University of Tasmania

Harmonic Based Extended Techniques and their Compositional Applications:

An Investigation in New String Technique

An Exegesis Submitted to

Conservatorium of Music

in partial fulfilment of the requirements for the degree of

Bachelor of Music with Honours (or Bachelor of Music (Elite) with Honours)

by

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Hobart, Tasmania

September 3, 2019

Declaration

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Rhys Gray

September 3, 2019

Abstract

I propose to explore a range of extended techniques that utilise the harmonic series and assess how they can be used in my, and other people's, creative practice. These techniques include (but are not necessarily limited to) multiphonics, subharmonics, and audio-processed harmonics. Due to the scope of this project, stringed instruments will be the primary focus. For the purposes of brevity, these harmonic-based extended techniques will simply be referred to as 'techniques' throughout the paper, except for when differentiation between standard techniques is needed.

While some techniques such as harmonics are well established and understood, others, such as subharmonics, are still immature in terms of both repertoire and resources available. The timbral potentials of these techniques are uncharted territories and collectively represent a whole sound world that remains relatively inaccessible to contemporary art music composers.

To identify where further research is required, I will conduct a review of the literature and resources that are readily available to composers to assess what techniques require further investigation and refinement. By researching these techniques and the mechanics behind them, interviewing professionals, and analysing recordings made, I hope to gain a better understanding of how these techniques can be implemented in my practice. As part of both the analysis of techniques and my compositional practice, I will assess not only the compositional potential, but also the practicality of techniques. Reviewing the feasibility and

notational aspects of the techniques will render the exegesis a practical document to reference for performance and composition.

I aim for my resulting exegesis to become a useful reference source for artists interested in learning about the mechanics, qualities, and potential implementations of these harmonic based extended techniques. The works that I compose accompanying the exegesis will show idiomatic treatment of the techniques and serve as references as such in the exegesis. The dissemination of the material I research will contribute to the accessibility of new sound possibilities for artists.

Thank you to my supervisor, Matthew Boden, my teachers Dr. Maria Grenfell and Dr. Scott McIntyre, my piano teacher Sally Ward for inspiring my passion in music, my family, and my cats Buttercup and Millie.

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Chapter 1

Literature Review and Methodology

Literature Review

This study builds on and contributes to the catalogue of resources available to composers interested in implementing harmonic based extended techniques in their practice. The topic of "Harmonic based extended techniques and their compositional applications" is broad, and I will be unable to explore the entire corpus of techniques available to all instruments. This is by design, as certain instruments lack certain facets of research, while others are already well documented, the most obvious example being string harmonics, which are common practice. This broad topic affords a certain level of flexibility to explore what is both novel and feasible given my available resources, all under the unifying theme of harmonic based extended techniques.

Many of the techniques that this study deals with are still in their comparative infancy, especially notationally. As such, engraving the works produced in the course of this study is a more subjective matter, rather than the well-established practice that it normally is. A review of the available literature makes it clear that attempts have been made to standardise contemporary music notation, but have either fallen short, or are now outdated. Kurt Stone organised an international conference on new musical notation in 1974 in Ghent, Belgium, and then produced the treatise *Music Notation in the Twentieth Century* in 1980 as a result of the conference.[1] This, along with Gardner Read's 1979 *Music Notation*, served as a strong base for the standardisation of music notation, but both are

1. Kurt Stone, *Music Notation in the Twentieth Century* (New York: W. W. Norton & Company, 1980), xiii.

mired by their age and computer based notation not being widespread.[2] It is therefore unsurprising that both omit stringed multiphonics, subharmonics, and the many other techniques covered in my study, which largely postdate publication. Gould's 2016 book *Behind Bars* immediately became the gold standard of engraving manuals, her decades of notational and editorial experience at Faber Music lending weight to her comprehensive treatise. But the same new techniques are omitted from Behind Bars, with Gould stating:

> 'I have been highly selective in the choice of extended instrumental and vocal techniques included in this book, but it is intended that this should give the reader the facility to create notation for other techniques not in common use.'[3]

Gould's book is less prescriptive than its forerunners, and focuses more on creating a consistent style language, providing the reader with the tools of standardised and codified 'common practice' notation to build new extended technique notation. As such, for all notational aspects, I will be drawing upon the Gould for the philosophy of engraving, if not exact notation, which has the benefit of almost forty years of introspection against its peers.

Gould provides the tools which Ellen Fallowfield uses to construct a notation method for string multiphonics in her PhD 'Cello Map', which represents an excellent framework to follow. A detailed, process-oriented review of technique informs the creation of resources which are then analysed.[4] Fallowfield's analysis produced the website cellomap.com, a manual of techniques for performers to use. She states that her text maps:

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2. Gardner Read, *Compendium of Modern Instrumental Techniques*, 1st ed. (Westport, Connecticut: Greenwood Press, 1993).

3. Elaine Gould, *Behind Bars*, 1st (London: Faber Music, 2011), iii.

4. Ellen Fallowfield, "Cello Map: A Handbook of Cello Technique for Performers and Composers" (Thesis, University of Birmingham, 2009).

> '[...] "actions that a cellist can make" onto "sounds that a cello can produce". In other words, we have tried to reduce the cello and cellist to scales of actions and sounds, and show how cellists can influence sound (loudness, overtone content, pitch...) by their actions (bow speed, contact point, stopping position...). This standpoint is a deliberate move away from providing performers and composers with catalogues of special effects and extended techniques. Instead, we would like to provide information about how the cello works that can serve the imagination of performers and composers.'[5]

This approach 'future proofs' the thesis by abstracting the elements into their most base form, showing all of the sounds a cello can make using all of the actions a cellist can perform. While the website is comprehensive, Fallowfield seemingly avoids making any judgement calls on the compositional applications of the techniques that she reviews, and the reader is left to draw their own conclusions on the compositional effectiveness of any given technique. Fallowfield does, however, note that a repertoire gap exists for etudes exploring multiphonics for the cello, and indeed, the entirety of the string family. As part of my practice-led research, it seems fitting to compose a piece that addresses this repertoire gap.

Bertram Turetzky's book, *The Contemporary Contrabass* was written to exemplify the contrabass as a serious solo and melodic instrument, which was underrepresented in the literature. He theorised:

> '[...] concertizing was the key, which in the 1950's was impossible mainly due to the lack of literature. I attacked this problem in two directions: 1. Locating original contrabass music from the eighteenth and nineteenth centuries, and 2. Commissioning twentieth century music.'[6]

His practice-led research centred on seeking to understand the techniques that contemporary composers would use in solo contrabass repertoire. Turetzky

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5. Ellen Fallowfield, "Cello Map," accessed May 31, 2019, `http://www.cellomap.com/`.

6. Bertram Turetzky, *The Contemporary Contrabass*, 1st Edition (California: University of California Press, 1974), vii.

deliberately omitted including any guidance or judgements on notation, or categorisations of the difficulty of the techniques, stating that

> '[...] the time between this printing and the second edition will suffice to suggest and select the best notational concepts from a more substantial literature than we possess now.'[7]

The second edition saw Turetzky call for more experimentation with multiphonics, stating:

> 'I know of no music employing string multiphonics [...] this is entirely new ground, it remains for composers and performers to build the usable technique.'[8]

The specification of both composers and performers being needed to 'build the usable technique' is peculiar, until one re-examines the context, in which Turetzky knew of these techniques, and was attempting to rectify it through commissioning new literature. Performers and researchers such as Fallowfield are necessary to establish the technique, but without composers implementing the research carried out by them, it is impossible for a 'usable technique' to be built.

Thomas Howell's 1974 book, *The Avant-Garde Flute* followed Turetzky's contrabass technique book, as part of Turetzky's *The New Instrumentation* series, which was published by California Press until Scarecrow Press took over in 2004.[9] It is relatively conservative in its content, and has many omissions. Howell's contributions are overshadowed by Robert Dick's *The Other Flute*, which was released the following year, and was notably used as the primary reference for

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7. Turetzky, *The Contemporary Contrabass*.

8. Betram Turetzky, *The Contemporary Contrabass*, 2nd Edition (California: University of California Press, 1992), 138.

9. Fallowfield, "Cello Map: A Handbook of Cello Technique for Performers and Composers," 4.

microtonal flute fingerings by John Cage in the preface to his piece *Music For.*[10] *The Other Flute* is a thorough, if esoteric performance technique manual, presenting each fingering and its resultant multiphonics one after the other, using a chart of descriptions to specify the qualities. It specifies the following: 'exact pitch, ease of response, starting time, stability, dynamic range, timbre, and, if present, noise level, residual tone, and degree of modulation.'[11] While this text focuses more on instruction, it is an efficient system, and provides much more information than Howell's fingering charts, which were presented without any accompanying context. Dick sorts the multiphonics into four classes graded by difficulty. The multiphonics are presented in order of their method of production; multiphonics derived from natural harmonics, from fingerings of chromatic pitches, and those based on microtonal segments. The scope of my research is limited to the multiphonics based on natural harmonics. From the perspective of a composer, Dick's book provides ample resources on the qualities of each multiphonic, but generic descriptions of their characteristics; enough for a composer to assess whether any given multiphonic is worth investigating with a flautist. While the scope of my research focuses on stringed instruments, Dick's method of cataloguing different fingerings is a logical and comprehensive model to follow.

The Contemporary Violin is one of the more recent books in Turetzky's *The New Instrumentation* series. It provides a comprehensive review of various violin techniques, but attempts to shy away from any implication of notational authority, most notable in the section on multiphonics, which seems to contradict rules

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10. John Cage, *Music for : Parts for Voice and Instruments without Score (No Fixed Relation), Title to Be Completed by Adding to "Music for"– the Number of Players Performing.* (Henmar Press, 1984), `https://login.ezproxy.utas.edu.au/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=cat02831a&AN=UTas.b2468591&site=eds-live`.

11. Robert Dick, *The Other Flute*, Second Edition (New York: Multiple Breath Music Company, 1989), 84.

codified by Gould (though to be fair, the Gould postdates Strange).[12] Fallowfield identified issues with the presentation format of *The Contemporary Violin* in the literature review of her thesis:

> 'The reader will find [information about col legno battuto] under the first chapter heading: 'Bowing Technique', the subheading 'Col legno battuto'. Later, chapter three: 'Percussion Techniques' includes the subheading 'The Bow', in which col legno battuto is described again.'[13]

Though the scope of my study is significantly smaller in scale, presentation of the findings is paramount to maintain accessibility as a resource. Given that my study focuses on harmonic based extended techniques, overlap of techniques such as multiphonics is possible, and therefore needs to avoid the structural pitfalls of Strange's layout where information is repeated. Fallowfield's later concern of a need for a balance between subjectivity and level of detail when describing technique and sound is also relevant to both the Strange book and doubly so to the study. These manuals merely describe the qualities of various techniques, whereas my study will be dealing with the compositional applications of the techniques. Taking the extra-musical content such as blending, appropriateness for use in pitch sets, and other aspects of composition into account poses a significant threat to the usability of my study due to information overload. Marcus Weiss and Giorgio Netti discuss the reasons for limiting their study to extended techniques in the introduction to their book *The Techniques of Saxophone Playing*, stating:

> 'It might indeed be conceivable to compile a multi-dimensional "Encyclopaedia of Saxophone Playing" [, however] the demands on

12. Patricia Strange and Allen Strange, *The Contemporary Violin: Extended Performance Techniques*, 1st ed. (Los Angeles, California: University of California Press, 2001), 134; Gould, *Behind Bars*, 257-258.

13. Fallowfield, "Cello Map: A Handbook of Cello Technique for Performers and Composers," 12.

> presentation and readability would be so complex as to make such a text impractical'[14]

So far, all of the literature reviewed (with the exception of the Gould and other engraving manuals) has been written either with the performer in mind, or has been written by an instrumentalist. Much of the composer-focused literature is found in the form of orchestration manuals, such as Samuel Adler's *The Study of Orchestration* and Walter Piston's *Orchestration*.[15] Attempting to cover the breadth of the art of orchestration, let alone composition, necessitates the omission of extended techniques. This is the inverse of the issue Weiss and Netti encountered, where their study required an omission of ground-level theory regarding the technical aspects of saxophone playing. Read's *Compendium of Modern Instrumental Techniques* touches upon multiphonics, but delegates to Dick, Howell, and many of the other books from Turetzky's *The New Instrumentation* series for notation and structure.[16] It becomes apparent that no matter the author, instrument, or technique, the work of packaging extended technique information for composers is left to somebody else. Composers seek to cover the entirety of the craft, while performers seek to cover the entirety of the instrument. Therefore, there is a dearth of resources for composers seeking to incorporate harmonic based extended techniques into their practice. My study addresses this by covering the playability, notation, and implementation of harmonic based extended techniques across relevant instruments. Through practice-based research, the exegesis produced by my study will document the process of composing using these techniques,

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14. Marcus Weiss and Giorgio Netti, *The Techniques of Saxophone Playing* (Kassel: Barenreiter-Verlag Karl Votter, 2010), Introduction.

15. Samuel Adler, *The Study of Orchestration*, Third Edition (New York: W. W. Norton & Company, 2002); Walter Piston, *Orchestration*, First Edition (London: Victor Gollancz Ltd., 1969).

16. Read, *Compendium of Modern Instrumental Techniques*, 160.

refining the methodology and notation through the creation of several new works. The resulting document will fill a hole in literature aimed at composers by acting as a practical manual for those interested in implementing harmonic based extended techniques in their own practice.

Methodology

My research topic "Harmonic Based Extended Techniques and their Compositional Applications" is a review of techniques, and how they can be incorporated in my own practice. As such, it is highly subjective, and the research methodology will reflect this, being largely qualitative based. Quantitative based research, such as the analysis of techniques using spectral analysis will be used to support subjective claims. Each technique will be reviewed individually, as they are discrete from one another. Because many of the techniques are uncommon or difficult, consultation with players is paramount to undertake a fair assessment of the techniques. Document analysis of technique manuals will augment oral history research into the qualities and attributes of techniques.

To make an educated opinion on the value of a technique, data must first be collected. Compilation of techniques both in isolated, controlled environments, and in context in musical works will allow a full and accurate use of the analytical method on recordings. Using a Fast Fourier Transformation as in Riera's thesis on saxophone multiphonics, the prominent harmonics of each technique will be uncovered, for harmonic analysis.[17] Examination of techniques in musical context will allow for value judgements to be made about the musical effectiveness of the technique. The recorded data will be treated, and then interpreted and analysed, with the results being implemented in new works.[18] Through this process, my research will feed into my practice.

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17. Pablo Ernesto Riera, Martín Proscia, and Manuel Eguía, "A Comparative Study of Saxophone Multiphonics: Musical, Psychophysical and Spectral Analysis," *Journal of new music research* 43, no. 2 (2014): 202–213, accessed May 9, 2019, https://login.ezproxy.utas.edu.au/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=rih&AN=A891785&site=eds-live.

18. Rita Torres and Paulo Ferreira-Lopes, "Multiphonics as a Compositional Element in Writing for Amplified Guitar (2)," *Journal of Science and Technology of the Arts* 4, no. 1 (December 27, 2012): 61–69, accessed May 9, 2019, doi:10.7559/citarj.v4i1.67, http://artes.ucp.pt/citarj/article/view/67.

A holistic approach, taking both the sound possibilities and the player implications ("is this technique too difficult for the average player?", "do I need to write for specific artists if I want to use this technique?", etc.) is necessary to evaluate its overall potential for incorporation in my practice. To overcome this, oral history methodology will be used to gather first-hand experiences and opinions on techniques. In Barnett's "Aspects of Vocal Multiphonics", she conducts several interviews with singers to better understand the way the technique functions from a performer's perspective.[19] Interviewing musicians able to play these techniques will deepen my understanding of the mechanics and technical aspects of creating these techniques. While my research is concerned with how I personally can incorporate these techniques into my practice, an effort to interview peer composers will be made, especially those that share common compositional traits with me. Their experiences with composing for these extended techniques will provide more data points to draw comparisons from, and contemporary composer's compositions and feedback were a valuable component of Dr. Sarah Watts' thesis to assess the effectiveness of the techniques.

Augmenting the interviews, document analysis will be used on technique manuals that detail the production and quality of techniques. By building off the framework of classification articulated in Robert Dick's seminal *The Other Flute* and extending it to accommodate a variety of techniques, comparisons across different techniques will be able to be made.[20] Through this, an understanding of the technical and mechanical aspects of the techniques will be gained. Techniques will be assessed on their practicality, ease of use, timbral qualities, and

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19. Bonnie Mara Barnett, "Aspects of Vocal Multiphonics," *Interface* 6, nos. 3-4 (December 1977): 117–149, accessed May 9, 2019, doi:10.1080/09298217708570239, http://www.tandfonline.com/doi/abs/10.1080/09298217708570239.

20. Dick, *The Other Flute*.

compatibility with my practice. Notation for the techniques varies from composer to composer, and where a common notational standard has not been developed (such as violin subharmonics), a document analysis of current notational standards will be undertaken, making reference to Elaine Gould's seminal text on music notation, *Behind Bars*.[21] Through this, and subsequent consultation with players, development of a consistent and effective notational language can be achieved.

Through the collection of data from a multitude of sources and a range of different methods, it will become evident how harmonic based extended techniques are to be treated idiomatically. By undertaking a holistic review of the techniques including performer and composer points of view, the qualitative research I perform will enable not only me to incorporate these techniques into my own practice, but future composers that are interested in these techniques.

21. Gould, *Behind Bars*.

Chapter 2

Assessment of Harmonic Based Techniques and Repertoire

Harmonic based techniques invariably make use of the harmonic series in one way or another. The harmonic series is a sequence of tones in which the frequency of each is an integer multiple of the fundamental frequency. The earliest forms of tuning systems were based around these, but modern instruments are tuned around equal temperament. The pitch of sound on stringed instruments is determined via tension, effecting the speed (and consequently pitch) the string vibrates at. Altering the tension is most commonly achieved via fingerings on the instrument's fingerboard, but bow pressure can also play a part in pitch production (see subharmonics).

The objective categorisation of techniques is a Sisyphean task due to the variability of the techniques, but general guidelines can be made; Dick's *The Other Flute* makes good use of quantifying qualitative data about the properties of multiphonics, and the idea of his tables will be used, adapting the format to each technique.

To be able to pass any judgement on the techniques, we must first understand these techniques' capabilities, limitations, qualities, considerations, and values. Without references to other composers' works, any implication of authority on what constitutes as 'idiomatic' writing is baseless. As such, references to other works will be used to support claims. Where no such references are available, it will be marked as the author's personal opinion.

Background

Provide an overlay of the techniques and explain how they work, the general benefits and such.

Research statement/problem

Techniques are under-developed and/or under-used.

Aim and scope of thesis

Examples of use in current literature will support use-case scenarios, dearths of usage will support the fact that they are underused.

Significance of work

The production of technique and its uses.

Subharmonics

First discovered by Mari Kimura, subharmonics are a type of overpressure which produces a sound lower than the fundamental.[1] When the bow is drawn across the string, the drag of the bow twists the string, creating torsional oscillation. Under the right conditions, these can interact with the string to produce an identifiable pitch lower than the fundamental.[2] Older strings work better for production of subharmonics, and the lower strings are more suitable due to the pressure needed.[3]

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1. Mari Kimura, "How to Produce Subharmonics on the Violin," *Journal of new music research* 28, no. 2 (1999): 178–184, accessed April 11, 2019, https://login.ezproxy.utas.edu.au/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=rih&AN=A212434&site=eds-live.

2. "Subharmonics.," *New Scientist* 191, no. 2571 (September 30, 2006): 60–60, https://login.ezproxy.utas.edu.au/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=asn&AN=22720971&site=eds-live.

3. Kimura, "How to Produce Subharmonics on the Violin."

Works featuring subharmonics

One of the newest string techniques, subharmonics are still in their comparative infancy, and their notation has not been formalised. There have been several different ways of notating them, each with their advantages and disadvantages.

Possibly the first person to make use of the technique, Crumb described what we know as subharmonics as 'pedal tones'.[4] The use of square noteheads and a separate stave for the resultant pitch makes the technique clear and readily understandable.

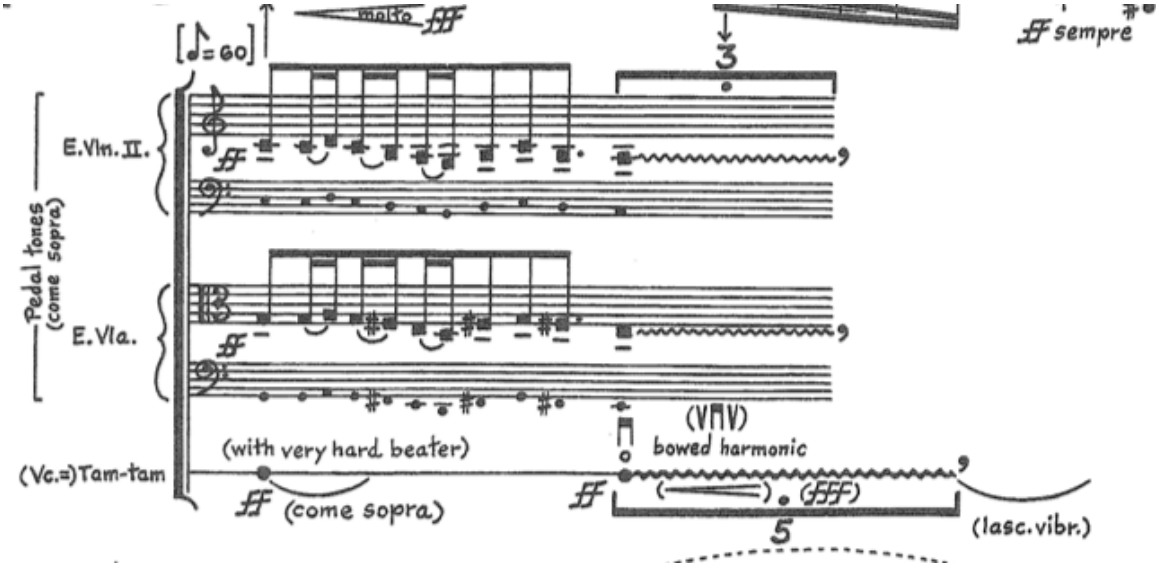

Figure 2.1. Excerpt from Crumb's *Black Angels*.

Gerard Grisey's *Vortex Temporum* features overpressure, with a subharmonic of specifically a seventh. Somewhat abstracted out, this hides the intended effect behind symbols, and is slower to sight read.

4. George Crumb, *Black Angels (Images 1) [Music] : Electric String Quartet.* (Peters, 1971), https://login.ezproxy.utas.edu.au/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=cat02831a&AN=UTas.b1139221&site=eds-live.

