Computer use in music for the pipe organ and real time dsp - or the music of Janus

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Abstract

Ever since the Bremen Radio Broadcast Performance – 20 May 1962 – a broadcast that included Gyorgy Ligeti's 'Volumina', Mauricio Kagel's "Improvisation Ajoutee" and Bengt Hambreaus' 'Interference' – all compositions that exposed a whole new world of texture, timbre and musical possibility, the pipe organ has been reclaiming a position of prominence in contemporary art music. The timbral, technical and musical possibilities exhibited in these compositions and the more recent advent of accessible and portable real time dsp (Digital Signal Processing) has encouraged an ever widening range of composers/performers to write for the instrument, extending both its timbral potential and inherent spatial possibilities. These developments have changed our expectations and perceptions of what a pipe organ musically can be and do. In this paper I shall provide a brief background to this development, focussing on four significant and recently composed works for pipe organ and electronics. I shall explore how the instrument's apparently static timbral world is dynamically altered, and the means by which this alteration is achieved.

Introduction

The function and control of timbre by the player of a traditional acoustic pipe organ can be equated in contemporary electronic musical terms to the control and building of sound through additive synthesis. In the last few years a number of composers have also taken advantage of increased portable power and availability of software and vst plug ins to create a new timbral world for the pipe organ. The extraordinary sonic richness of the acoustic organ provides a wonderful source for the digital signal processing (DSP), creating new sounds, not just imitating organ sounds, but opening a whole new range of timbres and aural spatial relationships, changing our expectations and perceptions of what a pipe organ musically can be and do.

Pipe organs have many different styles that may be defined by continent, nationality, region, era and individual builder. Today the pipe organ is often associated with Christian religious institutions, often of a highly conservative bent and accordingly music associated with the pipe organ is assumed to be similarly styled. This attitude however ignores the significant music composed since the 1950's till today, and now often performed on organs in large civic buildings.

Before proceeding, it must be emphasized that compositions for acoustic instruments with digital signal processing are not new, for there are compositions for flute and realtime dsp from as early as 1952 (Penny 2009). Bruno Maderna Musica su due dimensioni (1952) for flute, percussion and electronic sounds is certainly one of the earliest examples. Within a couple of years, composers such as Edgar Varése, Otto Leunig and Vladimir Ussachevsky were composing works for acoustic instruments, accompanied or expanded by recordings and processed sounds.

In 1958 (six years after the first work combining acoustic instrument and manipulated sounds) Swedish composer Bengt Hambraeus composed two significant works for organ and manipulated organ sounds on tape - Doppelrohr II and Konstellationer (1958). The works are highly significant in the lineal development of the organ as an avant-garde instrument bridging the span between the so-called 'experimental' works of Olivier Messiaen and Gyorgy Ligeti's Volumina (1962) The quasi electronic clusters of Volumina that so shocked many listener did not arrive from a vacuum: timbral explorations from composers such as Tournemire, Messiaen, and Hambraeus may be directly traced forward to Ligeti and so, for all its radicalism, Volumina represents Ligeti '...searching for what the next step is in any field. What next step is implied…' (John Cage quoted in Duckworth, W p 28) This lineal quality in avant-

garde music can be traced as strongly in organ music as any instrumental genre, though this trail is beyond the scope of this paper.[1]

Between the late 1960's and late 1980's there was parallel experimentation in avant garde organ music - composers including Australians Warren Burt, Stephen Ingham, and Ron Nagorka looking at combinations of taped sounds and organ and those like Gyorgy Ligeti, Iannis Xenakis or Stephen Montague who extended performance techniques acoustically.

Definitions and Background : Live Digital Signal Processing and organ

A brief and simple description of what we mean by music composed for pipe organ and Real time Digital Signal Processing (DSP): a pipe organ in which, in addition to the acoustic qualities and potential of the instrument that are already established, microphones placed in and around the organ input signal to a processing unit. This then sends processed sounds from the organ to a speaker system in the same physical space, so blending the acoustic and electronic sounds in a coherent whole to an audience. The configuration of all these elements is variable and dependent upon the room in which the organ is situated, the layout and disposition of the organ, and the musical requirements established by the composer.

Wolfgang Mitterer (Linz) and Morgan Fisher (Tokyo) - are both improvisers who the organ and live dsp of the organ sound. Some other recent examples of improvisor/keyboardists include Chris Abrahams and Charlemagne Palestine - both using pipe organ with other (non organ based) realtime dsp in their improvisations. [2]

So far the earliest example of organ with live digital signal processing appears to be: Hans W Koch orgel/topographie (1998) for one performer inside a church organ with live-electronic, a second performer at the keyboard. It uses a hand held microphone to amplify certain sounds from deep within the organ.

