Antony: A Reimagining

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ABSTRACT

We present a re-realization of David Wessel's Antony (1977). Antony was originally composed using a novel set of additive synthesis techniques developed for the 4A and the PDP 11/40. Those techniques continued to play a role throughout Wessel's life as an improviser, and inspired many of his students and colleagues. Our re-realization of Antony involves using those same techniques to reinterpret and perform the very piece that they were used to create.

1. MOTIVATION

David Wessel (1942–2014) was an influential pioneer in computer music and psychoacoustics as well as a performing artist, whose interests and influence spanned multiple disciplines ranging from music perception and cognition to audio signal processing to instrument design and pedagogy. He was the director of research and software development at IRCAM from 1976-1988, after which he joined the faculty of UC Berkeley, serving as the director to CNMAT until his death. Well known for his enthusiastic and infectious personality, he served as mentor and collaborator to countless artists and researchers in a great variety of practices and disciplines. He passed away suddenly on Oct. 13 of 2014.

Immediately following Wessel's death, several colleagues and admirers posted the YouTube video of his 1977 electronic work *Antony* on their Facebook page in memoriam. It began a discussion about the piece between MacCallum, Freed, and Goodheart, all of whom saw it as a foundational work—both to the future direction of Wessel's research and creative interests, but also to our own. The idea arose to do something involving the piece as a tribute to our lost colleague and mentor, and to this end approached the San Francisco Tape Music Festival. We were immediately given a spot on the festival.

Upon being given the technical specifications for the SFTMF, a 16-speaker array installed at the Victoria Theater in San Francisco, the question of how to fit the piece to that space came to the forefront. The extant realization of *Antony*, used for the Wergo[1] recording, is a 2-channel stereo piece. The possibility of playing the piece "as is" over the system, or attempting to spatialize it in some way, seemed to miss an essential element of Wessel's work. Our feeling was that the process through which the original *Antony* had been realized, and even more so the techniques that had emerged from that process and found future realization in improvisation, real-time synthesis, and instrumental interface design, was a focus on engagement with the present. *Antony* is one of the few fixed-media pieces Wessel had ever created—his work was not focused on generating works fixed in time that would be played again and again, unchanged. Rather, it was about fluidity, change, and temporal immediacy. He seemed well aware of how electronic music, while possibly still being a great work of art, is anchored in the technologies and perspectives of the time of its creation in a very apparent way. So we began to search for a way to pay tribute to Wessel and to the fixed nature of *Antony* in a way that also pursued this engagement with the present.

We were conscious, all during this undertaking, that this version we were creating was not to try to make *Antony* "better," (or worse!) but simply to speak to the "now," to the circumstances of its performance. We decided the only way to keep the aesthetic richness, complexity, and identity of the original piece while allowing a way in for our own participation was to use those tools and techniques that Wessel had passed down to us to reinterpret the original material itself; tools for which *Anthony* itself had been seminal. In this way, both Wessel's original work, the technical and aesthetic legacy of that work, and our own creative processes inspired by that legacy, could all coexist.

2. HISTORY OF *ANTONY*

Shortly after Wessel's arrival at IRCAM in July of 1976 he began working with Giuseppe Di Giugno, who brought the 4A synthesizer from Italy, a digital oscillator bank. This was the first machine of a series developed in subsequent years at IRCAM, the 4B, 4C, and finally the 4X. At a sampling rate of 32kHz, the 4A synthesized 128 wave table oscillators in real-time. It was interfaced to the Unibus of a PDP 11/40 16-bit laboratory computer that ran the RT-11 real-time OS. Fortran programs sent control parameter values to the 4A. The frequency, amplitude, and phase of each oscillator were

controlled independently as they indexed values from a wave table that held any stored function.

Antony has been described as a piece composed for tape, but this quote from the composer reminds us that the late 1970's was a transitional time for digital computer music:

"Working on Antony really piqued my interest for the realtime aspects of live performance, although I was still working primarily with these music languages like Music V and Music X and so on."[1]

Mainframes were at their peak in the late 1970's, but minicomputers and more portable and affordable oscillator bank machines were being commercialized such as the Fairlight CMI.

The programs Wessel wrote for the PDP 11/40 allowed him to control the 4A synthesis process in real-time, but only in a studio. The environmental requirements of the PDP 11/40, its reliability and the size and weight of the rig were prohibitive for live stage performance. In addition Wessel discovered that performance bottlenecks between the PDP 11/40 and the 4A prevented clean control of more than 64 oscillators. The solution was to build the piece in 4 layers of 64 oscillators by multitracking. As well as performing on each take, he did the final mix to two channel tape. *Antony* was first presented at the 1977 ICMC at the University of California San Diego. It has been played regularly since. An extract was used in Daniel Vigne's *Retour de Martin Guerre* and Antony is the opening music for the 2002 film *Baader*, directed by Christopher Roth.

Another implementation constraint of the 4A shaped *Antony*: without frequency interpolation that would be built into the later machines of the series, the basic oscillator parameters of the 4A had to be changed slowly to avoid artifacts and oscillators had to be faded out in amplitude before frequency changes were sent. The resulting algorithm later called "migration"[2] was well suited to the contemporary aesthetics of spectralism. *Antony* was influenced by György Ligeti's *Lux Aeterna* and by the French spectral composers especially, Gérard Grisey. In *Antony*, the harmonic flow was continuous in character with no discernible changes—no beginnings, no ends, just gradual evolution. This control structure developed for Antony afforded exploration of transitions in real time. The user stayed one step ahead and set up new frequency maps towards which the oscillators would migrate once they had reached the previously-defined frequency map.

As the first and most widely recognized piece for the 4A, *Antony* gave Giuseppe Di Giugno useful insights into how oscillator control could be improved in subsequent machines. The difficulties Wessel encountered with timely scheduled control of future events motivated important innovations such as a hardware priority queue in the Lucasfilm ASP[5] of Andy Moorer and the appearance of time stamps in Open Sound Control[6].

In 2003 Wessel received a request to perform a new live electronic work at the San Francisco Electronic Music Festival (SFEMF). The performance piece presented, Singularities, used a migration-inspired control structure. As in *Antony*, the emphasis was on slowly evolving spectra. Using Don Buchla's touch-sensitive controller, *Thunder*, he assigned different frequency maps to positions along the touch strips for each of his fingers and mapped the pressure applied to each strip to intensity. One hundred oscillators were used for each of the eight fingers and each of the fingers could interpolate along the strip containing four frequency maps. This was the last time David Wessel performed a work built specifically around large migrating tone banks, as he incorporated the technique into an ever growing number of control structures for various sound synthesis methods under the command of his fingertips in real-time.

3. REALIZATION

The migrator, conceptually, is an integral estimation algorithm that works by treating a target spectrum (list of frequency, amplitude pairs) as a probability mass function and sampling from that distribution. In the resulting spectrum, all frequencies are given the same amplitude and the peaks and troughs of the original spectral envelope are approximated by virtue of the fact that more components of the output spectrum will be assigned those frequencies that had large amplitudes (i.e., higher probabilities) in the input spectrum.

In 2003, in preparation for his performance at the SFEMF, Wessel implemented a version of the migrator in Max/MSP[2] consisting of three components:

1. Named table objects filled with x,y pairs that represented frequencies and amplitudes, and would be interpreted by the migrator as probability mass functions. These tables could be loaded from saved data or created in realtime using a tool such as fiddle~.

2. A patch called migrate which would maintain a list of frequency, amplitude pairs that it would update sequentially, drawing samples from the table objects.

3. One or more instances of oscillators~[3] that would realize the output of the migrate patch. oscillators~ (as well as sinusoids~) is designed to take a list of frequency, amplitude

[1] https://cycling74.com/2005/09/13/an-interview-with-david-

[2] https://cycling74.com

[3] http://cnmat.berkeley.edu/downloads

pairs that describes the state of all sounding oscillators. A feature of oscillators~ is that if the frequency or amplitude of an oscillator is changed, that oscillator will interpolate smoothly from the current value to the new one over the course of a signal vector.

The migrate patch (figure 1) would change the frequency of each oscillator in turn by setting the amplitude of a given oscillator to zero and outputting the entire list of frequency amplitude pairs. It would then wait 25 ms before drawing a sample from the current table object and setting the frequency of that oscillator to the obtained value and outputting the entire list. It would again wait 25 ms before finally setting the amplitude to its original value. The two 25 ms pauses were designed to give the oscillator being updated time to fade out over the course of a signal vector ensuring there would be no clicks or *glissandi*. Other implementations of the migrator were explored in [2].

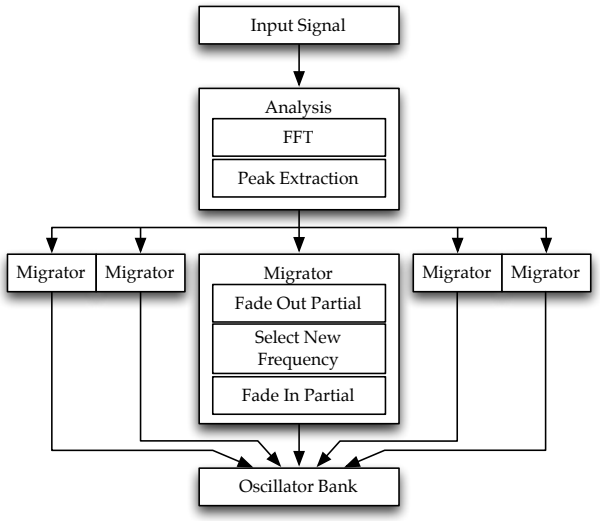

Figure 1. Schematic diagram of the migrator with analysis and resynthesis modules.

For our revisiting of Wessel's work, we analyzed the original recording of *Antony* in real-time using sigmund~[4] and fed the output into the migrator object described in [2]. We analyzed each of the two stereo channels separately and used 3200 oscillators to resynthesize each channel. Even with such a large number of oscillators, we found that the spectrum seemed biased in the high frequency range and so filtered the output using a number of biquad~ filters.

An interesting feature of the recording of *Antony* is that the DACs that were used to record to analog tape were fairly noisy. When analyzing the recording using a tool like sigmund~, that noise will inevitably find its way into the analysis. We attempted to mitigate this by raising the amplitudes of the analysis to a small power in order to emphasize those peaks more likely to be non-noise, however, we found that the result seemed to be deviating from the original source material.

For the realization of the piece, we wished to blend other material into the analysis source—material that Wessel used later in his life during his time at UC Berkeley such as recordings of the Sather Tower bells. The intention was to create a subtle timbral reference to those things that were important to Wessel's later use of the migrator without overshadowing the original features of *Antony*. For this, we used radial basis function interpolation [3,4] as a controller, which let us blend different mixtures of source material together as input to sigmund~.

Antony begins with a long fade in, and it was our intention to preserve that in performance. We decided to project that part of the recording unaltered before fading in the resynthesized version nearly two minutes into the piece. Similarly, we ended the piece by returning to the original recording as a mirror image of the opening of the piece. At a few landmark moments in the middle of the piece, we also brought the original recording to the forefront as a way of ensuring that certain structural features of the work would be clearly heard.

While the two channels of *Antony* have different material, there is not much active spatialization between them. We wanted to make use of the 16 channel *acousmonium* that was constructed for the SF Tape Music Festival, but without overshadowing the content of the piece. To that end, we kept the original recording fixed in two pairs of distant speakers (upstage and in the balcony), and gently rotated, occasionally changing speed and direction, the resynthesized material throughout a ring of eight speakers surrounding the audience.

4. DISCUSSION

As mentioned above, in revisiting *Antony,* our intent was not to improve upon the work, but rather, to pay *homage* to those techniques and ideas we learned from our time with Wessel that have become integral to our individual practices as composers, performers, and researchers. Working closely with him, we all had the privilege of hearing him rehearse and perform on a regular basis, and it was clear to us that while *Antony* remained a static recording, the processes and ideas he developed to create it were very much part of a

[4] http://vud.org/max/

dynamically evolving instrument, which, when coupled with his physical interfaces, was highly personal.[5] The thought of playing a recording of *Antony* seemed to us antithetical to the role that the migrator played in David's musical life, and of his focus on the immediacy of music making made possible through computer-based processes. We chose then to use *Antony* as the source material for processes that it engendered as a way of returning them, briefly and symbolically, to their origin.

5. CONCLUSION

The process developed in this approach point toward a complex relationship between source material and recreation. The work is not simply a recreation (or re-imaging) of the original, but rather the original remains present throughout the work, moving back and forth between a literally sounding presence and a remediation made possible by its own processes: Antony then stands as both itself and its own creative legacy. This interpenetration and overlap of the historical and the present we felt consistent with the nature of Wessel's influence on us: While Antony in its original version is often seen as a fixed media work, it is equally a set of evolving processes, processes that speak to musical and creative immediacy. This version of his foundational work stands as a respectful tribute to Wessel's unique vision, not simply the aesthetics of the work's creation, but the concrete realization of his inspirational engagement with the creative present..

6. REFERENCES

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