

***Immersive Pipeline* research report**

by Dr. Blanca Regina. June 2018.

Last review Jan, 10th 2019

Supervised by Prof. Atau Tanaka.

Abstract

This report examines immersive experiences in the context of social shared spaces. It presents the *Immersive Pipeline* research project led by Prof. Atau Tanaka and funded by the AHRC/EPSRC Research and Partnership Development call for the *Next Generation of Immersive Experiences* from January to June 2018. It covers a historical and technological overview of state of the art on this field, cases of study and interviews in depth with some of the participants.

<https://vimeo.com/303504093>

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<http://sonics.goldsmithsdigital.com/immersive-pipeline>

1. Introduction: What is an Immersive Experience?

Sound and image constantly surround us, their presence is ubiquitous therefore we are all part of an immersion, whether or not we are aware of it. Immersive experiences introduce audiences to digital journeys where they are transported through any sort of device to any kind of content from for example, a social media thread to an educational science project, an architectural simulation, a film, an art installation or a mediated performance. Immersive experiences take on forms of audiovisual communication configuring mediated enveloped environments. From experiences on telephones to multichannel screens in physical or virtual spaces. In the Immersive Pipeline project, we investigated the different kinds of immersion and narrativity and ask whether they are individual or collective experiences and how are and can be transported from one to another scenario.

1.1 Spatial cinema, introduction to the elements of a shared immersive audiovisual experience.

While digital technologies are relentless in pursuing novelty, a century of development in the history of film, expanded cinema, and the evolution of narrative, have introduced audiences to a number of immersive audiovisual storytelling projects and spatial cinema.

On these experiences, we have witnessed constant format changes in music and visual arts and the transformation and advances in the history of digital video and sound, linked to the evolution of computing developments. These inter related practices and mediated forms of presentation connect with the pre-cinema inventions such as diorama, panorama and the multimedia performances by Georges Méliès 'phantasmagorias' developed at the end of the XIX century that led to many developments in narrative, film language and technology.

Throughout the last century, we will witness the transformation from the mechanical to the digital era, entering in the XXI Century with a new technologic and media landscape, the digital and immersive culture.

Buckminster Fuller carried out early experiments with domes and immersive architecture in the 60's and wrote the prologue to Gene's Youngblood, *Expanded Cinema* (1970). This seminal text introduces the concepts of intermedia arts and multimedia culture as new artistic contexts for film and video. *The Expanded Arts Diagram* (1966) by George Maciunas includes Expanded Cinema and many interrelated art forms from verbal theatre to anti-art, linking cinema and other art-forms. These ideas were later expanded at the London Filmmakers Cooperative in the UK since the early 70's onwards.

According to Dr Karel Doing¹, fundamental events on the history of immersive experiences are 'The Vortex Concerts' held by Jordan Belson and Henry Jacobs in 1957 to 1959 at the Morrison Planetarium, San Francisco and Stan VanDerBeek's *Movie-Drome* theatre at Stony Point, New York in 1965. Stan VanderBeek (1927-1984), who was an american student of Buckminster Fuller at Black Mountain College, imagined that theatres would be connected via satellite

¹ Karel Doing presentation at Immersive Pipeline Workshop, from Expanded Cinema to the Immersive Pipeline, April 2019, Goldsmiths London

transmission and that images will be sent across the network, connecting people all over the world helping them to understand each other and eliminating the reason for war. Pioneers of immersive experiences, VanderBeek created the 'Movie-Drome', a dome theatre built by himself with multiple projectors that surrounded the audience. The novelty of the situation required him to give directions to the audience explaining to them what will be the best way to experience the event. At the 'Movie-Drome' the audience will be lying on the floor with their feet towards the middle of the space. Vanderbeek was going around the space performing with slide-projections that completed the multi-projection experience while he was also drawing on overhead projectors. This positioning of the audience in the space introduced a new concept of experience. These same design ideas will set a precedent and a field, developed further at the current immersive spaces around the world and in our present times.

1. 2 From single user VR to shared immersive experience.

Notions of reality and space had broadened experientially through digital media. According to the pioneer in media studies, Marshall McLuhan, our senses and experiences are expanded by the media that surround us and that through every day use, our perception and consciousness includes these mediations naturally and as 'by osmosis' transferred to new generations.

With computer-based stereoscopic display technologies have appear, virtual reality, augmented reality, mixed reality (as well as mediated reality and diminished reality² and other new terminologies that emerge as new technologies arise). These related concepts have been developed to the point that the limits that separate them become increasingly invisible – they represent forms of immersive experience. As digital media objects, they can exist in variable forms, potentially in infinite versions.³ These definitions are different points along a spectrum of immersive computing, spanning digital and physical space.

The immersive culture connects with new audiences experiencing multimedia content at high speed. VR headsets provide an individual simulation of total immersion by delivering high-resolution audiovisual experiences. In isolation, any reference to the physical space is transposed to the virtual space, body, space and time awareness decreases as there isn't any contact with any external and environmental factors. This isolation is connected to the use of technology on a single user experience setting.

In contrast, the production of immersive experiences in a physical audiovisual environment connects us with the social and visceral experience and its collective expansion through technology. The event becomes of a shared immersive experience with multichannel video and

² - VR/ Virtual reality creates a simulated world once ones place the VR headset or eyewear. An experience that transports the user to a different place that is generated entirely by technology.

- AR/ Augmented reality overlays generated images or video on top of the reality. Is integrated into video games, marketing strategies in the form of catalogue apps...

- MR/ Mixed reality (MR) combines both generated images and real-world object, providing a real-world presence to intelligent virtual objects with human interaction.

³ According to Lev Manovich the principles of New Media are numerical representation, modularity, automation, variability and transcoding. The Language of New Media, 2011, The Mit Press, Cambridge, Massachusetts.

surround sound composition. In these venues, we can enjoy without the need for VR eyewear or headphones.

There are now numerous immersive cinema projects and audiovisual performances created for surround cinema. In the UK, examples of this spaces are the IMAX cinemas, which screen size is comparatively more significant than a regular cinema. Other venues present even bigger surround screens and sound systems facilities including spaces with rounded vaults, for example, the dome at the National Space Centre in Leicester and International Space Innovation Centre in the UK with 9.5K and 28 sound system channel video wall and satellite applications.

For the last 20 years we have witnessed the creation of new education programmes, audiovisual companies, venues, festivals and new audiences for the digital media entering in the realm of new media immersive content, language and legacy of the electronic media and culture. New technologies are connected to new narratives shaping the digital culture and future. The understanding of this cultural shift and its implications is vital to understand how they can help drive social and economic prosperity. Immersive technologies are connected to the shared immersive and social experience, bringing these audiovisual immersions to a physical space and as a collective experience rather than an individual one using goggles or screen devices.

2. Immersive Pipeline research objectives.

The Immersive Pipeline research project⁴ was funded by the AHRC under the Next Generation of Immersive Experiences programme and looked at the production of pipelines and translators for the authoring, sharing, and touring of immersive audiovisual performative artworks.

Partners of the project included the some of the most relevant and pioneer institutions in this field, Société des Arts Technologiques, Institute for Sound and Music, Recombinant Media Labs, Sonic Womb, GarageCube, publisher of MadMapper and Modul8, Derivative, publishers of TouchDesigner, NSC Creative, UK distributors of Front Pictures.

The research project aimed to create content production pipelines to allow artists to concentrate on the creative aspects of their immersive works, and facilitate the conversion and translation of existing works from one format to another. The project goals were also to provide a research platform and to answer the following main questions:

- *Can we identify best practice in immersive production techniques to define an authoring workflow for new immersive audiovisual performance works?*
- *Can we draw upon the wealth of existing practice for it to drive technology development, instead of technology determining creativity?*
- *Can we create technologies for the translation of creative work from one immersive format to another in such a way to maintain original creative intent, and liberate works from being inadvertently site specific?*

⁴ Immersive Pipeline Research project <http://sonics.goldsmithsdigital.com/immersive-pipeline>

The project ran in the six-month period, January to June 2018, and consisted of a workshop; a performance event; site visits to partner sites; festival/conference presentations; and the development of hardware and software prototypes. The project conducted ethnographies of prominent artists, curators, and technologies, gathering data and testimonials from national and international experts on the field. The project research was carried out in the Embodied Audiovisual Interaction (EAVI) research unit, and its events took place in the Sonics Immersive Media Labs (SIML) facility, both at Goldsmiths, University of London.

3. Immersive Pipeline research development.

3.1 Immersive Pipeline workshop –February 12-13th, 2018, Goldsmiths, London.

A scoping two-day workshop was held on February 12-13th, 2018 Goldsmiths, London and gathered project partners, national and international academics, artists and practitioners specialized in audiovisual experiences and immersive media. The sessions presented historical and technical overviews; descriptions of current and best practices; mapped out international networks connecting education, research centres, and industry. In addition to the project team, core participants included: Luc Courchesne (SAT), Naut Humon (Rml CineChamber), Dr Karel Doing, Nick Meehan (Hexadome), Paul Mowbray (NSC Creative), Francois Wunschel (MadMapper), Prof Julian Henriques (Goldsmiths) and Dr Blanca Regina. In addition to workshop presenters, discussion sessions included the participation of students, artists, and programmers in attendance.



Dr Karel Doing⁵ introduced the history of Expanded Cinema as a precursor of the current wave of immersive experiences and spaces. Introducing the pioneers of experimental cinema, Doing introduced film performance and its transformations as central element of immersive audiovisual practices.

Luc Courchesne a founder member of S.A.T (Societe des Arts Technologiques in Montreal) presented his lecture via Skype, somehow as a glimpse to pioneer video artist, father of video streaming Nam June Paik. From the SAT in Montreal, Canada, he started his intervention by recounting how he had witnessed Buckminster Fuller's geodesic spaces as a child in the sixties

⁵ Karel Doing's thesis 'Ambient Poetics and Critical Posthumanism in Expanded Cinema' enquires the possible overlaps between these different fields. In conclusion he proposes new forms of humility, doubt and listening to be advanced in today's over-confident and exploitative human culture.

during World Expo Montreal. Artist and academic, Luc is a new media artist who has produced multi-screen interactive narratives since the 1990s. Starting with four rectangular screens, he eventually developed bespoke systems for live action filming in 360°. The SATopshere was built in 2010 and is a public full dome venue housed in the S.A.T. Arts Centre. In 2014, they began to organize the annual Immersive Experience (IX) symposium series. IX refers to immersive experience design as a parallel to UX, or user experience design. For Luc, coining the term, immersive experience, provided the SAT with a way the VR community without being limited VR.⁶

Naut Humon presented the CineChamber⁷ as well as a series of immersive projects he carried out since the 1980s and 90s. Under the name, Sound Traffic Control, they began with multichannel sound and immersive theatre and eventually added multichannel image projection. As Recombinant Media Labs, Naut has worked as a curator and organizer, presenting Kurt Hentschläger & Ulf Langheinrich's duo Granular_Synthesis groundbreaking work, + MODELL 5. With CineChamber, Naut moved from spatial sound to spatial cinema. In 1999, they presented, *9 hours 9 minutes and 9 seconds* on September 9 of 1999 at Ars Electronica in Austria, Linz consisting of 61 timed modules created by 33 participants.

When you get a large canvas, you really have to think and rethink of how are you going to deal with spatiality. We were working for years with spatial sound putting speaker in each corner but in this environment you do have speakers in each corner and you can see it so you can work with surround sound. But when you are dealing with spatial image how do you coordinate that? How do you compose that? What are the challenges⁸?

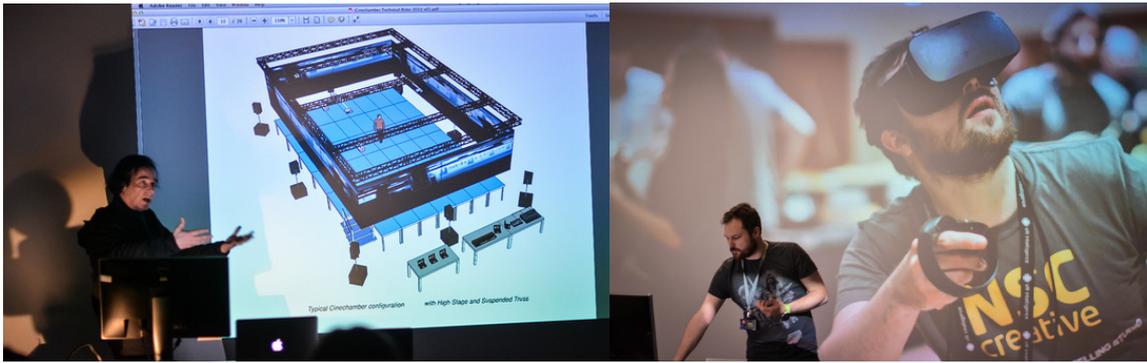
The CineChamber stabilized as a ten-screen configuration (8m x 12m) in a rectangular shape with 16.8.2 surround sound. Initially set up in San Francisco it has since been set up in different venues such as theatre stages, concert halls, and auditoriums in the US and Europe including in 2011 at CTM⁹ at Haus der Kulturen der Welt in Berlin. They have commissioned numerous modules, installations, performances and workshops including works by more than 50 artists including Maryanne Amacher, Edwin Van Der Heide, Ryoichi Kurokawa, Christian Marclay, Fennesz, Lillevan, Masako Tanaka, Blixa Bargeld, Carsten Nicolai, Frank Bretschneider and Ryoji Ikeda. Recombinant Media Labs hosts artist residencies and organizes an annual festival in San Francisco.

⁶ Luc Courchesne talk at [Immersive Pipeline Workshop](#), February 12th 2018, Goldsmiths London.

⁷ CineChamber <http://recombinantfestival.com>

⁸ Naut Humon Immersive Pipeline workshop April 12th 2018. Director of RML Cinechamber <http://rml-cinechamber.org>

⁹ Cinechamber at CTM <https://archive.ctm-festival.de/archive/ctm11/transmediale11.html>



Paul Mowbray presented the work of NSC Creative, a Leicester-based creative and technology studio. NSC Creative has access to the largest planetarium dome in the UK with 18 meter diameter 360° dome environment, the National Space Centre in Leicester. A smaller version of the Dome, three meters of diameter negative pressure studio dome created for demos and prototyping and is available for touring. Mowbray is co-producer of Full Dome UK, a festival focused in immersive experiences created in 2012. NSC Creative produces content for VR in stereoscopic 3D. NSC Creative is UK distributor for Ukrainian software company, Front Pictures, publishers of the Screenberry 360. This multi-projection and auto-calibration projection mapping software is a multi-calibration system that has a multi-stage auto-alignment system that does edge blend and intensity mapping. This system allows a fast turnaround for complex projection environment like a curve space and allows the performer and artists to focus on the experience and allows capture of the image and transfer to the system that is calibrated to the area. Paul described that the challenges on immersive experiences are on how to expand and to design to a specific eye point, getting away from that averted vision or 'sweet spot' and how there are also other options for artists to visualize, test and prototype a project in VR. Mowbray introduced composition strategies for creating visuals for virtual reality projects and immersive spaces

François Wunshel architect, artist and programmer cofounder of Madmapper¹⁰ discussed the essential relationships between the built environment, its sight and surroundings. His work is between the physical and digital work, based on the understanding that architecture is immersive, as one has to go inside it, and is experienced as one lives in it. The digital element is combined as another layer that adds on top of that reality. Therefore the pixels of the image can be understood in two ways, one as a character of the story and the other as the environment, space. On the tools and elements that enable these, for design and creation of space, they work adding lighting to the architecture and video using video mapping. For that, they designed the tool Madmapper to be able to address these different realities at the same time software that allows transforming the lighting and the video projection of a specific space in real time. They can match the physical and the digital with it. In architecture they use Autocad but with Madmapper allows you to draw in the space directly in real time. Regarding his experiences with full dome performance he pointed the following:

- *Immersive = all you know is wrong.*
- *Immersive = constraints, as a direct access to creativity overcome the challenges.*

¹⁰ Madmapper <https://madmapper.com>

Regarding audience studies, in immersive experiences the movement of the audience is dynamic not static. Looking at the idea of the context of place and how can we associate this with the experience itself. The idea of place is a significant part of the immersive experience. Therefore, when you walk into space, there is an experience expectation so going into a cinema, a museum, a community where there is a high concentration of visual and sound art.

On the subject of space and its importance, Nick Meehan, Artistic Director of the Institute for Sound and Music (ISM Berlin),¹¹ presented the new immersive audiovisual facility and project Hexadome.

Initially focused on sound, immersive art and electronic music, as the three points of demonstration, their project *Hexadome* is an example of immersive experience in site specific, comprising a structure with six screens and a multichannel sound system, presented in May 2018 where they commissioned more than ten artists pairing sound and visual artists including pioneers as Brian Eno and Tarik Barri, Holly Hendon and other seminal artists of audiovisual immersive experiences.

Prof Julian Henriques from the Media & Communications department at Goldsmiths made two presentations, a science communication project, and a multi-screen graphical story. The Sonic Womb project, carried out in collaboration with medical researchers at University College London, looks at the most intense immersive experience, the baby gestation in the mother's womb. Looking at what the auditory world inside the womb is like, their work focuses on finding a way to demonstrate what the baby hears initially, presenting the results to the medical profession in order to understand the damage that is done to the babies in incubators. This project is initially designed on medical grounds to understand how the experience of the new babies can be improved. What was found is that the baby has three channels of sounds. They initially designed the *Sonic Womb Sound Orb* presenting an individual experience and their future looks at the immersive collective experience. With the Immersive Pipeline project, they seek to add a visual dimension to the current immersive auditory experience.

Dr. Blanca Regina presented the initial case study related to the conversion and translation of immersive projects, from conversion of technologies to adaptation to different spaces.

The session included two discussions around the state of the art. Participants included Chris Allen (The Light Surgeons), Vicky Bennet (People like us), Nick Rothwell (Ravensbourne University), Steve Beresford (musician), Francisco Bernardo and other PhD students.

The discussion introduced the new topics and provided data for our research that is developed in our conclusions,

What tool needs to be developed or provided in an immersive facility?

What are the conditions and accessibility to work on these spaces?

¹¹ ISM, Hexadome <https://berlin-ism.com/en/about>

If artists may confront the same problems, what can we make available so where an artist?

What can kind of works can we create in these facilities?

How quickly you get adjusted to the space as an audience, in the darkness and with the sounds coming to you?

3.2 Immersive Pipeline performance event at S.I.M.L. – April 12th, 2018, Goldsmiths, London.

The Immersive Pipeline performance event was a presentation on immersive audiovisual performances at Sonics Immersive Media Labs (SIML), at Goldsmiths University of London on April 12th, 2018. The research hosted a micro-residency with local and international artists where we produced presentations of their work and their work in process at a surrounded audiovisual facility with floor to bottom screens, six projectors and a surface area of nine meters long and five meters and a half wide.

The event presented four different live performances with enveloped sound and video of a total duration of twenty minutes each. Each work presented different aesthetic, narrative approaches, and methods for the creation of enveloped sonic and visual compositions for immersive experiences. From film-based content modified with real-time effects to procedural graphics and sounds, generated by code and computer algorithms. The presentation of the works lasted an hour and accommodated sixty people in each presentation. Throughout the day, three presentations were showcased, one for academics in a short version and two for the public in the hour version. The public performances and micro-residency provided an opportunity for artists to reflect upon their practices and methods and introduced a new catalog of immersive audiovisual works to researchers and audiences in the UK.

Lillevan Recherche and Atau Tanaka presented three short audio-visual immersive pieces looking at the body as a source of the sound, image, and physical expression. Atau's sound performance was generated with a sensor system detecting the electromyogram (EMG) signal, electrical impulses from the nervous system causing muscle tension, and renders a musical instrument the performer's own body, allowing him to articulate sound through concentrated gesture. Lillevan's abstract moving images created immersive organic scenarios of some natural phenomena where Atau was framed. The movement of Atau produced and modified the sounds that were extended through the graphics emulating fire, water and gas. Lillevan's organic compositions and poetic metaphors were films processed in real time responding to the audio performance with the tool for visual performance, Modul 8¹², connecting the graphics to the

¹² Modul8 is a software for live visual performance developed by GarageCube, a company established in 2005 by Yves Schmid and Boris Edelstein, based in Geneva, Switzerland. Modul8 was started with the intention of providing a tool for VJing in OpenGL www.garagecube.com/modul8

sonic performance. The audiences were on the floor directing their sight to Atau's body and arms that were generating and controlling the sound with his movements. *Loup*, a single short recorded sample of howling wolves that are stretched and transposed, creating a continuous growling. *Lifting*, where whistling oscillators are modulated in frequency and amplitude, recalling the classical Theremin. *Myogram*, a direct sonification of muscle activity where we hear the neuron impulses of muscle exertion as data.



Alex Augier and Alba G. Corral presented their work in process *end(O)* an immersive audiovisual performance that comes to life each time differently.

Their work at SIML provided an opportunity for the development of their first immersive audiovisual work in progress that a month later was expanded and translated to the dome at S.A.T. for a presentation at Electra Festival in Montreal, June 2018. The duo with Alba creating the visuals and Alex working on the sound immersed the audience in a dreamlike experience for twenty minutes. That was of a surrounded canvas for a real-time painting that evolved into a moving image composition with sound, configuring an abstract expressionist audiovisual immersive work created with procedural graphics using a self-made tool created in Processing¹³ that was receiving data from the sound via OSC¹⁴.

All OSC data are float, from 0. to 1 (normalize).

OSC data come from Alex sound devices,

- Ableton Live, using a MaxForLive patch:

- To write visual controls according with the music. For example, to change a global visual preset and allows Alba to focus on another (and more interesting) control. In this case, it looks like an envelope/automatization.

- To write some triggers according with the music. For example, each kick is connected with a trigger and Alba can use it to make what she wants. For example, to change the colour... In this case, it looks like a MIDI note.

¹³ Processing is an [open-source](#) graphical library and [integrated development environment](#) (IDE) designed by Casey Reas and Ben Fry for the electronic arts, [new media art](#), and [visual design](#) communities with the purpose of teaching non-programmers the fundamentals of [computer programming](#) in a visual context. Processing uses the [Java language](#), with additional simplifications such as additional classes and aliased mathematical functions and operations. <http://processing.org>

¹⁴ OSC stands for open Sound Control a digital protocol for networking sound synthesizers, computers, and other multimedia devices for purposes such as musical performance or show control.

- Max patch. Alex uses the patch for spatialization and FX control (monome, arc):
 - To synchronize visual parameters with the space position of sound
 - To synchronize visual parameters with my controllers ((as filter, drive...). For example, they could synchronize the sound filter with the brightness....

OSC data was sent with 60 Hz frequency to be synchronized with Processing fps and refresh rate of screen. Alex uses a [speedlim] object in Max to do that a [change 0.] object to sent only data that changing (object).

For the artists, the conception of this work followed the concept of *Gesamtkunstwerk*, implying that one dimension did not take precedence over the other but is completed. The electronic sounds where spatialized connecting its movement to the abstract landscapes and colorful moving images created by Alba using real-time painting gestures on her tablet, and changing her composition with midi signals.



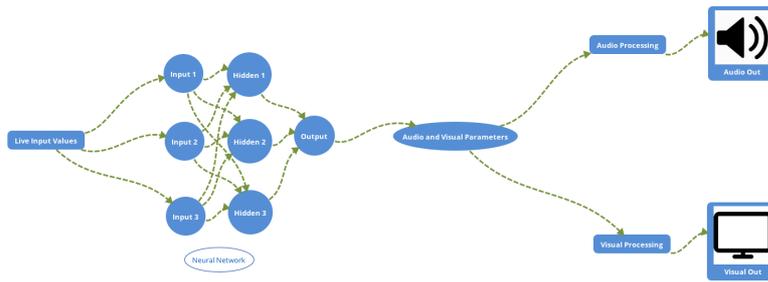
Bryan Dunphy presented a solo performance with procedural sounds and graphics created in OpenFrameworks.¹⁵ With a minimal aesthetic in sound and visuals space was transformed in an electronic landscape with moving 3D audiovisual objects. For ten minutes, the audience was immersed in a computer graphics space as if were floating in an abstract video game environment that was modified by Brian pulses changing in real-time. Following the visual music tradition, Bryan's created generative 3D procedural graphics with three different color groups that represented a different frequency band (low, mid and high) The green tones represented the low frequencies, the grey tones to the mid-range and the purple tones to the high frequencies. The graphics and audio were not affecting each other but coming from the same source, a trained computer neural network that displayed audio and visual outputs that Bryan chose and displayed for his artistic purposes. The sound composition of the piece was with the audio synthesis of additive and frequency modulation synthesis. Whilst the audio and visuals are not directly affecting each other in code, the artistic mapping of audio and visual material in the training phase was based on the phenomenon of cross modal ventriloquism where similar movement in sound and visual material help to bind the two media in the audience's perception.

Diagram of the performance setup for Ventriloquy 2 by Bryan Dunphy

¹⁵ OpenFrameworks is an open source toolkit designed for "creative coding" founded by Zachary Lieberman, Theo Watson and Arturo Castro. OpenFrameworks is written in C++ and built on top of OpenGL.

<http://openframeworks.cc>

Live AV Performance System



Throughout the week we conducted one to one interviews with the artists involved Alba Corral and Alex Augier, Lillevan and Atau Tanaka and Goldsmiths Ph.D. student, Bryan Dunphy.

The immersive audiovisual performance event was a demonstration of the primary goals of the project, also for the conversion of works from one space to another with a different technical setup.

3.3 Visit to Hexadome, a new immersive facility – April, 2018, Martin Gropius Bau, Berlin

'Hexadome' is one of the latest new spaces for immersive audiovisual designed by ISM, Institute for Sound and Music, presented at the museum Martin Gropius Bau in Berlin in Germany, in April 2018. It is an audiovisual space with fifty-six speakers, and six screens all surround. It was developed by the ISM in collaboration with Pfadfinderei and ZKM, Center for Art and Media and incorporates the Klangdom sound system, developed by ZKM, Institute for Music and Acoustics. They did not give headsets and headphones to the audience because specifically, they were trying to promote the idea of the shared direct experience, the importance of the space is key to the creation of the work.

On the artist's work process Brian Eno, the organizers pointed out how he started his work with a finished composition and then when he entered the space and he realized the architecture and also the reverberations of the space, he started working on a new piece and then in another new piece. They pointed out that it is essential to know or to explore the architecture, space where this kind of work is presented.

Hexadome's main interest was to make an immersive collective experience integrated into the museum, Martin Gropius Bau as the context is crucial for this work and especially what we are trying to put forward which is to associate this work with the museum experience. The unfortunate thing is that in many cases museums were not necessarily designed where the sound is a consideration. So that had to create a structure that fortunately can work within the beauty of the space itself, but that has active control over the characteristics of sound.

Moreover, on the opposite side the way the visual structure was designed to not only provide the audience with the immersive visual experience but also to remind of the majestic space, very ornate and unique in its own right that was occupying.

So to have an audience walking and to have an experience of being enveloped in sound but also surrounded by these windows into the world that the visual artists are creating for it and still understand that we are within the context of the space it is essential.

On the curatorial theme, they created a programme, in multiple with artists coming from different backgrounds different aesthetics of sound, immersive art, and electronic music community. They worked with artists that were locally based, so Frank Schneider, Tarik Barri, Holly Hendon, Marcel MFO, Peter Van Hoesen and also look at a right balance between

establishing and emerging artists. Brian Eno was invited because his interest in new technologies and because he was previously at ZKM very impressed de Klangdom sound system and was an excellent opportunity for him to work with immersive sound and light

We were also curious to see on check how an artist who is already experienced with multichannel and sound environments will work with Klangdom sound

The organization mission is to create awareness for this kind of works and eventually find a home a new home a new museum experience for this kind of works.

3.4 Creating S.I.M.L. Simulator and presentation at Splice Festival - May 2018, Rich Mix, London

The technical setup of the immersive audiovisual facility at Goldsmiths University, S.I.M.L. comprises six professional HD video projectors, screens, and a multichannel surround system.

The Immersive Pipeline team developed the canvas resolution calculations and provided software setup with a middleware application for the graphics and visuals, an advanced tool for video mapping Madmapper, which allowed artists access to the multiscreen canvas using their tools for content production and video performance.

This S.I.M.L system allowed multiple configurations with a total canvas size of 7680 x 800 pixels been able to reach a higher resolution of 11520 x 1200 pixels. To provide an ongoing system for the development of the Immersive Pipeline research the project created the S.I.M.L Simulator, consisting of a physical on a scale simulator of the S.I.M.L, Sonics Immersive audiovisual facility at Goldsmiths University. This miniature on scale simulator provides a physical simulator for researchers and artists to create, perform and play their compositions in real time without time and space restrictions. The simulator is a 1:10 scale system of the S.I.M.L space of a total size 1,30 meters x 60 cm. Designed by Dr. Blanca Regina and Prof Atau Tanaka it has six mini projectors HD with tripods, a foldable miniature of double-sided projection Perspex.



It is controlled with the same middleware software than the actual facility and driven by MAC laptop with two Triple Head to go, Matrox graphics cards, providing a complete canvas resolution of 7680 x 800 pixels and frame rate of 60 Hz.

At Splice Festival¹⁶, May 2011, Prof Atau Tanaka, Dr. Blanca Regina with PhD student Bryan Dunphy presented the simulator to the public. For the simulator, Bryan Dunphy adapted the

¹⁶ Splice Festival <http://www.splicefestival.com/line-up/immersive-pipeline/>

code to use fewer resources of the laptop computer, to 1280x 800 pixels. His project consisted of mirroring and inverting the selection to transfer it to the miniature as it was previously done in the original space.

3.5 Case studies: Conversion/Translation of formats

One of the focuses of this research has been the translation of immersive audiovisual projects from one venue to another venue with different spatial configurations and formats. Focusing in the image conversion, like in painting in digital image different canvases exist with different size, aspect ratio, resolution and shape.

The spaces that involved the conversion were SIML a six screen 16:10 aspect ratio rectangular space, Cinechamber at ten screens, 16:9 aspect ratio rectangular space and Satsosphere a dome with Modular screen configuration: 180°, 210° and vertical 230° by 360°, 18m in diameter, 11.5 to 13m high, 8 video projectors, 157 speakers.

From one image format to another conversion possible solutions include:

- Stretching - to lengthen by pulling from one of the sides of the frame of the video horizontal or vertical
- Cropping - the process usually consists of the removal of some of the peripheral areas of an image to remove extraneous trash from the picture, to improve its framing, to change the aspect ratio, or to accentuate or isolate the subject matter from its background.
- The letterbox - is the practice of transferring film shot in a widescreen aspect ratio to standard-width video formats while preserving the film's original aspect ratio
- Zoom - image changes from a long shot to a close-up or vice versa.

To verify and study the conversion of works from one space to another, we focused on three examples to extract some conclusions:

3.5.1 From CineChamber to S.I.M.L with Naut Humon and Blanca Regina

3.5.2 From Satsosphere to S.I.M.L with Lillevan

3.5.3 From S.I.M.L to Satsosphere with Alba Corral

3.5.1 From CineChamber to S.I.M.L with Naut Humon and Blanca Regina

Our first case study was to work with a seminal piece from CineChamber, Recombinant- Festival catalog and translate it to S.I.M.L space. The selected piece was from Masako Tanaka, a panoramic pioneer of CineChamber's format with a soundtrack by Oval.

The original project was of 10 films that had to be stitched with ten projectors. Each original film size was HD 1920x1080 pixels and was distributed in 10 projectors. The objective was to convert the spatial cinema work of Masako Tanaka developed for CineChamber, a rectangular space with ten-screen, ten video projectors with 16:9 aspect ratio to S.I.M.L, a rectangular facility with six screens, six video projectors with 16:10 aspect ratio. The calculations of the resolution were as follow:

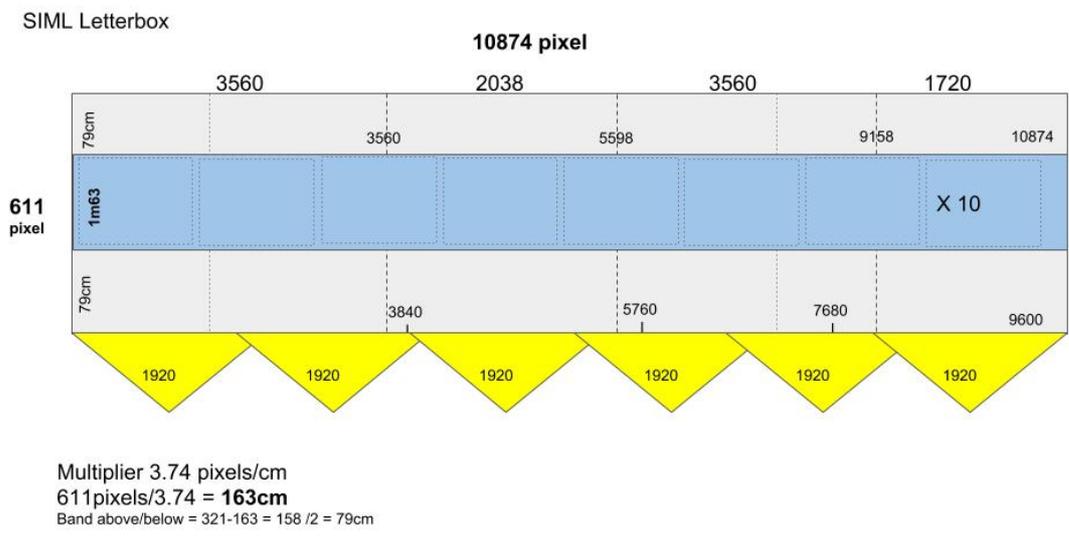
CineChamber Canvas Size = (1920 x 10) H x 1080 V = 19200 x 1080 pixels

S.I.M.L Canvas Size = (1920 x 6) H x 1200 V = 11520 x 1200 pixels

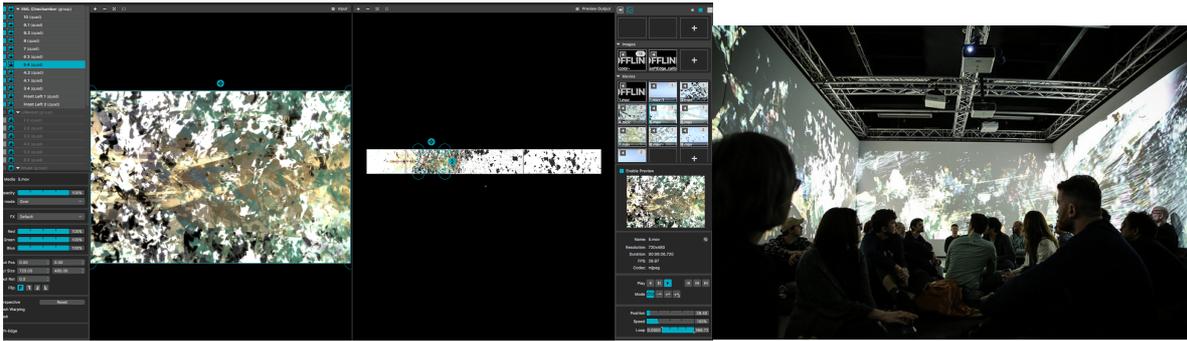
S.I.M.L final Canvas Size for performance = (1280x 6)H x 800 V = 7680 x 800 pixels

Converting CineChamber → SIML

19200 x 1080 → 7680 x 800 pixels

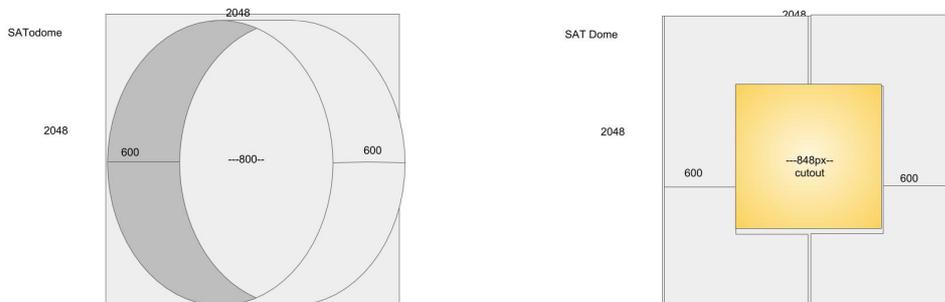


The outcome of translation of the work was completed by Blanca Regina and Atau Tanaka and supervised by Naut Humon and Barry Threw. The case study for this conversion had a duration of five minutes and was presented in public SIML performances. The end tool for the translation was a project created MadMapper that involved a real-time conversion and output to six projectors without any edits using the original video and sound sources. The final conversion method implied scaling down, stretching without creating a differential distortion and letterbox the original content to display the content. The sound was stereo and distributed across the four plus one speakers in the room



3.5.2 From Satosphere to S.I.M.L with Lillevan

A significant difference, both for creating and viewing, in this two spaces depends on its space design. The different forms of viewing implied differences in imagining, creating & testing the visual content. Lillevan used some of the same source material for both venues, adapting for technical reasons as well as artistic and poetic concerns.



S.I.M.L Canvas Size = (6 projectors)

Lillevan resolution at SIML was of 7680 × 800 pixels

Satosphere canvas Size = (8 projectors)

Satosphere resolution for live performances = 2048 x 2040 pixels

SIML displays moving image wrapped around the viewer - more or less at eye level. SIML is close to an aquarium. SIML called for the rectangular base clip, while allowing for collage fragments of any dimensions desired

SAT displays video around AND overhead. From the audience point of view, the experience is more of a cathedral - the visitor automatically looks up

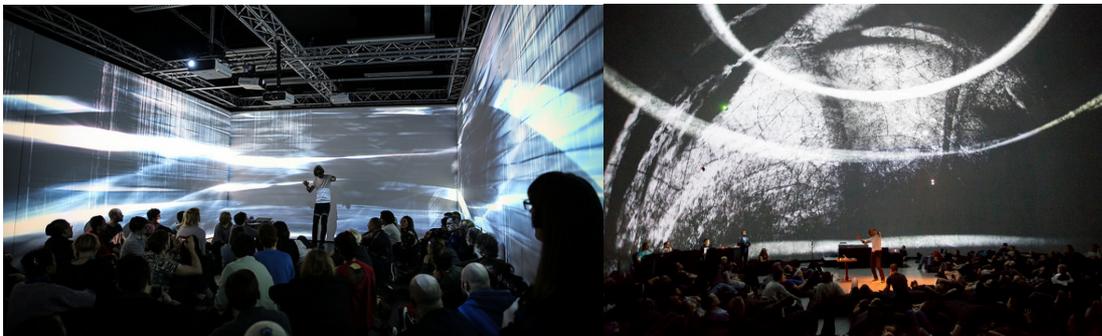
Regarding the live performance aspect, SAT required a large square material, size & codec were predetermined.

For SAT he had to pre-render material, during the performance he could only mix some pre-rendered layers, change colors, but could not actually create or strongly manipulate his material during the performance.

At SIML he could create and manipulate material during the performance, also because SIML was devised to allow to plug in and use own software. SIML provided a more exciting space regarding laboratory/studio/rehearsal – as it allowed greater freedom for real-time interaction and experimentation in the days preceding the performances.

In conclusion, for somebody focused on moving imagery in the world of single-channel video (16:9 or 4:3) the immersive spaces present an incredible revolution; we are no longer limited to a fixed frame aspect. However, the new freedom can only be explored if the artist has plenty of time to play, experiment, make “mistakes”, find a new moving image language. Of course, we can enjoy merely distributing our images around the room, but that would be too little and too simple for these new immersive possibilities.

*In immersive spaces and audiovisual systems, we do not have a real standard. We are still discovering new ways to do this. There are quite a few places in the world. Each place has to be calibrated and configured. This is a new form of presentation, a new language, a big immersive poetic moment. We have a very high tech space where we are doing real-time organic compositions.*¹⁷.



3.5.3 From SIML to Satosphere with Alba Corral

Alba Corral prepared *End (0)* an immersive audiovisual performance with Alex Augier in April 2018 at SIML, London, a rectangular facility of six projectors and six screens floor to ceiling. A couple of months later they travelled to SAT Montreal and adapted the work to a dome facility

¹⁷ Interview to Lillevan Recherche by Blanca Regina at a Goldsmiths University April 12, 2018. ‘Lillevan is an animation, video and media artist. He is perhaps best known as founding member of the visual / music group Rechenzentrum (1997-2008). Lillevan, has performed and collaborated with many artists from a wide array of genres, from opera to installation, from minimal electronic experimentalism to dance and classical music; performed and exhibited all over the globe, and at all the major media festivals’ <http://www.lillevan.com/biography/>

at SAT, Montreal.

Converting SIML → Satsosphere

S.I.M.L Canvas Size = (6 projectors)

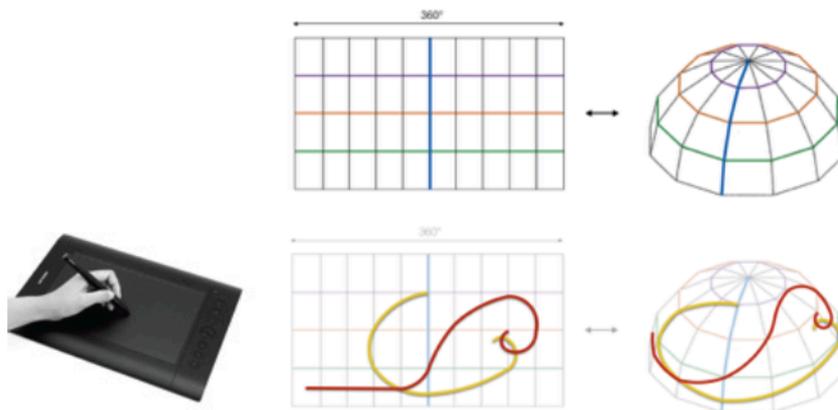
Alba resolution at SIML was of 3840 × 700 pixels

Satsosphere canvas Size = (8 projectors)

Satsosphere provided two resolution options:

Final resolution for live performances = 2048 × 2040 pixels

Final resolution for screenings = 4096 × 4096 pixels



Both spaces are different; the dome is a rounded vault forming the roof of a building or structure with a circular base and SIML is a rectangular space without a screen on the top. The Satsosphere has a variable configuration on its space allowing three different internal layouts. The geometry changes in both spaces as they are different, from a square to a sphere or semi-sphere. The change of shape its essential therefore the composition changes. In the dome, you play with the top part that cannot be explored in the rectangular space. In the dome, the top and the horizon are essential. The horizon is the same in both spaces. For example, the content of the lines works in both projects for the vertical movement. Technically the resolution that Alba used was different according to how the composition will be configured to space.



The Full dome is a space in total darkness, which produces a very intense spatial experience, where you quickly lose the reference of space and time. For example in VR the light of the goggles is perfect, but the light contamination of the real is space is much different. Also, the factor of the speed and size of the movement.

Considering the work and its content same elements were shared on the same cases, once the technical side was conveyed the artists established that music would modify the visuals, so they can loop and improvise throughout the scenes that lasted around four or five minutes each but when the point of transition was established the new scene was reconnected. At a studio with multichannel sound systems the sound spatialization compositions can be produced but to produce the visuals in any other space presents more complications.

Considering the audiences in both venues, each show was different with the same score and different interpretation, some common elements of sonic or visually. The audience took different positions sometimes sitting, laying and others standing.

Conclusion

- Immersive environments had been considered a **field of research** since the 50s of the XX Century, from architecture, science and humanities studies to the actual developments of virtual reality and augmented reality. Many aspects and elements are central to the developments of new software and digital projectors to the present times since the early 70s of the XXth Century also a concern of early cinema.
- **There is a cultural content shift.** The electronic music culture has reached the museum and museum needs to adapt to these new works that require technology and space to be presented, enacted and displayed. There is a need for more time using facilities for the research and production of immersive audiovisual compositions.
- **Categories in the immersive** computing spectrum are continually appearing, and the new glossary of the acronyms of the future is continuously expanding. Within our research, we focus on the most social and embodied category of this spectrum. Immersive collective experiences are at the opposite side of the computing spectrum of reality, same mind set but without a headset. This way of showcasing and producing films and performances introduces a new language and compositing methods in audiovisual production and digital storytelling. Audiences adapt the content with their imagination. As audience, you have a range of view, and a listening capacity.
- The **authoring workflow** for immersive audiovisual composition varies depending on the facility. These productions do not follow the same conventions of single-screen cinema as a result in no longer showcased in one screen. Each artist has its way and

method to produce content. Image content production tools, different languages, and aesthetics. The production of image and sound in the digital has multiple ranges of approaches. Audiovisual content production can be done with analogue and digital media and can be driven by physical interaction and machine learning. Visceral and moving image performances with digital media.

- **There is a need access to the history of the existing practices** and to transfer the needs of the creators it to guide technology can serve the new concepts and ideas that reply to the actual concerns and development of the language. The creators use different tools and have different ideas of what the format can do. For many artists, there is a need to have a technician helping supporting the translation. From what we can find there is no standard on the tools. Standards are good but we cannot make a standard as it emerges from the practice. So, the constrains on immersive spaces indicate a solution.
- **From the composition point of view** of immersive experiences essential elements are framing, resolution and point of view of the experience. Clear specs of the system, maps and dimension of the space and templates are essential elements for the translation and adaptation of the work to a new space. What finally matters for the work is the smoothness of the animation, for example, to play 60 frames for seconds.
-
- **Technical vital elements** in surrounded cinema include create a seamless canvas by using multiple projectors (blending), were we cannot appreciate the stitching between them, avoid or correct distortion of the image and colour difference between them.
-
- **Technology is constantly evolving**, therefore, image resolution, types of light, brightness, contrast and aspect ratio. Another element that has been central to software development has been to be able to control the content (input) and transport it to the projectors and space (output). Syphon, Spout, and NDI are essential protocols that allow transferring and transport visual content in real time from one input to many outputs of vice-versa. The tools are changing fast so there is a democratisation of technology. Still the cost of the technologies is high.

A few of organizations have a permanent setup, even SIML in Goldsmiths is a shared space. CineChamber and Hexadome don't have a permanent setup either. The domes have it but there is a limited access to these spaces. Therefore, there is a lack of time for artists in immersive spaces for developing their work. Space availability is restricted. Most of the facilities are shared spaces that accommodate a number of manifestations and activities. VR and simulators can provide a solution but they can't provide access to the visceral experience. This is reality and we are living in a virtual reality not the other way around, states Vicky Bennet, considering the creation of works for this immersive space. For making her piece after creating 10 minutes of the piece she tested it in the real physical space, she couldn't build it in the virtual space, she needed the real space to understand how the imagination of the audience will process the experience she needed a test for the physical for the visceral experience. You can make different associations when you are designing.

In all the spaces, there is limited time to rehearse. There is a lack of spaces and immersive these facilities. **Simulators** for immersive audiovisual projects facilitate the creation and understanding of works providing a solution to one of the main issues addressed by artists and researchers the need for more time for the production, creation, and development of immersive projects. As it's not possible to always tests in the final scenarios the VR provides some solutions for certain stages on the project such as the composition of materials. It's a revolution that provides some solutions. Also, VR is a technology that stills evolving constantly. Virtual reality is really important because it can simulate the environment. You can get a lot of work done there. As a preparation for the big scale space. But there are problems when you change scales.

There are also scale model's physical models that can be done with an affordable budget. For example, the mini Siml or the Dome developed by Front Pictures. But that does not provide enough feedback. The model works in a very different way so it will prepare for some but won't avoid terrible situations that may happen in the actual facilities. Technologies are fragile and you need to push the signal in big dimension spaces.

Another important factor regarding long hours working in these spaces is the lack of light When space is completely dark after long hours working the body resents due the lack of natural light, so the productivity resents. Therefore, to follow up developing the immersive works alternative spaces are requested. That is when simulators and other studios that will help to visualise and test the work became an important feature.

Video-mapping technologies are consolidated as the technique of assigning visual content into architecture and bi-dimensional or tri-dimensional spaces On tools, there are different tools for production of content and at the end of the chain, pixel pushing to distribute the content across multiple outputs. For example madmapper

Addendum

Interview by Blanca Regina for the Immersive Pipeline Research, April 21st 2018

I'm Tarik Barri, I'm an audiovisual artist and we are in the Martin Gropius Bau in Berlin in Germany.

How was the experience to create for the six-screen space that ISM Hexadome created?¹⁸

I can tell you a little bit of how this came up. Nick, one of the main organizers of the Hexadome project was aware of my work for quite some time and I had been invited to some other works that he organized, and those were more standard events with a screen and two speakers, but he was very interested in that whole idea of a more spatial exploration of sound and visuals and that led him at some point to create this crazy Hexadome project with the whole 54 speakers 6 screens all surround.

That completely fits the way I create music because I create music by creating a virtual 3D space in programming language and within my own program that I made I fly through this virtual space. And by flying I fly pass musical melodies and rhythms etc. so the path determines what we hear so determines basically the structure of the composition. That whole principle is inherently built around this idea of being surrounded by space, been surrounded by sound. This system that the ISM setup just enables me to really show it in that exactly that way, that you don't just have a 2D screen and you imagine the space around you but you can actually see the space around you and with all the speakers around you can hear the whole space around you.

Please let us know a little bit about your tool, software. Are you using it for visuals too?

Both for sound and visuals I made my tool. Originally I made it mainly for sound but it was very evident very early on, that will only work emotionally if the visuals are going to match the emotional intensity of the sounds. So whenever the sounds became more beautiful I felt ok the visuals can stay behind so that's how I basically learn to programme both in a way that I'm now very happy with because both sides constantly inspired each other.

Did you manage to perform live your work at Hexadome and how was the experience?

This software is made as live software so I most often do my stuff with my tridimensional world live and this is a great way to get a more playful natural intuitive feel to your own music if you can actually play with it rather than if you have to really think it all through and let the computer render for two days and then you hear see the results, I like that is more direct.

However, right now what happened is that I made an installation version that is not totally live at all because with the six screens around and with the amount of details that I still want to have its impossible to really get a proper really nice result doing it live and I don't want to compromise all results that's why I choose to make it as a installations.

How was this idea of the collaboration and did you know the artist before the commission?

Sure I knew Tom because I was already doing visuals with his performances. I work a lot. Basically, I very often accompany musicians when then make music and then I do the visuals. I've done that with Robert Henke, Nicholas Jaar, Paul Jebeanasam so I have these collaborations with people where they do all the music and I do all the visuals.

This is one of the rare times where I also do both music and visuals at the same time. I'm not sure if I can say that I most want to do that but I'm very happy that I can include this in my practice cause my whole system came from that idea. And I use that system sometimes pure visuals with other people but actually, I like to use it in a more complete holistic way and I think there are lots to explore there also in a way that you often see in the world and Id like to go further and explore. Basically, it's a door that is now thanks to the exhibitions and the collaborations with Tom is a bit more open so lets open to see what we can explore there.

What will you recommend for not reinventing the wheel on AV immersive or immersive Sound? To go one step further?

Oh wow, I think one thing is to look closely at other peoples work and see what you see too often. Very many artists in many fields they repeat each other over and over again and it becomes like a straight jacket, I guess is how fashion works very often. Lots of people wear the same things. I think is ok that there are traditions and that we can agree on certain things as a society. But in art especially, I think and for some reason, in this whole electronic, technological art there is this sort of too often used aesthetic, I don't know if it's like a male aesthetic, like a man like or something. Ok so its technology and is straight and hard and it needs to be connected with scientific data. I respect that but also I was mocking it a little bit because I've seen it too many times so I'm getting sick of it. I think it's nice to sometimes have a bit more randomness and a little bit more playfulness. Because technology can be complicated and all that kind of stuff but at some point, if you want to go a little bit further just than just looking at technology you can go through it and

discover other worlds which don't blind so closely to the zeros and ones and go to the colors that are beyond that.