**Presentation at Understanding Visual Music - UVM 13, 8-9 August 2013, General San Martín Cultural Centre, Buenos Aires, Argentina**

This is a ‘script’ of the presentation I gave at the Understanding Visual Music - UVM 13 colloquium - reconstructed from my presentation notes and iPhoto slideshow and with minimal ‘tidying up’. Typically, I underestimated the amount of material I’d prepared and didn’t manage to deliver all this within the presentation.

The thumbnail guides are complete - bar my software demos - and the video of the slideshow is online at: https://vimeo.com/93608325.

This PDF is embedded in the relevant post at my ‘The Augmented Tonoscope’ website at: http://phd.lewissykes.info/uvm-13/ - which also includes excerpts from the call, my abstract, additional links and critical reflection.

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**Introduction**

It’s a pleasure to be here, thanks for the opportunity, not least because it’s such a relief that I don’t have to spend the first five minutes of my presentation explaining what Visual Music is.

I’m hoping to share key aspects of my Practice as Research PhD project - The Augmented Tonoscope. I’m going to try and not repeat what’s already in my abstract and biography.

My research is ongoing, so this is more about “work in progress” than a summary of my final thesis.

My presentation is going to be quite practically focussed - I’m going to share key aspects of the development of my instrument and some exploratory artistic works that I’ve used to test out ideas - and I’ll try and weaves some of the underlying theory in.

But I have tried to pinpoint watersheds in my thinking and breakthrough moments in my practice - not only to serve as milestones in the development of the research but also to highlight key ideas and an emerging congruency to my thinking - of a harmonic complementarity between sound and image.

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**Background**

I was in this… and this… etc.

[show slides]

My experience has given me a reasonably firm grasp on contemporary audiovisual practice and culture.
Motivation

[show Spacequatica clip]

Although proud of the work I collaborated on as part of The Sancho Plan, I left because of a growing dissatisfaction with the audiovisual production process. Although the connection between the music and visuals were direct and literal - the animations were triggered simultaneously with the music - each work took months to produce, mostly because of the slow and painstaking progress of the animation. There were enjoyable moments of convergence but for much of the time audio and visual development ran as parallel but separate processes. I think this is true of much audiovisual composition.

Post The Sancho Plan I formed a new collaboration with composer, performer and programmer Nick Rothwell. We had intended to work together on audiovisual performance… but we ended up exploring sound and interaction through physical works that investigate rich musical traditions, such as PEAL – a laser-controlled virtual church bell tower, the headline art commission for Sound and Music’s Expo Festival in 2009, and a magnetically triggered Modular Music Box shown at Kinetica Art Fair ’11, Netaudio London (at the Roundhouse) and the BEAM festival.

This seemingly tangential practice has with hindsight, been literally instrumental in my approach to my PhD.

I realised that what I was really interested in is the real-time interplay between sound and image - of trying to merge the making of music and the creation of visuals into a single workflow. My thinking is that if music and image are linked from the outset and then throughout all stages of the production process this may create audiovisual work of a different quality.
**Visualising Sound**

So I set about designing, fabricating and crafting a real-time, hybrid analogue/digital audiovisual instrument.

It makes sound ‘visible’ as physical patterns on the surface of a drum-skin, but the intention is to augment these patterns with real-time computer animations generated from mathematically derived virtual models of various oscillating and harmonic systems.

[show initial concept, exhibited at BEAM 2012]

**Cymatics**

For the analogue component of my device, my practice involves a close examination of a natural phenomenon - stationary or standing waves. Their effects have been noted for centuries and is described through Cymatics (from the Greek: κῦμα “wave”) - the study of visible stationary wave patterns induced by sound. Dr Hans Jenny coined this term for his seminal research into these natural phenomena in the 60s and 70s, using a device of his own design - the ‘tonoscope’. Essentially what you see are discreet, geometric patterns that are an analog of sound in visual form.

This excerpt from a documentary on Hans Jenny was particularly inspirational. If Jenny could create such a direct correlation between sound and image 50 years ago using little more than sand sprinkled on a piece of rubber stretched over the end of a cardboard tube which he then sang down, what could I do realise today with all the technology and shared knowledge at my disposal?

After much prototyping I managed to achieve comparable results.

[show Jenny video, AT prototype]

**Virtual modelling**

I’m also looking to create real-time computer animations generated from mathematically derived virtual models of various oscillating and harmonic systems.

An obvious choice was to create a virtual drum head based on the mathematics of a vibrating circular membrane. It uses the GNU Scientific Library to compute values of the regular Bessel function… though I have Mick Grierson to thank for the initial implementation.

[show app]
Interestingly, I’ve been able to show some agreement between this ‘perfect’ drum head and my analogue drum skin… but the analogue drum-head is far from ideal.

[show Studio 180713 - AT patterns by frequency.mjdoc]

Example artworks

I’ve also investigated Cymatics through exploratory art works…

1. Cymatic Adufe

The Cymatic Adufe is a sound responsive gallery installation made in response to an invitation to feature work as part of a travelling exhibition - the 21st Century Rural Museum - organised by fellow MIRIAD PhD candidate Cristina Rodrigues as part of her research around raising the issue of ‘desertification’ in rural Portugal.

On a study trip to Monsanto, a small mountain top village in the Idanha a Nova region. I was inspired by the Adufeiras de Monsanto - a group of mostly elderly women from the village who celebrate their traditional culture by performing folk melodies using just voice and an Adufe - a square framed hand-drum of Arabic origin - while dressed in brightly coloured traditional costume.

[slides + video]

The patterns you see projected on the adufe are another example of my exploration of real-time computer animations - in this case the Superformula - a generic geometric transformation equation developed by Johan Gielis that encompasses a wide range forms found in nature.

I use FFT analysis to track the melody of the Senhora do Almortao as sung by Cristina, using the amplitude of certain notes within the melody to change variables within the formula, while applying the harmonic relationship between successive notes and the tonic or root note - the song is in C# major - to drive the symmetry of the shape. I then use beat detection to ‘snapshot’ the dynamic patterns - you might just be able to see this as light grey - and draw it to the screen.

[show Processing app]
2. The Cymatic Cello

I was invited by my Director of Studies to join him in an artist residency with the Manchester Camerata - Manchester's Chamber Orchestra. They wanted artistic interjections into their UpClose season - a series of concerts where principal players from the orchestra perform solo and small ensemble works in intimate venues. It was a great opportunity to test out some of my music visualisation ideas alongside world class musicians.

This work visualises the Sarabande from the Suite for Cello no. 2 in D minor by making visible the vibratory patterns that occur naturally on the back plate of the instrument as it's being played. The effect is known to some luthiers who tune their instruments according to these modes of vibration using a technique of sprinkling fine powder onto the front or back plate while playing a note of particular pitch at volume through a speaker directly below its body. I reproduced this technique in my studio and photographed the 'scale' of visible patterns that emerged across the register of the cello. With Ben Lycett, I then coded an application that 'tracks' the pitch of the cello during the performance and simultaneously displays the nearest corresponding ‘tuned’ image of naturally occurring patterns. It was a little crude… but a good ‘proof of concept’… which I refined for a subsequent work Stravinsky Rose.

3. Stravinsky Rose

My own modest contribution to Whitney's legacy, applying and adapting his algorithm as part of my series computer animations - is to conceive of the periodicity of the algorithm - that fact that it’s end point is also its start point - to represent a single octave scale - so that notes an octave apart produce essentially the same pattern - which I think this is a fair correlation to our perception of pitch.

I used this technique to create a visualisation to accompany another UpClose performance - Stravinsky Rose - Stravinsky's 3 Pieces for Solo Clarinet performed by Fiona Cross. Drawing on Whitney's legacy, this custom-coded, real-time visualisation adapts his geometric algorithm, ‘The Roses of Grandii’, to
create dynamic ‘naturalistic’ patterns representative of each piece and more or less equivalent to the harmonic structure within the music itself.

You’re going to see a full dome version of this piece as part of the programme tonight at the Galilei Galileo Planetarium screening.

[show UpClose 4 video]

4. The Whitney Modality

I extended this visualisation further into a small interactive exhibit for the Ways To Escape_ exhibition organised by colleagues at Manchester Met. I wanted to create an immersive audiovisual experience, so used video goggles to display the work and a monome64 - a minimalist controller that is a grid of buttons and decoupled LEDs programmed using a serial protocol very similar to MIDI - as a user interface.

[show Whitney Modality of sketch]

Musical interface

So now I had some of my basic building blocks - analogue and digital visualisations of sound - I needed a mechanism to create audiovisual composition - some form of musical interface that would allow me to access these cymatic patterns and harmonic based virtual models… and I realised a traditional chromatic 12-ET tuned keyboard wasn’t appropriate. I also needed a way of recording, arranging and mixing.

So I looked to artistic investigation into Cymatics… and while there are numerous examples of artworks that deploy Cymatics - here’s a few examples - there are few that explore Cymatics as a means to create a form of visual or visible music - with the exception of the Cymatic Music project of John Telfer.

John Telfer’s Cymatic Music

Telfer has conducted an extensive series of experiments into the cymatic patterns generated on the surface of a bowl of water - and through this empirical study that there seems to be a correlation between symmetry and frequency… but he argues that this correlation isn’t found within 12-ET tuning which implements a consistent interval between the notes in its scale - because this is actually mathematically unharmonious. He proposes that you need to move to Just Intonation based tuning - where the intervals between notes are calculated based on small whole number ratios… because these tuning systems, although ‘off’ to our 12-ET attuned ears - are actually more mathematically harmonious.
Telfer goes on to develop the Pythagorean Lamdoid - the overtone and undertone series into a matrix - a grid a squares each of which define a specific whole number ratio - so a square at column 3 row 4 represents a ratio of 3/4 or .75 of the root frequency - 330Hz if the root is concert A at 440Hz. He has then analysed this matrix looking for harmonic structures and patterns and has used a colour coding to map those ratios on the matrix that are more or less consonant with each other.

Telfer himself has used this system to develop custom-made stringed interments that implement aspects of this system.

I was struck by how similar the matrix was to the grid of the monome... and so built an interface that allowed me to access Telfer’s matrix using the monome as a physical window onto it.

[show Lamdoma Monome]

Close

I think that's about it...

I hope that was of interest...

Thank you.