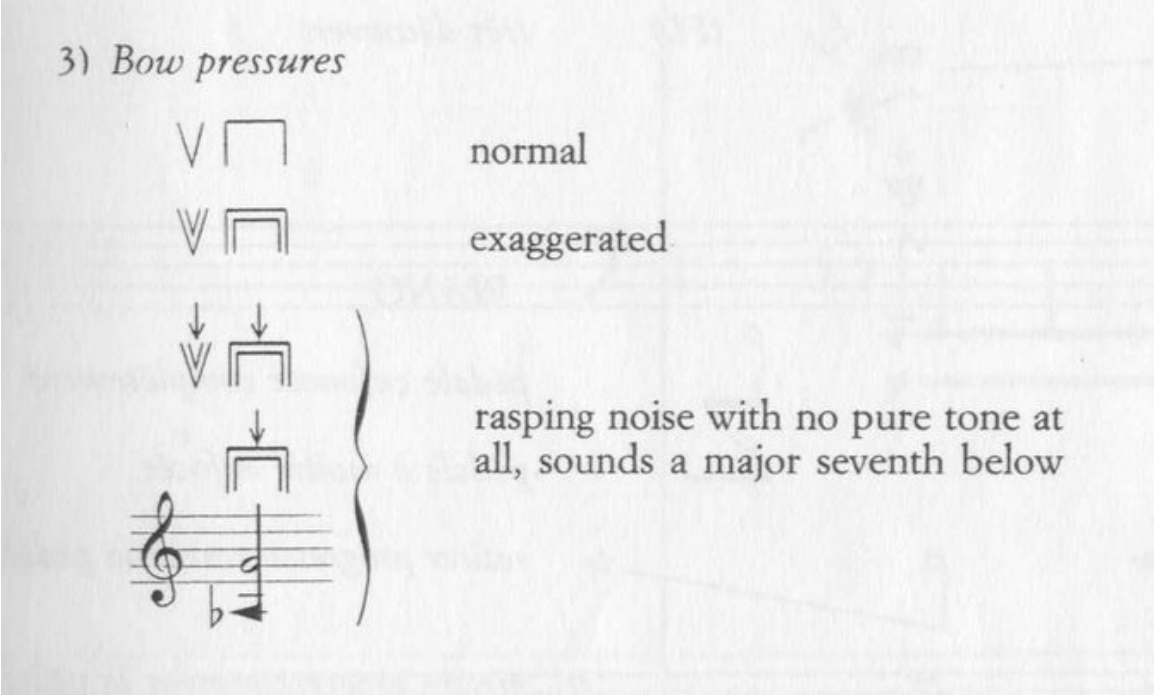

Figure 2.2. Excerpt from Grisey's playing instructions for *Vortex Temporum*.[5]

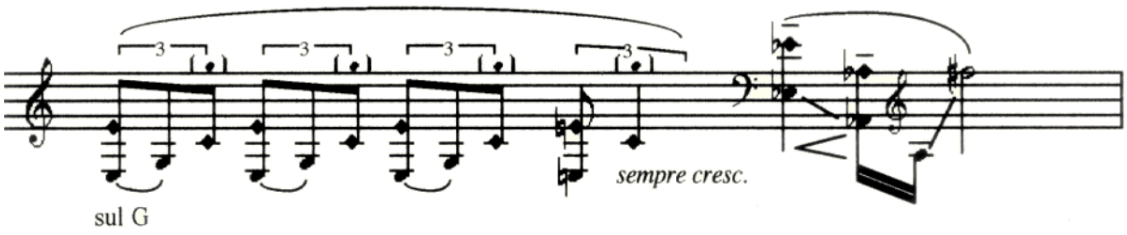

Figure 2.3. Excerpt from Kimura's *Gemini*.

Mari Kimura's *Gemini* is an example of idiomatic usage of subharmonics on the violin. Kimura's notation practice of using a harmonic denoting the intended pitch below the fundamental is similar to the standard notation of harmonics, which Gould states is to 'write harmonics as the player will finger them.'[6] Unfortunately, this method proved somewhat counterintuitive in practice, as the notation was too similar, and caused sight reading issues.

6. Gould, *Behind Bars*, 413.

Botting notes that experimentations with octavic subharmonics yielded a pitch slightly flatter than an octave. He states

> 'I developed a left hand finger technique whereby I rotate my hand slightly clockwise, pivoting on the finger stopping the string, which has the effect of sharpening the subharmonic enough to be more in tune with the fundamental.'[7]

Notation of Subharmonics

Notationally, the best practice appears to be following Crumb's approach, condensing into one stave where possible. Musicians are better at sight reading above the stave than below the stave, so unlike natural harmonics, the need to split into another stave to show the resultant pitch is likely to be more common for composers wishing to use subharmonics. Below, I demonstrate the use of subharmonics twice in my work *The Veldt*, for solo viola.

Multiphonics

Multiphonics are most commonly the domain of wind, and occasionally brass instruments, but they are an emerging technique in string writing. They are produced when fingerings split the string between two natural harmonics, allowing for the string to resonate at multiple frequencies. Multiphonics on stringed instruments are difficult, but with appropriate preparation and notation, are feasible. Production of multiphonics, as with wind instruments, is not guaranteed, and can be dependant on a variety of external factors, including the humidity, make of the instrument, bow used, and other variables that are outside of the control of a composer.

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7. Thomas Botting, "Developing a Personal Vocabulary for Solo Double Bass Through Assimilation of Extended Techniques and Preparations" (Thesis, University of Sydney, 2019), 111, https://ses.library.usyd.edu.au/bitstream/2123/20352/1/botting_ta_thesis.pdf.

Fallowfield explores multiphonic production on the cello in her thesis CelloMap comprehensively, with video recordings of all possible multiphonics and permutations, including pizzicati.[8] These are isolated, though, and give little indication to the difficulty of the multiphonics.

Ashley John Long's 'The Modern Double Bass' website serves a similar purpose as Fallowfield's CelloMap for the double bass.[9] He divides them into different categories, some of which have more information and detail than others. Despite this, it is a valuable resource,

Type	**Description**
'Natural' multiphonics	Chart of different fingerings, similar to Fallowfield.
Pizzicato multiphonics	Description of technique, production, and result.
Textural multiphonics	Description of technique, production, result, and considerations.
Multiphonics behind the bridge	Description of technique.
Artificial multiphonics	Chart of different fingerings, similar to Fallowfield.
Percussive multiphonics	Description of technique, production, result, and considerations.
Timbral multiphonics	Description of technique.
Transformative multiphonics	Description and production of technique
Multiphonics through Variations in Finger Pressure	Description of technique, production, result, considerations, and example.

Works featuring multiphonics

Iannis Xenakis Theraps

Kaija Saariaho Folia

Brian Ferneyhough Trittico Per G.S

Barry Guy Statements II

Notation of Multiphonics

Thelin's thesis on double bass multiphonics states:

8. Fallowfield, "Cello Map: A Handbook of Cello Technique for Performers and Composers."

9. Ashley John Long, "The Modern Double Bass," accessed September 2, 2019, `https://www.themoderndoublebass.org.uk/`.

> 'Multiphonics is [sic] always notated with the harmonic diamond sign, in tablature notation indicating finger positions rather than musical pitches. I suggest using the symbol M. above or below the note to indicate that it is a multiphonic sound, together with the indication on which string to play the note (in Roman numerals).'[10]

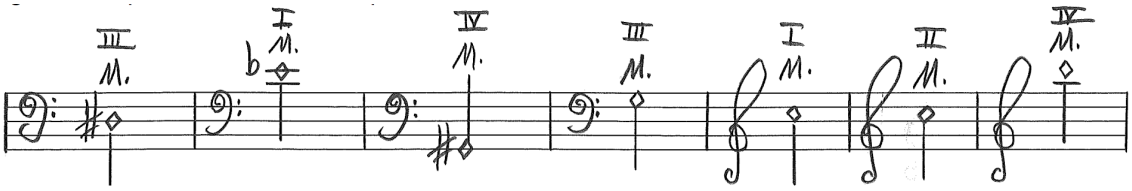


Figure 2.4. Excerpt from Thelin's thesis.

His notation suggestion is a somewhat less sophisticated version of Fallowfield's suggestion to notate the approximate pitch down to the cent necessary to produce the multiphonic. Due to the symmetry of the production of harmonics on the string, Fallowfield specifies both upper and lower positions necessary to produce the same multiphonic.[11]

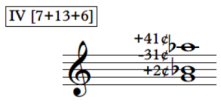
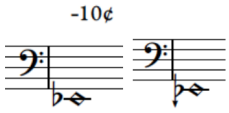
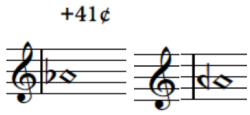
Multiphonic	Resulting pitches	Location of multiphonic on the lower half of the string (the position of the highest contributing harmonic) LH side: exact position RH side: approximate position	Location of multiphonic on the upper half of the string (the position of the highest contributing harmonic) LH side: exact position RH side: approximate position
IV [7+13+6]			

Figure 2.5. Excerpt from Fallowfields's website.

10. Håkon Thelin, "Multiphonics on the Double Bass" (Norwegian Academy of Music, 2011), 6, `http://haakonthelin.com/multiphonics/uploads/files/4%20Multiphonics/Multiphonics%20on%20the%20Double%20Bass.pdf`.

11. Fallowfield, "Cello Map," index/the-string/multiphonics-and-other-multiple-sounds/fingeringcharts.html.

We can see this in practice in Oliver Thurley's work for solo contrabass, *yet another example of the porousness of certain borders*, where he adds another stave showing the intended pitches to be produced.[12]

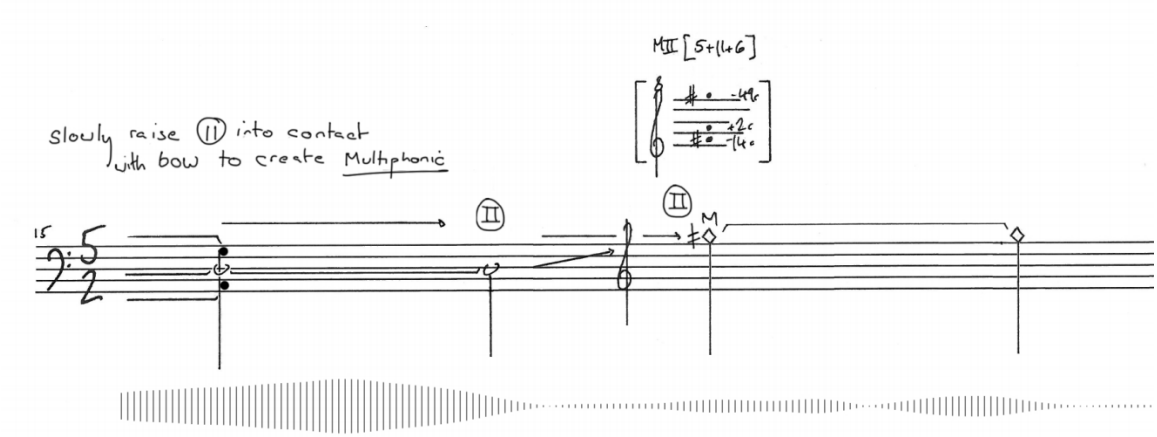


Figure 2.6. Excerpt from Thurley's *yet another example of the porousness of certain borders*.

Half-Harmonics

Half-harmonics is a term assigned to the fingering pressure found somewhere in between a regular note and harmonic. The timbral qualities of the half-harmonic are airier, with more white noise.

12. Oliver Thurley, *Yet Another Example of the Porousness of Certain Borders*, 2014, http://oliverthurley.co.uk/scores/yaeotpocb-score.pdf.

Chapter 3

Compositions

My folio of works comprises of four pieces. 'Doppelganger', for solo viola, 'The Veldt', for solo contrabass and electronics, 'Placeholder', for solo cello, and 'SecondPlaceholder', for string quartet.

Background

Implement the experiments in a musical context.

Research statement/problem

Compositions will show both how these techniques can be used idiomatically, and how they can inform my craft.

Aim and scope of thesis

Writing works which will increase the collective understanding of how to implement these techniques.

Significance of work

Incorporating these techniques into my compositional process will show the pitfalls and ways that these techniques can be used.

'Doppelganger'

Doppelganger is a piece for solo viola, written to explore the lower register of the viola using subharmonics juxtaposed with upper harmonics.

Findings of *Doppelganger*

Workshopping an early draft of *Doppelganger* with a violist, I found that the pressure needed to 'find' a Nulla malesuada porttitor diam. Donec felis erat, congue non, volutpat at, tincidunt tristique, libero. Vivamus viverra fermentum felis. Donec nonummy pellentesque ante. Phasellus adipiscing semper elit. Proin fermentum massa ac quam. Sed diam turpis, molestie vitae, placerat a, molestie nec, leo. Maecenas lacinia. Nam ipsum ligula, eleifend at, accumsan nec, suscipit a, ipsum. Morbi blandit ligula feugiat magna. Nunc eleifend consequat lorem. Sed lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eu purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eu enim. Vestibulum pellentesque felis eu massa.

'The Veldt'

Inspired by the eponymous short story by Ray Bradbury, *The Veldt* is a composition for solo contrabass with electronics. Similarly like the namesake, this world is filled with danger but also beauty. It is non-programmatic, and my intent with Veldt was to create a soundworld and space that the performer was able to 'roam around' in, and features several sections of improvisation on pitch-sets. Lorem ipsum dolor sit amet, consectetuer adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetuer id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu,

pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Findings of *The Veldt*

Writing for contrabass, I found Nulla malesuada porttitor diam. Donec felis erat, congue non, volutpat at, tincidunt tristique, libero. Vivamus viverra fermentum felis. Donec nonummy pellentesque ante. Phasellus adipiscing semper elit. Proin fermentum massa ac quam. Sed diam turpis, molestie vitae, placerat a, molestie nec, leo. Maecenas lacinia. Nam ipsum ligula, eleifend at, accumsan nec, suscipit a, ipsum. Morbi blandit ligula feugiat magna. Nunc eleifend consequat lorem. Sed lacinia nulla vitae enim. Pellentesque tincidunt purus vel magna. Integer non enim. Praesent euismod nunc eu purus. Donec bibendum quam in tellus. Nullam cursus pulvinar lectus. Donec et mi. Nam vulputate metus eu enim. Vestibulum pellentesque felis eu massa.

In conclusion, these techniques are underrepresented because of a variety of reasons, one of them being that there is a lack of resources dedicated to writing for them. Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

Impact and Further Research

This will help inform other composers interested in writing for these techniques. Further research can be carried out into other harmonic based techniques on wind and brass instruments. Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

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