Aus "sechzig" teil IV: paradiso infernale (1997)composed for an exhibition of Salvador Dali's xylographies after the "divina commedia" by Dante for two speakers (male/female), tenor saxophone, organ, synthesizer and live- electronic. In an email from Hans Koch to the author, he writes of the live dsp...

> I´d say it was a crude mix of ring modulation, some very cheap echo, filtering and some oscillators. i used a lot of feedback also fed trough the echo. the truth is, that i didn´t have much money at that time (not that i would now...), so started building my own circuits. they mostly worked, but had a peculiar sound. and then, failure sometimes has its own beauties :-) (Koch, H. (2006) Personal email to Andrew Blackburn)

Four Compositions for pipe organ and real time dsp

Dialogo Sopra i Duo Sistemi (2003 revised 2007)- René Uiljenhoet, for organ and quadraphonic live electronics, duration c. 18'30"

The title of this work also suggests its intent - a dialogue between two systems - one old and the other new. It is derived from the Gallileo Galliiei Dialogo di Galileo Galilei ... : doue ne i congressi di quattro giornate si discorre sopra i due massimi sistemi del mondo tolemaico e copernicano proponendo indeterminatamente le ragioni filosofiche e naturali tanto per l'vna, quanto per l'altra parte (1632), in which the author compares the prevailing concept of a flat earth with his own theory of a spherical,

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[1] The topic is explored in Blackburn (2008) *The organ as an avant garde instrument* unpublished paper.

[2] In this paper, the ability to reproduce music without the input from the original creator is a selective factor, and so the work of these practitioners is not considered.

rotating planet. Dialogo has received a number of performances[3] since its composition in 2003 and the most recent iteration of the score (2009) includes many warnings and notes that suggest they are born of performance experience. From the composers introductory notes "... Due to the musician operating the computer using both hands and eyes to operate the computer as well as the mixing desk, it is recommended to ask an assistant to help turning the pages of the score in order to stay synchronous with the organist...' or regarding the setup of the microphones in the organ case '... be prepared to spend a lot of time realising the installation and be careful not to damage pipes...during this installation process! Also make sure – in advance of the concert date – that the owner of the organ allows this harmless treatment to be executed.'

The electronics for this piece are programmed in SuperCollider 3 (http://supercollider.sourceforge.net) and a runtime and patch file are provided with the score. The setup requirements are as follows; OS X (10.4.8 to 10.4.11) running SuperCollider3 to version 3.3.1 (rev 9267) with a (minimum 8 I/0) audio interface attached.

> Eight microphones to inputs:
> 4 outputs (1 - 4 on interface) to mixer and to four amp/loudspeaker combinations, set up around the audience:
> Mic 1 is inserted in the Swell - left side;
> Mic 2 is inserted in the Swell - right side;
> Mic 3 and 4 inserted in the left and right of the Great;
> Mic 5 & 6 in the left and right pedal towers;
> Mic 7 & 8 in the left and right sides of the positive organ.

This arrangement - with less or more microphones has turned out to be a most successful arrangement for most organs. It is the maximum which has been used by this author, and allows for the true spatial expansion of the instrument within the performance space.

The software is set with 35 performance 'scenes' each descriptively titled, within a single user interface page.

Vanitas - Steve Everett

Vanitas refers to a type of still life painting consisting of a collection of objects that symbolize the brevity of human life and the transience of earthly pleasures and achievements (e.g., a human skull, books, musical instruments, decaying fruit and flowers, a mirror, and broken pottery) – a reminder that worldly riches cannot stop man's inevitable decay.

Such paintings were particularly popular in the sixteenth and seventeenth centuries, especially in the Netherlands.(Harlow, R (2007) Contemporary Organ Music Festival April 11-14, 2007 Programme notes, http://ecmc.rochester.edu/ecmc25/concert8.pdf last accessed 1 November 2009)

The aim of the electronic processing in this instance is, to create an impression of the decay and ephemeral nature of life, as depicted in the Vanitas paintings through effects used in the electronics including timbral shift, spatial re-location and tuning and detuning of the organ sound.

Vanitas is composed for organ with live electronic processing using Kyma[4] Sound Processing System. [5] Everett explains his technical requirements in the performance instructions are as follows:

> Four to eight microphones [are] placed as close as possible to the organ case in a
> vertical array on both sides of the performer. If possible it is desirable to place the
> microphones inside the case to avoid feedback issues related with microphones placed
> in acoustically rich halls and churches. This audio is then processed through eleven

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[3] eg Randall Harlow - Eastman Organ Festival, at the Laurenskerk, Rotterdam and recording etc

[4] www.symbolicsound.com

[5] A Max/MSP version of the electronics is available at http://music.emory.edu/COMPUTER/SE/VanitasMaxMSP.pdf

computer Sound Objects in Kyma created by the composer. Each Sound Object consists of three or more spectral filters, delays, and diffusion effects... scheduled with the Kyma Timelone and is notated in the score as " *Kyma 1-11

Ideally a four channel sound system with a fifth sub-bass channel, all hidden from audience view is preferred for playback. The goal of the live electronic processing is to subtly enhance timbral shifts, spatial location and tuning of the organ sounds.
(Everett, S 2005 p 2)

One of the important aspects of this piece is the relationship which is established between the acoustic organ and the processed sounds. In requesting that the speakers be concealed, Everett seeks to create a blend of acoustic and electronic sounds, but blurring the boundaries between them. Which sound source is responsible for each timbre or effect is rendered indistinguishable by concealing the speakers in and around the organ, and mixing the combination of sounds in the performance room. It is a compositional device that makes Vanitas distinct from the others under discussion in this paper.

Where Dialogo, Symmétrie Intégrante[6] and Eight Panels[7] exploit the potential for re-spatializing the organ and its relationship to the performance space through speakers placed around, amongst, above and below the audience, Everett arranges the electronic sounds so that they all appear to emanate from the organ itself. It is an idea currently being explored further by Christophe d'Alessandro et al, in a recent (unpublished) paper delivered at the 2009 ICMC in Montreal: The Ora Project: audio-Visual Live Electronics and the Pipe Organ.

Symmetrie Integrante (2007)- Andrian Pertout

A work for organ, flutes (3) and live electronics. (click here for a video example of excerpts of this piece and section[8]) It was commissioned for performance at the Melbourne Town Hall. It is a startling piece that contrasts instruments of different dimensions from the largest to shortest organ pipes (10 metres to 4 or 5 mm) as well as flutes alto to piccolo. The electronics are a minimum of four microphone inputs connected to a computer through a digital audio I/0 to a mixer incorporating a 4 channel sound diffusion system, ideally configured similarly to that of the Uijenhoet piece described earlier. Again, the music is arranged into preset 'scenes' - nine for the flutes and 4 for the organ. They were operated by the composer in the original performance and the composer is currently creating a more portable version in Max/MSP for another performance in the Organs of the Ballarat Goldfields scheduled for next January.

Programme 2 'Waves metaflanger5.0 VST plug in (a vintage tape flanging and phaser emulation audio plug-in that generates gentle choruses and dual delay flanging sounds to sharp phasing and extreme jet sweeps.)' (Pertout A Symmétrie Intégrante 2007 composer's performance notes) The actual settings of this scene are: mix: 100%; feedback: 80.0%; phase enable: on; filter type: low pass; cut off frequency: 1.2HΩ; filtering: on; delay: 9.0ms; tape: on; rate/oscillation speed: 0.10Hz; sync: manual; depth: 12.0%; link: off; waveform: triangle; stereo: 180.0º ; gain: +0.0dB.[9]

The effect of this is startling in impact, particularly contrasting the almost pure sine wave structure of the organ (registration specified as rohrflute 8' and 4' principal) with the triangle wave form inserted by the plug in and projected with the extreme 'jet sweeps' created by the wide stereo setting of 180.0º. Pertout found that DSP for the organ is most musical when manipulating quieter input levels, a facet that is common in all the works under discussion. The opening and closing sections of the work are loud (registration - principal chorus to mixtures) and his dsp in this is used to create waves of sound that

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[6] Andrian Pertout 2007

[7] Lawrence Harvey (in conjunction with Andrew Blackburn) 2007

[8] http://www.hutes.com.au/hute_1./Andrew_Blackburn_Video_Samples.html

[9] The full list of settings is provided in the compser's performance notes. Andrian Pertout has adopted the approach to performance that, given the relative transience of many audio applications, a technical list if settings is most desirable and this can be re-created in the software that is available to the performers.

project into the hall bathing the audience in an audio wash which exaggerates the wash of sound from the organ itself.

Eight Panels(2007) a structured improvisation - Lawrence Harvey and Andrew Blackburn

Eight Panels was also commissioned by the City of Melbourne and first performed in the Melbourne Town Hall in October 2007. It is a structured improvisation conceived by Lawrence Harvey in conjunction with Andrew Blackburn. The audio input arrangement from the organ is similar to that of Symmétrie Intégrante given above, but the output arrangement is considerably developed. Again, here the intention behind the work is to draw the organ from its location in the Town Hall (in a very large chamber across the full width of the stage

The work is built around 8 major sections, each one exploring different sets of dsp effects through the audio input from a carefully structured though improvised organ part. The output for the work is a 16 channel surround sound - two concentric circles of speakers placed around the audience, and within the audience space, four speaker 'trees' were positioned. These provided a highly specific sound source which was also positioned vertically in the aural space. Players required to perform this work are: organist and two sound technologists (one technologist controls the signal processing of the organ sounds, whilst the second controls the location of the sounds within the large space of the hall. The score is divided and precisely indicates this process. (see example above)
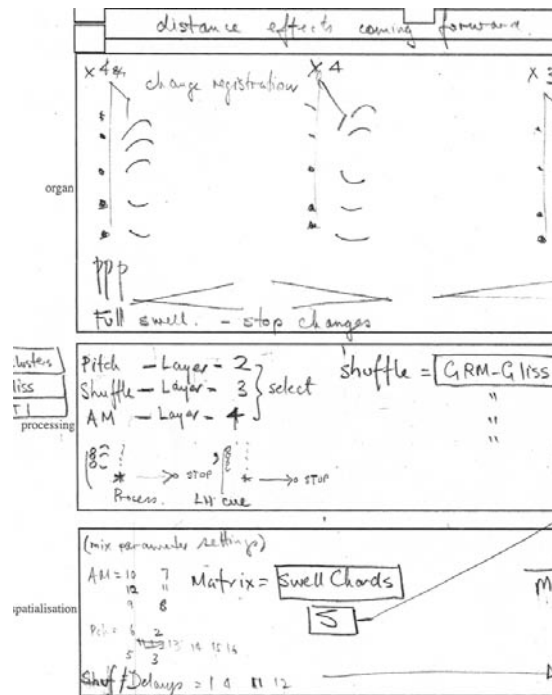
Harvey, L 2007 8 Panels Score Panel 5 (section)

Melbourne Town Hall Organ - the larger pipes on the facade are in excess of 5 metres in length.
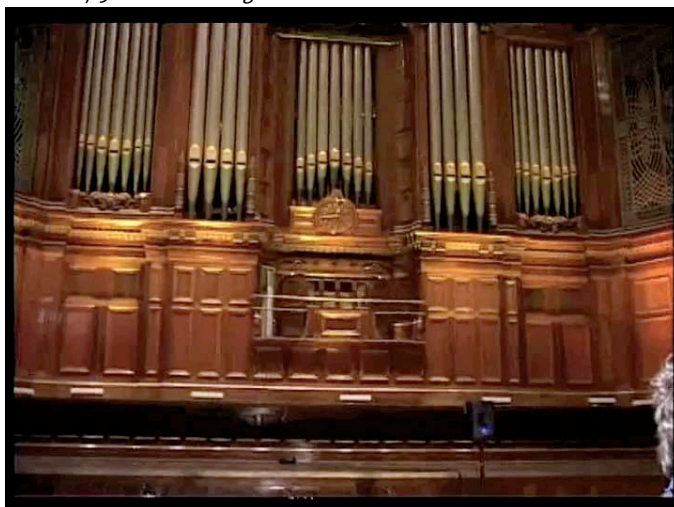
Conclusions

When used to manipulate the acoustic sound of a pipe organ, computers and computing offer extraordinary possibilities to impact on the timbral and spatial world of the pipe organ. There is an ever growing body of work for the organ with realtime DSP and an expanding number of composers around the world who are interested to write for this combination.

The works discussed all come from composers of very different backgrounds - and even cultures - yet in this frontier sound world there is a commonality of purpose as well as a (perhaps surprising) unanimity of what

works when manipulating acoustic organ sounds. As far as I have been able to ascertain, at the compositional stage, none of the composers were referencing earlier works, but all have used similar processing techniques; flanging, delay, reverberation, granular synthesis, ring modulation and more.

Everett S *Vanitas* - 2005 organist Randall Harlow mp3 perf 2007

Although there are some practical difficulties positioning microphones and speakers in and around large pipe organs, the musical result is well worth overcoming these potential pitfalls.

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Organist Andrew Blackburn
Click to play: