with the dynamic things that are thinging the life-world rather than in relation to a substantial and permanent vis-à-vis of a transcendental world. Any connection of myself to another thing or subject ensues in this dynamic. (Vogelin, p 94)

By extrapolation, everything present is a dynamic actant involved in the sensitivity of the membrane. This presents an interesting contrast between the reductionist ontology of the 'atom' and the expansion of an ecology of materials into the macro-environment where it is defined not by itself, but in its enfolding external relationships. Georges Canguilhem's defines the milieu as "an array of decentred and mutually influential relations between an organism and its surrounding environment" (Canguilhem, quoted in Roosth 2009). By extension, the acoustic milieu therefore can be said to be made up of mutually influential assemblages of organisms and their environments within a landscape of vibratory oscillations.

The assemblage in Nanovibrancy is made up of connected things extending the vibratory continuum upward and outward into anything and everything in the environment but extends even further through the air in the room into the listening bodies.

The model of tympanic listening through a membrane implicates the physiological hearing pathway as a series of connected, conductive mechanisms all grouped in an assemblage that effects the eventual signal that is perceived, even as it is an indication of an inter-subjective phenomenon.

From the listening body, the room as the metaphor of a resonating chamber implicates its structural components as material participants rather than passive observers of the performance. Sound accentuates the physical construct of an architectural space because at certain "resonant frequencies", the walls of a room will begin to ring, presenting every constructed space as a palpable entity with its own sonorous potential.

In Nanovibrancy the perpetuating feedback loop between the listening membrane and the gallery space becomes an aggregating mass of auditory feedback. These frequencies that arise through this process do so at the natural resonant frequencies of the architecture. Albeit, the architecture is a dynamic entity in itself, responding to change in variables like human movement, air flow, thermal flux etc.

Imaginative Listening

Sounding the membrane does not only reveal the material assemblages that bridge the listener and the object through conductive resonance; but through the cognitive activity of listening, it furnishes an imaginative proximity to the source.

Sound draws together the sounding object and the listening body in a relationship fortified by the acoustic connection of the two. Where Nanovibrancy aims to bridge the distance of scale, this is not an acoustic one but more an imaginative one. By amplifying the membrane, it presents the illusion that transplants one, blind, onto the surface of the membrane – What would the eardrum sound like if we were small enough to stand near it? (Figure 2)

In the metaphor of the nano-scopic microphone, the stimulation of "magnified" listening also presents a duality of cognitive spaces. In the first instance, the recording of nanoscale vibrations situates the context of listening within a visual causation of atoms vibrating i.e. my mind sees images of the atom in motion, the atom in the assemblage and so on because I know that this is the supposed result of the experimental setup. But in alluding to a post-perspectival space away from the inclination towards visuality, perceiving the space of the nano-cosm becomes a fundamental activity in reduced listening. It becomes an imaginative, mythological realm where the image is abstracted into its visceral, somatic and immersive soundings. In this position, I do not know, and I do not have to know what exactly constitutes these vibrations, I hear, feel and am immersed in it as a tangible, vibrant and energetic gestalt.

Nanovibrancy thrives on the imaginative experience of sound, one that emerges from sensory extension of our ears into the nanoscale. In the actual performance, the sounds that were present in the gallery space were not stylized representations of nano-activity; instead I sought to present the sounds as they were. As a result, there were often patches of silence, or low-level static sweeps that were not the most interesting sounds possible. This artistic tension in allowing the sounds to be themselves became a defining character of the performance and the developments leading up to it.

Conclusion and Further Thoughts

Nanovibrancy thus presents a site-specific installation performance that subverts the optical expectations of an objective science. Through its amplification of the minute vibrations on the membrane's surface, it unfolds the nanoscale interactions of molecular bombardment and thermal interference as an evolving soundscape over time. This enhances the emerging rhetoric of nanoscience as being invested in the materiality of atoms and molecules and their interactions with each other, and within the broader molecular environment. With the proliferation of haptic feedback devices that provide users with more tactile control over their samples, the visual output would then become connected to this ability to contact and change, becoming more of a sensory accomplice in the creation and manipulation of nanostructures.

In its ability to reach into the nanoscale, nanoscience becomes a milestone in the creation of scientific knowledge. This potential to now see, touch and hear at such a small, yet physically grounded scale goes beyond the social constructions of art and science. And in the work of Nanovibrancy, it reveals a deeper essence that is found within the vibratory continuum existing at the nanoscale. The words 'minute', 'miniscule' and 'infinitesimal' that litter the discourses of nanoscience become more than imaginative sources but palpable entities; the connections we forge across scales of perspective are now

founded within the common ground of vibrant matter. Our listening ear is to be reinvigorated by knowing its place in the atomic assemblage, and our imaginative minds brought to new spaces of creative exploration through the immersion of sonic potential.

Gaston Bachelard reveals in the Poetics of Space that such imagination of the miniscule cannot be founded upon the logic of human-scale perception, but instead need to be subtended down the rabbit hole of abstraction and absurdity. And as Nanovibrancy locates itself between the spaces of material resonance and mythological imagination; the milieus of fact and fiction, the fertile grounds of imagination and reality now collide and reside in close proximity with each other.

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