Algorithms, microtonality, performance: eleven musical compositions

Warren Burt
University of Wollongong

Algorithms, Microtonality, Performance: Eleven Musical Compositions

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Warren Burt, B.A., M.A.

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Thesis Certification

CERTIFICATION

I, Warren Burt, declare that this thesis, submitted in partial fulfillment of the requirements for the award of Doctor of Philosophy, in the Faculty of Creative Arts, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution.

Warren Burt

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Abstract

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Following a lifetime of creative work and investigation into algorithmic composition and microtonality, I became interested in the speculative mathematical music theory of Ervin Wilson. Encountering his work spurred me on to further investigations in sound and tuning, in a series of compositions using electronic, acoustic, and robotic acoustic instruments. Tuning ideas developed by Wilson and others were extended and expanded into several families of new microtonal musical scales, which were used as the basis for composing a series of algorithmic real-time musical works of extended duration. Some of these works involved collaborative relationships with other musicians, hardware and software instrument designers, and scientists. Wilson's ideas, such as Moments of Symmetry (MOS) scales, Euler-Fokker Genera, limit-ratios, the Scale Tree, and additive sequences and their derivation from number triangles, as well as other tuning ideas, such as permutations of the materials of the ancient Greek modal system were all extended and developed into families of interrelated microtonal scales. The desire to compose works of extended duration was aided by the large size of some of these scale families, which consist of between 60 and 276 new scales each. Acoustic instruments were built or adapted to perform some of these works, including microtonal plucked-string and percussion instruments, and the computer-controlled microtonal instruments of Godfried Willem Raes at the Logos Foundation, in Gent, Belgium. Other works used electronic timbres designed to explore placing of sound in space produced by the interaction of timbre, tuning and room-

acoustics. Software instruments designed to perform the algorithms used were developed in collaboration with John Dunn of Algorithmic Arts, in Fort Worth, Texas. Investigation into the role of timbre and tuning in sonification was carried out with the help of the Wollongong Room Calorimeter project, led by Professor Arthur Jenkins. This thesis discusses how these tunings, algorithms, real-time processes, instruments, and collaborative relationships were used in creating these compositions. Recordings of all compositions discussed are contained in the electronic Appendix, on the attached DVD-Rom. Catalogs of all scales used in the thesis, as well as *Scala* files for all scales, and all data used in composing the pieces is also contained in the Appendix. Additionally, a copy of the commercial CD release of *The Animation of Lists And the Archytan Transpositions*, one of the works discussed in this thesis, is also included.

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Introduction

I love playing with things. Language is a toy, as well as a tool. The eye is a collector of delights. And the ear: timbres, tunings, colours, pitches, rhythms, phrases, found objects, implied patterns, the lot. My musical work, though serious, is all a grand exploration for me. As a composer, I am a musical omnivore. I enjoy composing and making music in an extremely wide variety of forms and genres. And even within the confines of a specific area, I enjoy a diverse approach to my materials. . Unwilling to be hemmed in by any one musical or theoretical approach, I have ranged across a wide span of contemporary ideas, often with a sense of wit and humour. This humour, and this sense of play with materials, frequently expressed in the form of irreverence, is a vital and central part of my work. This might be shown by a quote from my 1996 article “Some parentheses around algorithmic composition” (Burt 1996a).

> In our collaborative 1979 super-8 film *Der Yiddisher Cowboy*, composer and cultural historian Ronald Al Robboy, discussing our collaborative and film-making methods, and alluding to the early film-making techniques of such cinema pioneers as Alan Dwan, says that I am the ideal collaborator on such a project because of my ability to make a piece out ‘any thin thread of trashy material’. This scene, in which Robboy is talking directly to the camera in extreme close-up, is immediately followed by a short flickering burst of hand-painted film. On closer examination, or showing in slow motion, the hand-painted film is seen to be a portion of the Fibonacci series, written in my handwriting, one number per frame. (Since the film dealt with many aspects of Eastern European culture and its influence on our lives, this was my loving and irreverent homage to my maternal countryman and teen idol Bartok.)”

This film was a comedy, and Robboy's remark about "any thin thread of trashy material" was meant humorously – he was going for a laugh. However, underneath the laugh was a serious statement – my use of structural bases for my work has encompassed both serious sources, such as chaos equations and recursive sequences, and silly sources, such as gambling charts and the output of damaged consumer electronics. My approach to both these sources has been the same. I treat both in a playful manner, delighting in the arbitrary; and in a very serious manner, seeing where a rigorous following of these sources leads. For me, working with mathematical systems, different tunings, and algorithmic processes, among many other things – that's fun, and that's play. That spirit of playful exploration should be seen as pervading this thesis.

This thesis is a survey of a series of musical works composed between 2002 and 2006. All of the works were made by applying a) an algorithm (or a process, or an information source) to b) a microtonal tuning system with c) some element of real-time generation or real-time performance involved. The pieces were realised with acoustic instruments, acoustic instrument samples, or electronic timbres. Choice of timbre was often a critical part of the composing process, as a number of the works also explore the relationship between tuning and timbre. Many other works were written during this period, but the works under discussion were chosen because they most clearly represent the intersection of the three main interests listed above.

This thesis is in three parts. **Part One** is a series of short essays dealing with some of the main aesthetic, technical and tuning issues used in these works.

Part Two is a description of the particular algorithms, tuning systems, and performance processes used in each work.

Part Three is a digital appendix, found on the accompanying data DVD, which includes MP3 files of recordings of all works discussed in this thesis, articles by the author referred to in the text; lists of scales (including several extensive catalogs of tunings used in the works), and other data. Each Folder in the Appendix is numbered in agreement with its corresponding chapter. For example, the composition *For JSB and JT* is discussed in Chapter 2.1. The recording of this piece, its score, and all materials related to it are found in Appendix 3.1. The reader is referred to the Table of Contents for further navigational aid through the Appendix.

This thesis assumes familiarity with the concept of musical ratios and cents for expressing tuning. The freeware software *Scala* (Op de Coul 2007) was used extensively, and *Scala* charts and terminology will be extensively used throughout the thesis. For those unfamiliar with *Scala*, it can be downloaded from the site quoted in the References.

A general word on my approach: I am primarily a composer, and only secondarily a theorist. Therefore, my main interest is in using new tunings and interesting algorithms as worked out in the time, space and texture of sonic composition. I am not interested in complete theoretical explications of particular harmonic or algorithmic ideas. This thesis will not attempt complete explorations of any of the concepts discussed herein; rather it will concentrate on the ways that I develop and compose with particular tunings and algorithms.

In the tuning charts in this thesis, cents will be rounded off to a maximum of 3 decimal places, unless the example requires greater precision.