**Nicolas Collins**
***The Evolution of 'Trombone-Propelled Electronics'***
**August, 2009**

## Background

My musical career, virtually from the start, has been peculiarly predicated on not making sounds; or, more precisely, on not intentionally producing new sounds "from scratch". As a college student suffering from Cagean stasis (if any sound can be a music sound, why make a sound?) I was obsessed with feedback: the Zen-like infinite amplification of silence that mapped acoustical characteristics of any space, big or small, into a sonic portrait, a site-specific raga -- turn up the knob and let physics do the rest, yielding an almost decision-free music.[1]

Moving back to my hometown of New York City after college, I found my influences expanding from the avant-garde to early hip-hop DJs, guitar-dominated noisy pop, and improvised music. I started working with early inexpensive samplers (most notably the Electro Harmonix *16 Second Digital Delay* and *Super Replay*) as means of recycling sound, rather than synthesizing it directly. I used these boxes in *Vaya Con Dios*[2], and *Devil's Music*[3]– the latter, for sampling and remixing of live radio broadcasts, was one of the earliest examples of the concert use of live sampling.

## The First Instrument

In 1986 I began developing the instrument that came to be dubbed "trombone-propelled electronics". It began with a homemade digital signal processor built up from a slightly obsolete digital reverb by Ursa Major known as the *Stargate*[4]. Pre-DSP, the *Stargate* processed digitized audio through a chain of discrete digital TTL logic chips. I embedded the motherboard from a *Commodore 64* personal computer[5] inside the *Stargate's* rack-mount chassis, pulled various key chips from the reverb, and connected the computer's parallel ports to the empty sockets. By hooking up a keyboard, monitor and disc drive I could program the *Commodore* to emulate the correct behavior of these chips (i.e., simulate reverberation), or perform my own weird variations (live sampling, looping, raspy time stretch.) This was a hybrid hardware/software antecedent of hacking the program code in a later generation of DSP-based processors, or writing your own patch in Max/MSP, and I produced unusual signal transformations as a result of the intersection of the two machines. When I finished a day's programming I'd burn an EPROM to insert in the *Commodore*; disconnect the keyboard, monitor and disc drive; seal the *Stargate* chassis; and carry a relatively portable instrument to the gig (this was long before laptops, at a time where live computer music involved television-sized boxes.)

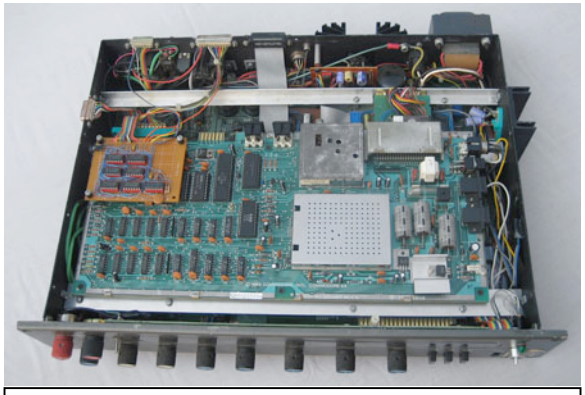

**Figure 1:** Ursa Major *Stargate* with additional circuitry, including Commodore 64 motherboard on top.

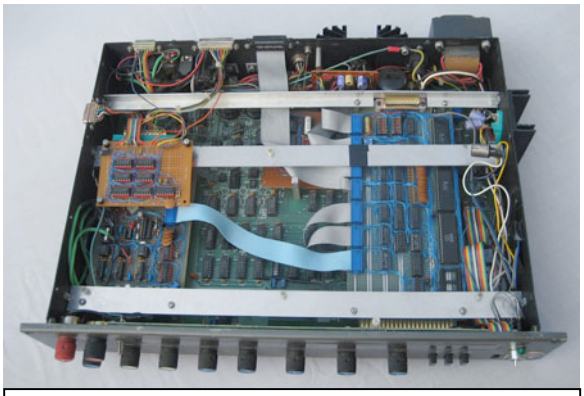

**Figure 2:** *Stargate* with Commodore removed, showing interface circuitry.

As I explained in my 1990 essay, "Low Brass – The Evolution of Trombone-Propelled Electronics,"[6] immersion in the visceral world of NY guitar bands left me increasingly dissatisfied with the cool, minimal theatre of knob-twiddling on stage. As I soldered and programmed I thought to myself, "what I need is a REALLY BIG slide pot." A glance around my loft settled on an old trombone I had bought years earlier at a church sale in southeastern Ohio for $12 – bingo! I mounted a rotary shaft encoder (essentially half a mouse) on the back crook of the trombone and, in truly Rube Goldberg fashion, coupled it to the movement of the slide via a retractable dog leash. I attached a small keypad to the slide where it could be played by the fingers of the right hand. By pressing keys and moving the slide I could change any parameter of my program as easily as clicking and dragging icons on a computer screen – the slide became my mouse.

**Figure 3:** Trombone showing keypad, speaker, tip of breath control visible behind speaker.

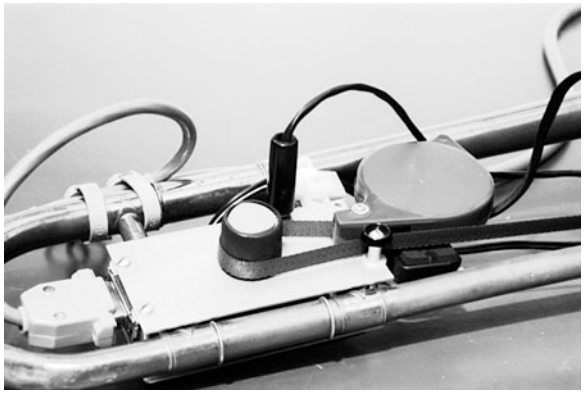

**Figure 4:** Detail of retractable dog leash around knob on optical shaft encoder.

I coupled a speaker (a high-frequency driver from a PA horn) to the mouthpiece such that the sounds of the *Stargate* could be sent through the bore of the trombone – moving the slide, manipulating a plunger mute, and aiming the instrument around the performance space added an additional lever of *acoustic* transformation to the digitally processed signals. The limited low-frequency response of the speaker-driver, combined with the acoustics of the trombone tubing, gave the instrument a rather quaint, gramophone-like character that was at odds with the reasonably sophisticated electronic resources.

Finally I mounted a breath control (from a Yamaha DX7 synthesizer) on the back of the speaker so that I could articulate the sounds by blowing -- I could select whether the output went to the trombone-speaker or to the stereo PA when a fuller, louder sound was wanted. I ended with something that looked like a trombone on life-support – almost an instrument, I used to say. (I should mention here that I have never played the traditional trombone.)

**Figure 6:** Playing the trombone, STEIM, 1988.

**Figure 1:** Trombone-propelled electronics rev. 1: modified *Stargate* below; Bryston *2B-LP* chassis above, containing amplifier channel for trombone speaker in right side, computer-controlled 8-input mixer on left (for selecting sound source to process.)

I initially designed this thing for one specific composition, *Tobabo Fonio*[7], in which I process Peruvian brass band music through a brass instrument. But unlike most of my circuits and programs, which often served as instrument and score for one specific composition, this odd device proved to be exceptionally versatile. Not only was it incorporated into several other composed pieces (most notably *Real Electronic Music*[8], 1986), but it also served as my entry into the world of improvised music as a player. The latter, initially via an invitation from Peter Cusack offered in the course of my first STEIM event in 1984, was facilitated by its unthreateningly "instrumental" appearance at a time when computers were, as I mentioned, much more appliance-like. George Lewis once said I was the first guy to take a computer on stage, but I smuggled it there in the guise of a

trombone. Over the next several years I performed with many wonderful improvisers in a lot of bars in a lot of countries – 42 short duets with 15 of my favorite players from this period can be on my 1989 CD *100 of the World's Most Beautiful Melodies*[9].

**Figure 2:** With Peter Cusack at Freunde Guter Musik, Berlin, 1989.

**Figure 3:** With David Moss, Wittener Tag für Neue Kammermusik, Witten, Germany, 1999.

Through a mixture add-on circuitry and programming, the instrument grew in capability and density until I filled every last nook of the *Stargate*'s chassis; it reached the hardware limitations of the Ursa motherboard, as well as the software limits of the *Commodore 64*. It continued to serve me well for many years, but I grew more restless the longer the system remained "closed," and I sought out new instrumental resources. For Essen-based flautist Lesley Oslon I transformed a tiny speaker into a substitute end-cork for her bass flute, and connected it to a hacked boom box skipping through a CD of shakuhachi music; in my composition *Shotgun* (1995) Oslon's flute notes mix acoustically with the CD sounds inside the bore of the instrument, producing unusual beating patterns and cross modulations[10]. Many hours were spent wrestling with a Concertina stuffed with a very early version of STEIM's SensorLab, but without producing music of any distinction. But like it or not, I seemed to have become a trombonist, of sorts. Then, in 1994, en route to a concert in London (another collaboration with Cusack, oddly enough), a Schipol taxi ran over the trombone. I played the concert on a curiously bent instrument, and continued to perform with it for several months until, seconds before beginning a live Dutch radio broadcast, it died, dramatically and permanently.

**Subsequent versions**

In the wake of the taxi trauma I had heeded the inner voice of the Boy Scout (motto: "be prepared") and had begun designing a second trombone controller, this one based on the STEIM SensorLab[11] (I was Visiting Artistic Director of STEIM at the time, and took advantage of the resident technology.) In lieu of the

cute but clattering dog leash, ultrasound measured the movement of the slide. The SensorLab generated MIDI (rather than NICI, as in my original system), which was sent to a commercially available Digital Signal Processor by Digitech (TSR-24S[12]) that replaced the hot-wired -- but now stone-cold -- *Stargate*. In February 1995 I was shedding tears over the loss of my long-time companion, but by March this merry widower was seen in public with rev.2. Over the next four years I extended the computer code and hardware, as I adapted the instrument for several composed works and improvisational strategies. It can be heard in several compositions on *Sound Without Picture*[13] and improvised duets with Peter Cusack on *A Host, of Golden Daffodils.*[14]

**Figure 9:** Trombone-propelled electronics rev. 2: Digitech TSR-24S above; Bryston 2B-LP chassis below, containing amplifier channel for trombone speaker in right side, re-packaged STEIM SensorLab in left.

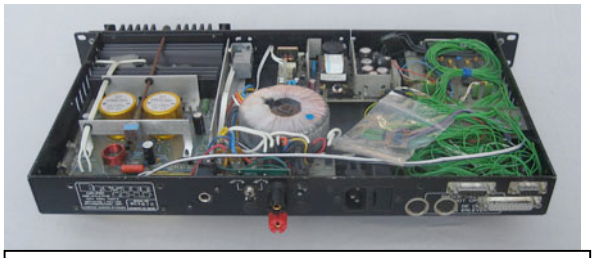

**Figure 10:** Open Bryston chassis, rear view, showing amplifier channel on left, SensorLab circuit boards on right.

But, as with the original, when expansion reached it the limits of the Digitech processor my enthusiasm waned. I gave what I thought were its last performances during a poignant US tour with Peter Cusack shortly after 9/11. But I dusted the instrument off two years later for a single 7-minute duet with trumpeter Jonathan Impett. Absence had clearly made my heart beat fonder. Peter Cusack asked, "does playing it bring you pleasure?" "Yes," I answered, so in 2004 I began work on rev. 3.0.

By the late 1990s live sampling had become a relatively common technique in venues ranging from the International Computer Music Conference to bar stages, thanks to a number of developments in the hardware and software domain, most significantly:

- The availability of affordable, versatile "Multi-effect Processors", which allowed a wide range of signal processing under MIDI control from a computer or MIDI instrument (Eventide and Lexicon were prominent companies in this field).
- Apple's introduction of the "PowerPC" line of personal computers, whose processors were fast enough to process audio without the need for dedicated DSP hardware.
- The parallel introduction of MSP, an audio processing software, bundled with the popular Max programming language, which allowed end-users to write programs that took advantage of the audio potential off the new

Apple hardware; MSP had many sampling-oriented instructions and features.
- The development of boutique software designed specifically for live sampling – most notably STEIM's LiSa[15], whose development was begun when I was Artistic Director.

On the other hand, almost no-one was working with acoustic instruments that could serve as both controller and speaker. At the time that I built my first trombone-propelled electronics, Nyle Steiner was designing a MIDI controller known as the "Electronic Valve Instrument" for Akai[16]. The EVI was based on a trumpet, with valve-type switches and a breath control, but it was strictly a controller -- it had no built-in loudspeaker, no acoustic presence. It was not until British composer Neal Farwell designed a speaker-driven trombone (after seeing mine at the Impett duo concert in 2003) for his 2006 composition, *Rouse*, that I became aware of any similar instruments[17].

Given this state of affairs, I decided to focus on three design areas in particular:
- Improving and emphasizing the *acoustic* quality of the trombone-propelled electronics, which was still a unique feature of my instrument.
- Trying to replicate in software some of the weirder audio processing of the first, hybrid signal processing system.
- Developing new routines that took advantage of the power and openness of the computer – most notably accessing my iTunes library with a slide-controlled jukebox-type program.

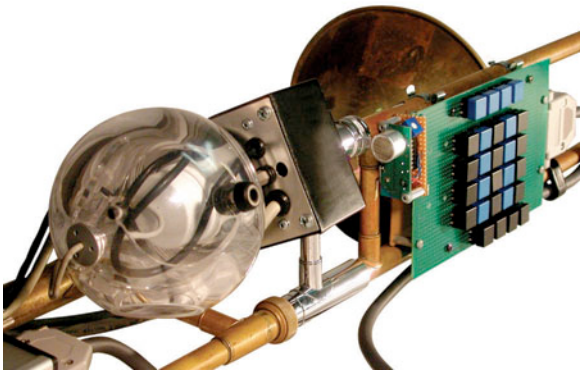

**Figure 4:** Trombone-propelled electronics rev. 3, showing iMac speaker, amplifier (in black box), ultrasound distance sensor, keyboard.

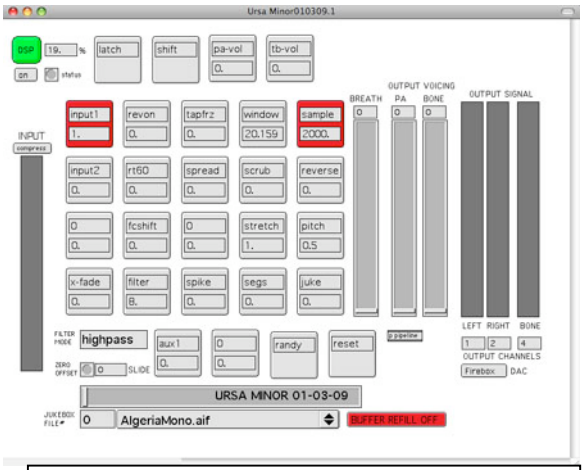


**Figure 5:** Screen shot of Max/MSP program for trombone rev. 3.

The new trombone's sensors (switches, slide, breath control, etc.) are read by Sukandar Kartadinata's wonderful *Gluion*[18] (a SensorLab for the 21st Century) and the data is sent to a Macintosh Powerbook, where all signal processing is handled in software (Max/MSP at the time of writing.) Having a fully software-based instrument has made it much easier to adapt to changing musical needs,

and I suspect I am less likely to hit a hardware-imposed ceiling than I was with in the previous versions. Thanks to advances in small speaker design prompted by the burgeoning market for iPod docking stations and compact computer sound systems I have also refined the loudspeaker technology: extending and flattening the frequency response, and at the same time reducing the weight and power requirements, resulting in a much fuller, louder acoustic presence. The current instrument uses a "crystal ball" speaker from an old iMac, powered by a tiny 10-watt amplifier; the previous generation employed a Fostex PA horn driver and a 50-watt Bryston 2B amplifier channel[19] that together probably added 10 kilos to my luggage. This instrument, literally held together with gaffing tape, was premiered in duet with Jonathan Impett at the *Sonorities* festival at the Sonic Arts Research Centre at Queens University (Belfast) in April 2005[20]. The hardware is pretty stable for now, and the software continues to evolve. 23 years on trombone-propelled electronics still bring me pleasure.

**Figure 13:** Rehearsal for first performance with trombone rev. 3, SARC, