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Interdisciplinary notes on research and practice relating to the digital in culture and society, as well as computers in the arts, humanities and social sciences

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Table of Contents

Mapping Meaning
Katie Ní Loingsigh, University College Cork 1

Digital Poetry in Digital Literacy
Jim Andrews 6

Recreating the eleventh century musical sequence *Victimae paschali laudes* using Max
Stace Constantinou, University of Northampton 9

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Mapping Meaning

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The Irish for computer is *ríomhaire*, a word initially used to denote a calculator but signifies a computer in modern Irish. Its meaning is steeped in culture. Arbuthnot, Ní Mhaonaigh and Toner (2019, 37) trace *ríomhaire* to the Old Irish period and demonstrate how an older word can be used effectively to fill a lexical gap in modern language. One who counts or calculates is defined as *rímaire* in eDIL, a digital dictionary of medieval Irish. Even though *ríomhaire* today refers to the machine rather than the person, its etymology fittingly demonstrates a long-established link between language, computers, and culture in Irish.

Language is intrinsically linked to culture. The words we use, and how we use them, provide an insight into our shared heritage, our interactions with others, and our surrounding environment. In the case of Irish, computers have played a transformative role in how the language is 'counted' in the 21st century. The intersection between computers, culture, and language is becoming more pronounced, particularly when taking technological developments and major Irish-language digitisation projects of recent years into account.[1] Drawing on this progress, this article aims to show how computers have become valuable tools in linguistic analysis; specifically, in the examination of phraseological expressions in various cultural, social, and historical contexts.

Phraseology can be defined as the study of fixed or formulaic expressions that are elements of the lexicon which 'go beyond the level of a single word but do not go beyond sentence level' (Pirainnen 2012, 32). Words combine to form expressions which frequently have a unique meaning that is often not predictable from the meanings of its individual parts. Such expressions can be interpreted on two different conceptual levels: on the level of their literal reading and on the level of their figurative or lexicalised meaning. Take, for example, the expression 'to break the ice' which literally means 'to break the frozen surface of a river, lake, etc.',[2] but also has a lexicalised meaning which signifies 'to break through cold reserve or stiffness, esp. facilitating conversation or social ease'.[3]

One of the earliest, and perhaps most famous, usages of this expression in its lexicalised form can be traced to Shakespeare's drama *The Taming of the Shrew*. In Act 1, Scene 2, the expression is used as a term for a social gesture. The character Tranio considers how best to pursue Katherine, the 'shrew' of the drama's title, and comments:

> *And if you break the ice and do this feat,*
> *Achieve the elder, set the younger free*
> *For our access, whose hap shall be to have her*
> *Will not so graceless be to be ingrate.*

Such expressions allow the speaker to convey complex ideas in a concise and efficient manner while avoiding overly complicated explanations. Even though many expressions are universal, and equivalents can be identified across languages, certain expressions are more culturally specific. Bragina (2000, 33) suggests specific expressions can be classified as reduced cultural texts which act as a repository of cultural connotations deriving from different types of discourse, i.e. ideological, mythological, literary, and folk discourse.

Looking to folk vernacular, the Dúchas project provides for the ongoing

[1] See further: Pádraig Ó Macháin, 'An Digitiú agus na Daonnachtaí in Éirinn', *Breac: A Digital Journal of Irish Studies* (October 2015).
[2] *Oxford English Dictionary*, s.v. "ice", accessed May 9, 2023, https://www.oed.com/view/Entry/90765?rskey=9yvBVe&result=3#eid.
[3] *Ibid*.

digitisation of The National Folklore Collection/*Cnuasach Béaloideas Éireann*. This folklore collection is recognised as one of Europe's largest ethnographic achives of vernacular culture.[4] Conchúr Mag Eacháin's recent publication, *Ó Cheann Ceann na Bliana* (2022), draws on material from The National Folklore Collection and focuses on customs associated with specific periods during the year. In his introduction, the first day of each season is highlighted in conjunction with accompanying celebrations:

> *Ráithe ó Lá Fhéile Bríde go Bealtaine,*
> *Ráithe ó Bhealtaine go Lúnasa,*
> *Ráithe ó Lúnasa go Samhain,*
> *Agus ráithe ó Shamhain go*
> *Lá Fhéile Bríde* (2022, 18)
>
> A season from St. Bridget's Day to May,
> A season from May to August,
> A season from August to November,
> And a season from November to
> St. Bridget's Day[5]

The significance of particular periods of time is also evidenced in the Irish phraseological expression *ó Shamhain go Bealtaine* (lit. 'from November to May'). From a phraseological perspective, this expression is relativity fixed linguistically and is usually used to describe something without a foreseeable end or something that may take a long time to complete.

1. *Scéal ó Shamhain go Bealtaine*[6] (lit. a story from November to May), a long rambling story.
2. *Cleamhnas ó Shamhain go Bealtaine*[7] (lit. an engagement from November to May), a prolonged engagement.
3. *Gnó ó Shamhain go Bealtaine*[8] (lit. work from November to May), work that takes longer than needed to complete.

The period of time cited in the above expressions is not directly related to the Gregorian months; or rather, the expression ó *Shamhain go Bealtaine* functions as a generic temporal reference emanating from an alternative conception or perception of time. Traditionally, *Samhain* marked the beginning of the new period or 'darker half' of the year. It is argued here that the expression *ó Shamhain go Bealtaine* reflects a cultural worldview, or *Weltanschauung*, that is encoded and transmitted through language. Looking towards the National Folklore Collection, further contextual information can be gleaned from the results of a simple textual search of the transcribed material available on the Dúchas database. In a story relating to Halloween customs, one informant describes this period as follows:

> *Bíonn morán clis agus seana nósanna dá imirt airt an oidhche sin cómh maith ag na nGaedheal. Tosnuigheann an sgoruigheacht an oidhche sin leis mar a deir an sean-fhochal: – "Sgéal ó Shamhain go Bealtaine"– sgeal fada fánach, leadaránach. Um Shamhain is ead do thosnuigheadh na sgoruideachta i dtigtibh cómhursain ins an tseanaimsir agus do hínnstí sgealta cois teine gach aon oidhche le línn na hoidhcheannta b'fada ó Shamhain go Bealtaine.*[9]

[4] See https://www.duchas.ie/en/info/cbe.
[5] All translations the author's own unless otherwise specified.
[6] *Foclóir Gaeilge-Béarla*, s.v. "scéal", accessed May 9, 2023, https://www.teanglann.ie/en/fgb/sc%c3%a9al.
[7] *Peadar Ó Laoghaire Idiom Collection*, s.v. "ó Shamhain go Bealtaine", accessed May 9, 2023, https://www.gaois.ie/en/idioms/4585548/.
[8] Ó Buachalla, *M055 Cnuasach Focal ó Mhúscraí* [Unpublished manuscript], s.v. "Bealtaine".
[9] "The Schools' Collection, Volume 0466, Pages 385-6", accessed May 9, 2023, https://www.duchas.ie/en/cbes/4742093/4735161; https://www.duchas.ie/en/cbes/4742093/4735162.

There are also many tricks and old customs played on that night by the Gaels. The social evening also begins on that night as the proverb states: – "A story from November to May" – a long-winded, tiresome story. At November the social evening used to begin in a neighbour's house during times past and stories used to be told by the fire every night during the long nights from November to May.

While *scoraíocht*, *bothántaíocht* or *airneán* primarily took place during the winter months, the longest and darkest nights of the year, the cultural associations enshrined in the expression *ó Shamhain go Bealtaine* are further reflected in Ardener's description of 'cultural time' (2007, 136):

> From the general Insular Celtic background we detect a division of the year into a 'light' summer half from 1 May to 1 November, and an opposing winter half. We note that the winter is the 'dark' half, like the annual night, and that the year begins with the winter, just as the Celtic day begins on the previous dusk. The old markers were the feast of the Calends of winter (*Samhainn*) which was fixed historically to 1 November, and the Calends of summer (*Bealltuinn*) ascribed to May.

Similarly, Danaher (1972, 11) notes the significance of calendar custom in folk tradition and its intimate connection with the daily and yearly routine of work along with its impact on the social traditions of the community. Expressions such as *ó Shamhain go Bealtaine* encode collective cultural experience which reinforce cultural values and beliefs, and create a sense of community related to natural cycles. The National Folklore Collection and large-scale digitisation projects such as Dúchas have increased the accessibility of such resources and, in turn, facilitate and complement linguocultural research.

In his analysis of the Irish expression *clocha ceangailte agus madraí scaoilte* (lit. tied stones and loose dogs), which functions as a synonym for a state of imbalance or inequality, Mac Coinnigh (2019, 51) argues similar expressions can be deconstructed using literary and historical research and should be read 'within their contemporary cultural, historical and socio-economic frameworks to decode meanings'. Interestingly, Mac Coinnigh (2019, 64-65) describes how *clocha ceangailte agus madraí scaoilte* gained currency in legal discourse following its use by Chief Justice Cearbhall Ó Dálaigh in the seminal case *Re Haughey* [1971] IR 217:

> To deny such rights is, in an ancestral adage, a classic case of *clocha ceangailte agus madraí scaoilte* [tied stones and loose dogs] Article 40, s. 3, of the Constitution is a guarantee to the citizen of basic fairness of procedures.

A simple search of the British and Irish Legal Information Institute (BALII) database reveals the numerous cases where this exact Irish-language expression has been referenced by various judges in the interim period. Looking at its contextual usage, Mac Coinnigh (2019, 65) highlights the use of the phrase 'ancestral adage' in Ó Dálaigh's famous quotation. While the search functions of the BAILII database are limited, a simple textual search of the phrase 'ancestral adage' produces several examples of other Irish-language expressions appearing in Irish court judgments. Interestingly, Justice Charleton references the expression *ó Shamhain go Bealtaine* in his judgment in *Nash v Director of Public Prosecutions* [2015] IESC 32 while discussing the issue of media reports in relation to jury and judicial deliberations.

> Absent extreme circumstances, it is difficult to know why the kind of allegation of deep-rooted prejudice

> arising from media reports argued for in this case is likely to remain or in any way to influence jury or judicial deliberations. As people know, paper does not refuse ink. People realise the limitations on what journalists can do and they also recognise the sense of the ancestral adage: *Scéal a théann ó bhéal go cluas téann sé ó Samhain go Bealtaine*. Facts, in other words, are different to gossip or comment. Facts can be relied on; chit-chat just cannot. A forensic examination is by nature careful and logical. Consequently, no reasonable person confuses prior knowledge of a case with mere acquaintance with whatever matters the media are in a position to report as if they are facts.

The 'ancestral adage' in its entirety, *scéal a théann ó bhéal go cluas téann sé ó Shamhain go Bealtaine*, literally translates as a story that travels from mouth to ear will last from November to May. Looking to its contextual usage, the expression highlights the importance of differentiating between the authenticity of facts as presented in court and information obtained from other sources such as media reports. Echoing Shakespeare's 'break the ice', this expression is used as a rhetorical device and concisely conveys the speaker's intention. Posner (1986, 1383) acknowledges the importance of rhetoric in law as 'many legal questions cannot be resolved by logical or empirical demonstration'. Similarly, Gadbin-George (2013, 6) notes how intertextual literary references, and Shakespearian expressions particularly, are more frequently being referenced by judges in European court decisions in an attempt to clarify a judge's legal reasoning. Rhetorical devices such as those discussed here can be seen as way to make court decisions easier to understand and more accessible to those not versed in legalese or 'lawyers' cant' (ibid.) Justice Charleton's use of the Irish-language expression *ó Shamhain go Bealtaine* not only functions as a linguistic device used to clarify a specific legal point in contemporary judicial discourse, but the expression itself acts a reduced cultural text that encodes a specific reference to Irish calendar customs and traditions.

The development of Irish-language digital databases with user friendly search interfaces provides researchers with new platforms to conduct research drawing on various resources and alternative perspectives. Improving search functions and accessibility enables researchers to fully engage with material previously not freely available in digital format. Despite major technological advancements in the development of digital resources for the Irish language in recent years, authors of the recently published Digital Plan for the Irish Language[10] have noted that not enough is being done in this area and urgent action is needed to ensure that Irish does not face digital extinction in the coming years.[11] While great strides have been made, there is an immediate need for further planning, or calculating as the *rímaire* once did, to ensure the language's digital future.

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Digital Poetry in Digital Literacy

Jim Andrews
vispo.com

Poetry has been associated with the teaching of literacy for a long time. Because poetry, in some ways, is the cherry on the top of literacy. In poetry we see something approaching our full humanity expressed in the technology of writing. Writing is a complex, subtle, highly expressive technology. Poetry is typically considered the highest form of writing because that's where we learn how to feel with language. Language in poetry carries human feeling, emotion, attitude, the tone of the inner voice, as well as thought. Poetry pushes the capabilities of language, tests it, throws it off a cliff, retrieves it, does it all again.

Computing environments have changed our typical reading and writing environments a great deal. We now typically read and write not only language but also images, sound, video, and code and programming. Also, the texts we read are often now interactive. Programming responds to what we write. All this changes what it means to be literate in the contemporary world. Just as poetry, for at least hundreds of years, has been the apogee of *literacy*, so too with digital poetry in *digital literacy*.

My first experiences with using technology artistically go back to my radio days in the 80s. I'd like to write about the dawn, for me, of understanding something about using technology artistically. Because it's relevant now to our digital experience and to digital poetry/literature.

I produced a literary radio show in the 80's each week for six years. At first, what I did was tape poets and fiction writers reading, and aired that. Sometimes I would do a bit of production on the material.

But then I heard a life-changing tape from Tellus. It was their #11 issue, The Sound of Radio, and it featured work by Gregory Whitehead, Susan Stone, Jay Allison, Helen Thorington and others. It was miles beyond what I was producing. It was interesting *radio art*. I was just putting work for print onto tape/radio. The Tellus tape was *audio writing*. This was art in its own right. Especially in the case of Whitehead and Stone, it was poetry not first written for the page, but created in almost a new language of poetry, with recorded sound and radio in mind from beginning to end.

It wasn't simply that it was impressive technically, as produced audio. The point is that, as interesting poetry to listen to, as recorded sound or as radio, this was far more interesting than listening to poets read their print poems. Some of them described themselves as audio writers. Whitehead did a tape called Writing On Air; another was called Disorder Speech. These writers took radio and recorded sound seriously as artistic, writerly, poetic media. It was literary inscription in sound, on tape, in radio. And it opened up great vistas to me in the realm of poetry and language.

I started corresponding with and reading essays by Whitehead about radio art and the art of sound. Not only was Whitehead producing fantastic audio–he was writing about the poetics of radio art brilliantly!

I began to realize that creating exciting art for a particular medium was not the same as simply making art developed for one medium available in a different medium. Why is that?

Art that understands and uses the special properties of its medium is not a weak echo of some other medium. The radio I'd been producing was not the art itself. It was providing an inferior experience of the books that the authors were flogging. The books were the art itself.

If you're not channeling the energy that flows through the special properties of the medium, those channels will work against you because energy flows through them whether you channel it or not. If you're not channeling it, the attention it gets—just by virtue of the nature of the medium—is noise

distracting the audience from whatever channels you are using.

For instance, reading text on a monitor is harder than reading text in a book because the medium is refreshing the image 60 times per second. And if there's stuff that's moving, that competes for attention. One way to use that energy is animation.

This topic about the value of dialing in the special properties of the medium is sometimes called *media specificity*; it's associated with the writings of the USAmerican art critic Clement Greenberg, primarily, but the way I think of it predates my knowledge of Greenberg and is more associated with Gregory Whitehead and Marshall McLuhan. My friend Jeremy Owen Turner tells me that thinking on the matter goes back to Kant.

So if we ask what the relevance of digital poetry is, say—and by that, I don't simply mean digitized poetry but poetry where the computer is crucial both for the production and appreciation of the work—we can say that it's important to digital literacy, to being fully literate in the digital.

Digital literacy is not only in knowing how to google the information you want, and how to check to see if it's accurate information—though that's important to being digitally literate—as opposed to being an easy mark for misinformation and scams.

It's also important to get a feel for how emotion and affect can be involved in interactivity. And how video and text can work together. And how sound and text and visuals can work together intellectually and emotionally. An important part of our contemporary computing experience is multimedia, the experience of several media at once. Multimedia poetry is intermedial, it relates the media, it makes them work together as one integrated experience. That is part of digital literacy too.

Poetry is where/how we learn to feel with language. Digital poetry is where/how we learn to feel with our expanded/changed language we experience in computing environments, our intermedial language, our interarts language, our new media language that is a confluence of language, image, sound, and interactivity.

While the digital can give us print and video and sound, etc—they're all just coded in zeros and ones—digital art is more than a bunch of old media tacked together. It's a new art form in itself. It isn't simply that it's uniquely multimedial or even intermedial, though that's an important part of it. And it isn't simply that it's interactive, though that's important too. And it isn't simply that it's programmable. In his book A Philosophy of Computer Art, Dominic Lopes proposes—as many others have—that *computer art* is, in fact, a brand new form of art. And if that's true, then simply digitizing other forms of art does not suffice to experience *computer art*—which is art in which the computer is crucial for both the production and appreciation of the art. It's art in which the computer is crucial as the medium.

Marshall McLuhan said that technologies are extensions of our senses. The telescope and microscope let us see things we can't see with the naked eye. Telescopes and microscopes extend our sight into the large and small. Telephones extend our hearing and voice over great distances. Technologies extend senses, our bodies, our capabilities. Computers extend our memory and our cognitive abilities. We can know things with a google that otherwise would take us considerable research.

Computers extend our senses, bodies, and abilities/capabilities, but it's digital poetry and other digital art (computer art) that extends our humanity throughout our new dimensions. Without computer art, the extensions of us we acquire via the digital are as claws without feeling. Digital art gets the blood flowing through our new abilities, gets the feelings going. Then we understand how interactivity involves our feelings, whether we know it or not. We begin to be able to think and feel at once with computers, through intermedial, interactive, interestingly programmed computer art.

Digital art also gets our digital shit detectors working. We can sense better the truly human, the fully human, the true. As opposed to accepting ads and such as expressions of truth.

Recreating the eleventh century musical sequence *Victimae paschali laudes* using Max

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This essay shows how the eleventh century musical sequence *Victimae paschali laudes* is recreated in Max using fifteen objects. The programming level is relatively simple. The desired musical outcome was in no need of more complex programming, as shall be seen.

Before showing how the Max patch works, a contextual exploration of the music of *Victimae paschali laudes* is presented for those readers unacquainted with it. Following this, the reason for using Max to recreate the chant is then given, before a detailed analysis of the Max patch is presented. Finally, a short section on how the audio material is created in the Max patch is put to use in another software programme Logic Pro X.

Brief Contextual Exploration of Victimae paschali laudes

The eleventh century musical sequence *Victimae paschali laudes* is ascribed to Wipo of Burgundy (CA. 995-CA. 1050) according to the Norton Anthology of Western Music (Burkholder and Palisca, 2006, p. 31).

Just James Greasby, in his PhD thesis devoted to bringing to light neglected music for Easter, says:

> Victimae paschali laudes was one of the four sequences retained by the Council of Trent of 1545-1563. This sequence, along with the Stabat Mater dolorosa admitted in 1727, is included among the five sequences which are still in use on designated holy days by the Roman Catholic 3 Church today. Greasby, J, J., (1972, p. 3).

Victimae paschali laudes is a religious chant often associated with Easter, the most important feast day in the Christian calendar, sung as part of the liturgy at Mass. The Mass includes a number of parts including the following: alleluia, verse, alleluia, sequence (Greasby, 1971, p.3).

Greasby goes on to say of the sequence that it is:

> an embellishment of the liturgy, an insertion between liturgical chants—the Gradual and the Gospel, originating about the eighth century: the sequence is thus an interpolation in the liturgy, but it is not an interpolation in a liturgical text. Greasby (1971, p. 15)

The sequence can be considered independent of the text and only forms meaning when connected with it. The eleventh century saw more creative freedom for those who compose music for the church as well as in certain secular contexts. As a result of such freedoms hundreds of sequences were written during this time. Sequences were widely adopted to be a part of the Mass as well as organised into large collections with specific sequences used for specific days (Greasby, 1971, p. 19). Whilst the history of the sequence is fascinating, there is, however, not the space here to reveal its fuller context.[1]

The text evokes the resurrection of Christ, and the redemption that he will bring to all of humanity according to the Christian religion. In modern chant books the sixth verse is omitted due to its reference to the notion of the deceitful Jews (Burkholder and Palisca, 2006, p. 31). Modern church leaders have apologised for this and have sought to uproot this calamity. The text nor its content

[1] For further details see the references section at the end of this essay.

was of any concern to me in creating my six-track EP, however. The sequence is separated from its text in my rendition, and as such is therefore devoid of its meaning. I have in fact written my own text for The SAPIAN Trilogy. Thus, by applying my own lyric to the melisma of the chant continue the tradition of such sequence making, the origins of which themselves arose by the practice of adding texts to existing melodies (Greasby, 1971, p. 43).

The chant has musical qualities such that they accord it longevity, according to John Julian, in his book "Origin and History of Christian Hymns of All Ages and Nations, New York, Charles Scribner's Songs":

> This fine Sequence is simple, scriptural, good in rhythm, and embraces in itself various elements which account for its popularity and long extended use. Luther held it in high esteem, especially admiring the terse and vivid picture of the conflict between Death and Life…
> (Julian, 1892, p. 1223)

applied.

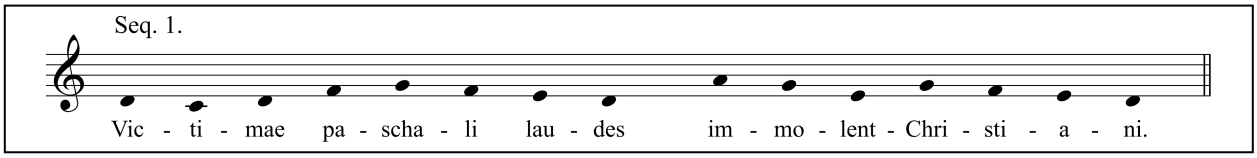
The chant is 'one of only five that are retained in the liturgy and standard modern chant books.' (Burkholder and Palisca, 2006, p. 31).

The first sequence (see Seq. 1.) that then forms the musical basis for the following six sequences. It ends with the notes: G, F, E and D, a pattern that occurs on other occasions throughout the music.

Why use Max to recreate an eleventh century sequence?

Chants are very attractive musical materials worthy of study and continual use. They have been bequeathed to us by previous generations. That some chants have survived the intergenerational evolution of cultural norms whilst most have not, in my view, implies that the enduring music has superlative quality that affords them their longevity.

The longevity notion, accurate or not, is however an after-thought. My first instinctive desire was to learn and play it (on my voice and an instrument) for the shear



Sequence 1. *Victimae paschali laudes* ascribed to Wipo of Burgundy (CA. 995-CA. 1050).
Source: Burkholder and Palisca 2006, p. 31

Similarly, what I find of value in the chant is its musicality. With its Dorian mode, uneven phrase, a range of a twelfth (wide for a plainchant), contour of subtle variation, and its atmosphere. In addition, its exemplary combination of repetition and variation, as can be seen for example in the deployment of descending stepwise melodic patterns at the end of each phrase. Most of the intervals move in step, very few are larger than a second. There are some thirds, occasional fourths and no interval larger than a fifth is

mystifying enjoyment of musicmaking. Then, later it became evident that the chant could be put to good use in my six-track EP *The SAPIAN Trilogy: part 1*.

In 2020 I began writing my six-track *EP The SAPIAN Trilogy*: part 1. The work was initiated as a series of musical exercises made for my students, to show how simple musical ideas can be made into more substansive material with limited software or technical resources. The limitation in this case is the digital audio workstation software Logic Pro

X. Having started to become rather fond of some of the musical exercises, I took the decision to develop them into a full-blown work.

Most of the six-track EP is produced using Logic Pro X. A software that offers users a comforting experience. It is user friendly and intuitive to operate. Without much experience of either music or DAW software users can quickly and relatively easily begin making rudimentary pieces using the wealth of pre-made loops and samples the package delivers. The music made in this way can sound derivative, however. In order therefore to produce music that sounds like it has not come out of the box, so to say, it requires more effort on the part of the user.

As I have been using Logic for many years, and prior to taking it up, used other DAW software, crafting different kinds of music in the programme now seems second nature. The square wave sound in Logic is, however, a bit too easy on the ear, for what I wanted in the EP, so, I made the decision to use Max for this one element. The Max sawtooth and triangle waveforms have a raspier quality than those used in Logic Pro X. And it was this rawer timbral quality I wanted to explore in the composition of *The SAPIAN Trilogy: part 1*.

In total nine Max patches were created named "Seq. 1.maxpat; Seq. 2.maxpat;…Seq. 7.maxpat." then "Seq. metro synch test", and "zSeq. 2 + rev.".

The first seven are straightforward realisations of the chant sequence. With the final two being experiments. In the end only the first seven were used in my EP. The two omitted patches were experiments too far and as such were rejected.[2]

The Construction of the Max Patch

In recreating the eleventh century musical sequence *Victimae paschali laudes* in Max, I used the following fifteen objects:

1. saw~ generates an anti-aliased sawtooth wave.

2. tri~ generates a triangle wave whose component frequencies are resistant to aliasing.

3. gain~ a slider that scales signals. It can also make a smooth transition as you move from one value of the slider to the next.

4. metro Acts as a metronome which outputs bang s at a regular, specified interval. This object uses the Max time format syntax, so the interval that the metro object uses can be either fixed or tempo-relative.

5. gswitch2 Send input to one of two outlets. Switches the right inlet between two output pathways.

6. Bang Output a bang from many outlets. Outputs bang messages out of each outlet (in right-to-left order) when it receives any input. The number of outlets is determined by an argument.

7. toggle Switch between off and on (0/1). When clicked, toggle outputs a 0 when turned off and a 1 when turned on. When giving input, a non-zero number will turn it on, a 0 will turn it off, and a bang will alternate the state of the toggle. All numbers are converted to integer and passed through unchanged.

8. number (integer and non-integer) Display and output a number. Displays, inputs, and outputs integer numbers.

9. kslider Output numbers from an

[2] Explained later.

onscreen keyboard. Outputs and displays note and velocity information using an on-screen keyboard.

10. mtof Converts a MIDI note number to frequency. Performs MIDI-note-number to frequency conversion. Frequency is reported in as a float in Hertz (Hz).

11. scope~ Visualize an audio signal. Visualize an audio signal.Use the scope~ object to visualize and audio signal using an oscilloscope-style display.

12. EZDAC

13. Message object (to bang out numbers)

14. Multiplication argument (amending the frequency of the triangle)

15. Division argument (amending the frequency of the triangle).

This simple patch has three main parts: 1) a sequence control mechanism, 2) a pitch generator and a 3) sound source/ timbre (including an audio output).

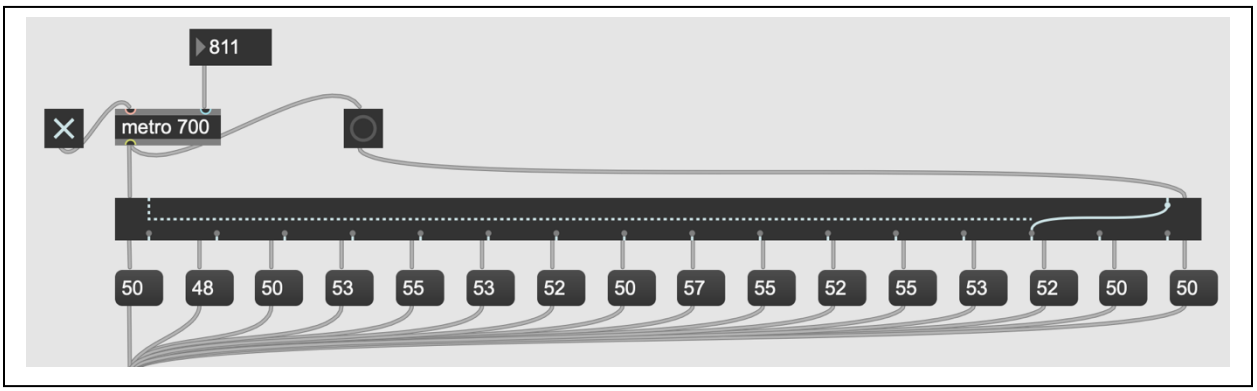
The sequence control is used to create the number of notes in each sequence, in the correct order. The pitch generator realises the pitches and converts the MIDI notes to frequency. Part 3 uses the sound source of a sawtooth wave, plus two triangle waves to realise the timbre.

The following sections look in detail at the patch, offering a deeper insight into its workings and rationale.

Part 1: The Sequence Control Mechanism

Part 1 is made by the simple use a metro object that releases a bang into a gswitch 2 with sixteen out gates (one for each note in Seq. 1 of *Victimae paschali laudes*). Each gate outlet is then connected to a number that conjoins to part 2 of the patch. A toggle is used to switch the metro (and therefore sequence) on/ off and a number object is fed into the righthand inlet of the metro to control the frequency of which the bangs are released. This in effect becomes the tempo control. Each number object, when triggered by the gswitch, sends the corresponding number to the kslider producing a MIDI note aligned to a pitch. To give an example, 50=D natural, 48=C natural.

The metro is set at 700, which means it will output a message every 700 milliseconds. This value was arrived at through a trial and error process of trying different values to hear which one worked best for the musicality of the sequence. The number object connected to the righthand



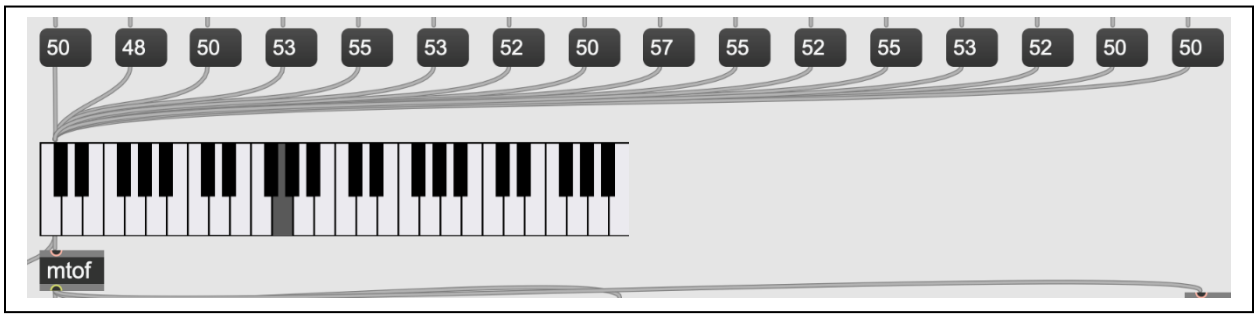
Part 1. The Sequence Control Mechanism used in the recreation of the first sequence of *Victimae paschali laudes*

inlet of the metro simply allows for the convenient fast-forwarding through the sequence.

Part 2: The Pitch Generator

The sixteen number objects from the above part 1 feed into the kslider (of part 2) triggering MIDI notes whose pitches are then converted into a frequency in Hertz (Hz) using the mtof object.

It can be observed that there are three message objects, one next to each of the gain~ sliders. Each message object has a different numeric value, starting on the far right: 91, 107 and 113. These determine the relative loudness of each harmonic component. The first message box is connected to the others necessitating, therefore, a simple push of this first message to simultaneously activate the other two,



Part 2. The Pitch Control used in the recreation of the first sequence of *Victimae paschali laudes*

Part 3: The Sound Source (timbre)

The sound source is the main reason for using Max as already stated earlier in the essay. A sawtooth wave and two triangle waves have been combined, in a very simple additive synthesis technique. The sawtooth is used as the fundamental tone. With the first triangle wave adding a harmonic component a fifth above. And the second triangle adding a component a fourth above.

The electronic sonic clarity of this simple sound source made using three components is what I wanted to achieve in the making tracks: 1b "Hail Self-Generating Reason" and 2b "The Seven Rules of The Omniverse Ordering of the Artificial Intelligent Vision" of my six-track EP, *The SAPIAN Trilogy*.

Three gain sliders were used to fine-tune the balance between the three harmonic components. The final result is that it has an almost low bit depth quality to it that lends itself well to the theme of the trilogy, a Super Artificial Intelligence order.

thereby determining the relative amplitudes of the harmonic components and hence the realising the final timbre.

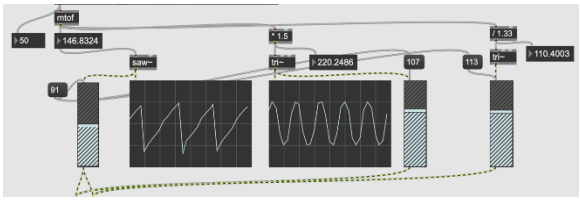


Figure 1. The Sound Source used in the recreation of the first sequence "Seq. 1.maxpat" of *Victimae paschali laudes*

The Whole Patch with Audio Output

The three gain sliders shown in Figure 1 can also be seen also in Figure 2, this time connected to the EZDAC, the audio output set to the hardware speakers on my MacBook computer.

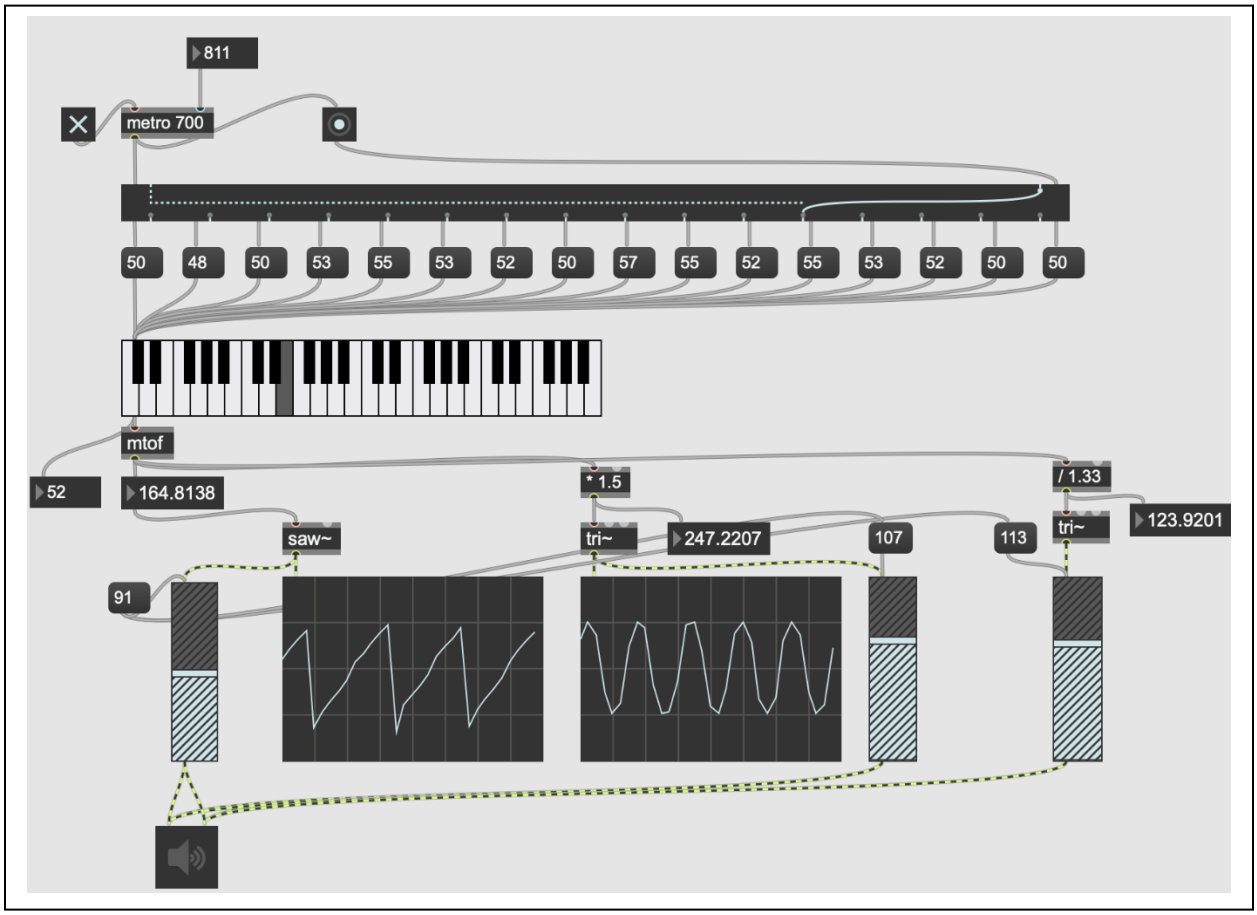
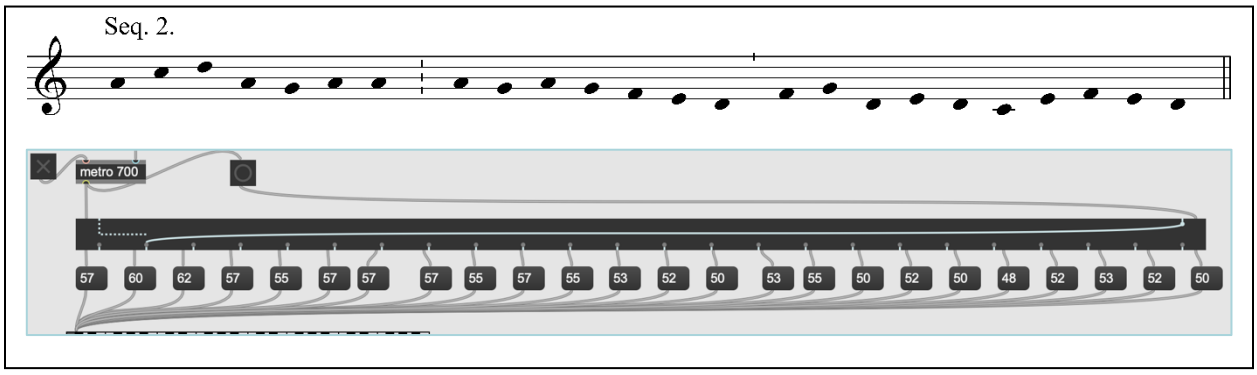


Figure 2. The Whole Patch showing the Audio Output

This concludes the Max Patch for Seq. 1 of *Victimae paschali laudes*. The following details each of the patches for the subsequent music of the chant. Given that only part two of the Max Patch is different for sequence 2 to sequence 7, the following therefore gives the details of only the deviations that occur in Part 2 of the Max Patch; the part that deals with the specific sequences of pitched notes.

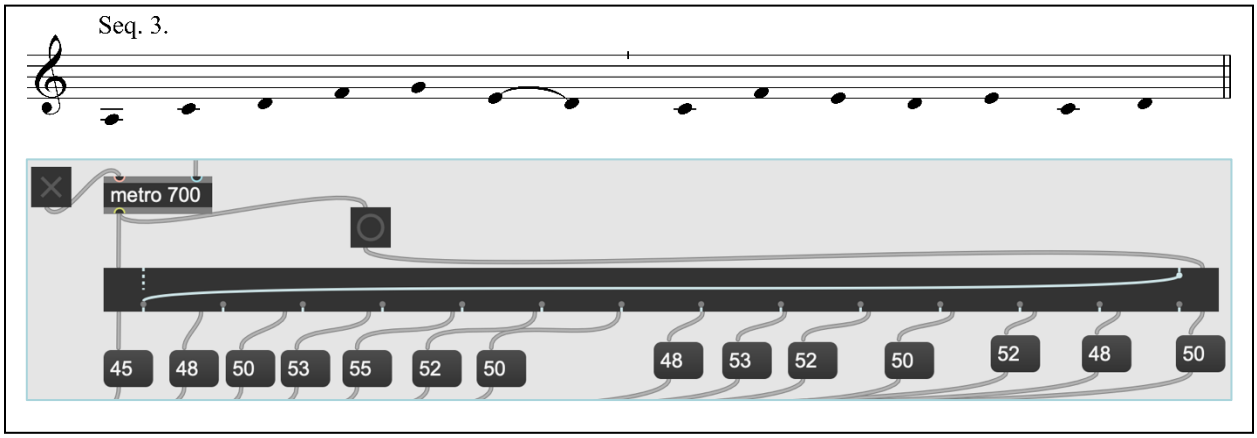
Seq. 2. The Pitch Control Part 2 element

The longest sequence in the series, consisting of twenty-four notes.



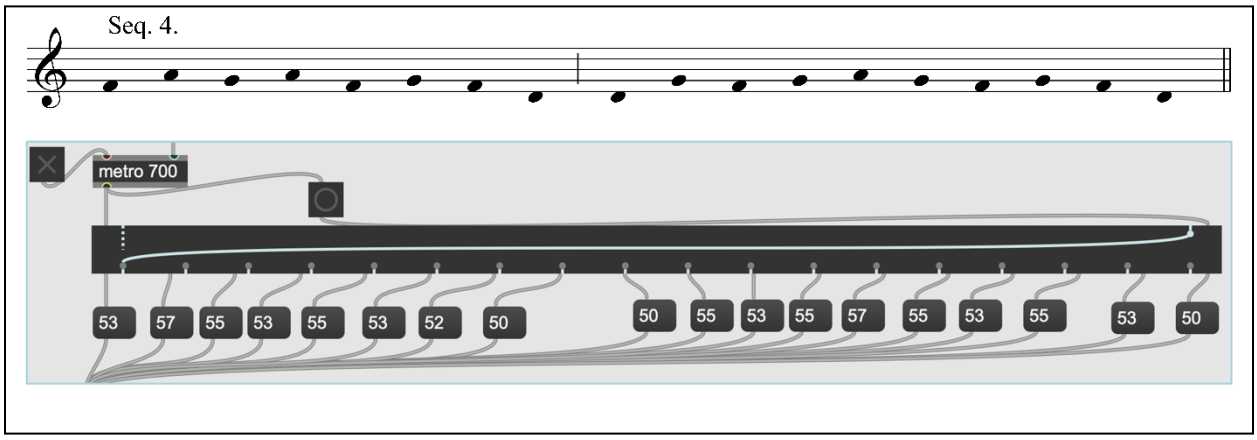
Seq. 3. The Pitch Control Part 2 element

The third sequence consists of fourteen notes.



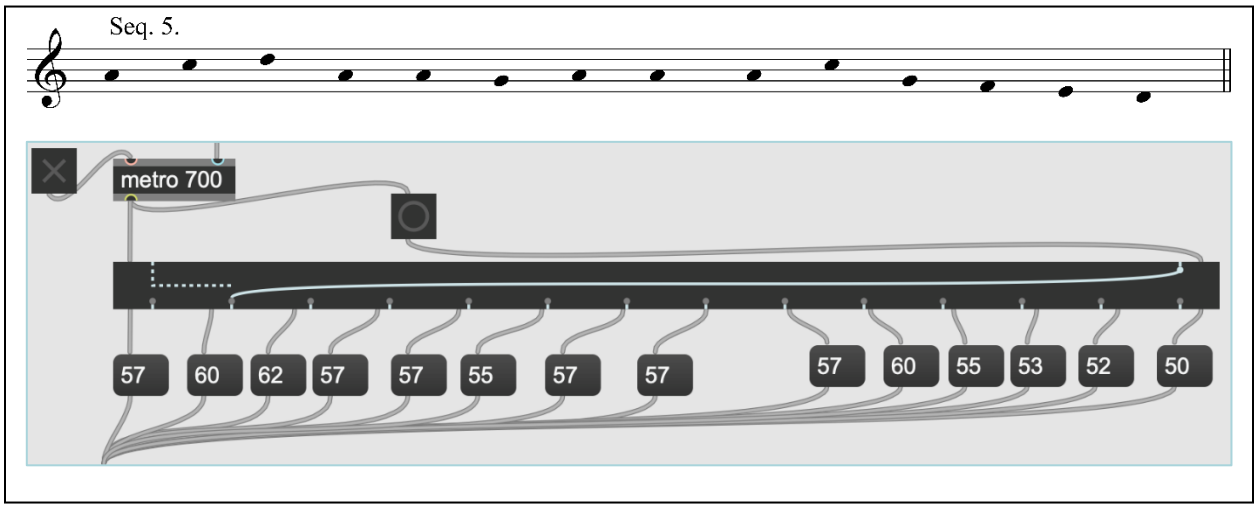
Seq. 4. The Pitch Control Part 2 element

In this eighteen-note sequence, it can be seen how the Max patch mirrors the phrasing of the notation, whereby the two D-naturals, steps eight and nine (number object 50) are visually separated. This allowed me to more accurately see where the patch corresponds with the music.



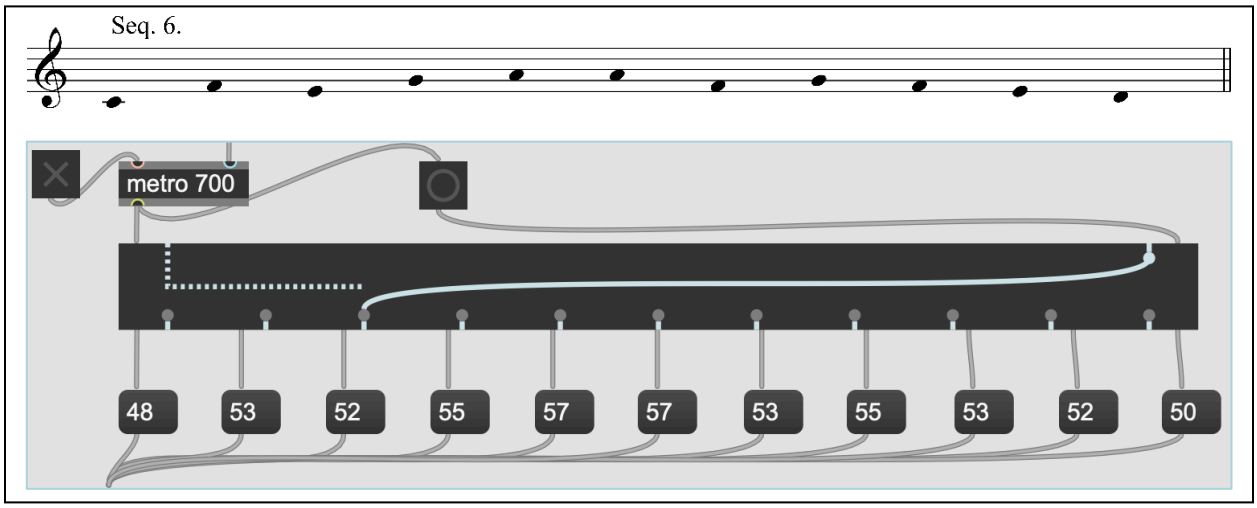
Seq. 5. The Pitch Control Part 2 element

The fourteen notes of sequence five are visually separated at the phrase point, as in the sequence above. This can be seen on number objects 57 steps eight and nine.



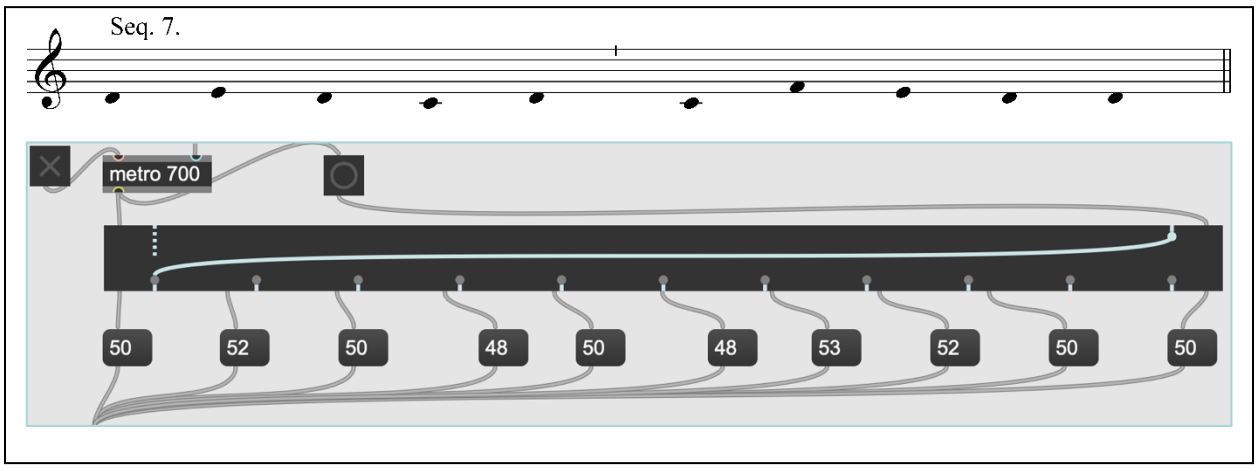
Seq. 6. The Pitch Control Part 2 element

The eleven notes of this sequence are easily visualised in one glance of the Max patch, so there was no need for separation.



Seq. 7. The Pitch Control Part 2 element

In this final, and shortest, sequence the double D-natural is included, unlike in the previous sequence, whereby grace-notes were omitted.



Two rejected patches "Seq. metro synch test" and "zSeq. 2 + rev"

The first rejected patch "zSeq. 2 + rev" includes three additional harmonic components in the shape of triangle waves, with a harmonic intervallic multiplication relative to one another of: / 1.33, / 1.167, / 1.125 and / 1.111. With each of the harmonic components being sent to a reverberation object from the BEAP section of the pre-made Max resources. The seconds rejected patch "Seq. metro synch test" includes the same harmonic content as the above patch, but also has a feedback loop element, whereby the frequency determined by the mtof object number is multiplied by 1.01 then feed back

into the metro, to provide a variable tempo directly related to the pitch step in the sequence. So, for example A=220 Hz gives a metro of 222 milliseconds where C=261.6256 Hz gives a metro of 264 milliseconds.

Sometimes in composition, but not always, more is less. Having made two patches with additional harmonic content as well as reverberation, in the end I simply preferred the rawer, raspier sound of the single sawtooth and two triangle waves. Given I knew the seven sequences would be recorded, turned into audio files, then imported in Logic Pro X, it was decided that it would be more preferable to shape the raw sound in the latter DAW, as will be seen shortly.

Recording the Output to Create Seven Audio Files

Because of the low bit depth quality of sound required, there was no need for sophisticated recording programming or hardware. Instead, the stereo mini-jack output of my MacBook was used to connect to two separate (left and right) quarter inch jack plugs connected to a standard audio interface connected to another computer running Logic Pro X. The signal to noise ratio was carefully analysis by making several versions of the *Seq. 1* to ascertain the optimal output level of the MacBook and input on the audio interface.

Integration of the Audio File into The SAPIAN Trilogy

Logic Pro X was used to firstly record in the raw audio. This provided me with seven audio files of each separate sequence of *Victimae paschali laudes* (see Fig. 3).



Figure 3. Logic Pro X used to record the seven Max patch parts for *Victimae paschali laudes*

Once the seven sequences had been turned into audio files there was no longer any need for Max.

Logic Pro X was then used to further emphasis the digital sonic quality of the audio, by the inclusion of four inline digital process:

1. EQ
2. Spectral Gate Filter
3. Phase Distortion
4. Compressor.

In addition, two pre-fade bus channels were used to send the signal simultaneous to two separate reverb digital signal processes. This then forms the musical accompaniment to the spoken word voice parts that recite the lyrics of the track. The spoken vocal part is also coloured using a variety of processes, including pitch-shift down to give the voice a more primal feel.

Five channels are used in total, one for the chant made in Max and four for the spoken word vocals. All are five are sent to the same two reverberation digital signal processes, aforementioned. The stereo master channel uses no additional inserts (DSPs). The exact same settings are used in both tracks: *1b Hail Self-Generating Reason* and 2b *The Seven Rules of The Omniverse Ordering of the Artificial Intelligent Vision* to provide sonic coherence throughout the EP.

Conclusion

This essay has shown how an eleventh century musical sequence can be realised using simple Max programming techniques.

A brief context of the musical sequence *Victimae paschali laudes* is presented before an exploration of the need to use Max, and how it is used in forming material for my six-track EP The SAPIAN Trilogy.

The raw perhaps raspy sound quality of the Max single sawtooth waveform and two triangle waveforms was the sound I wanted for my The SAPIAN trilogy. In addition, the simple nature of the way in which the gswitch creates the sequence, by switching from one output to the next in step, afforded the sound quality an extra, almost chip-tone like quality.

In total nine Max patches were created, two were reject with seven being used to make audio files that were then used in Logic Pro X to realise the final musical material. Each of the seven patches can be divided into three parts:

> Part 1: The Sequence Control Mechanism
> Creates the sequence of notes for each phrase in *Victimae paschali laudes*.
>
> Part 2: The Pitch Generator
> Generates the pitches applied to the sequence above.
>
> Part 3: The Sound Source (timbre).
> Realises the sequence and notes as a distinct timbre, by applying a single sawtooth waveform and two triangle waveforms, to form a raw, rasp like sound quality.

The simplicity of the Max patch is reflected in its use of only fifteen objects.

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Discography

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Scores

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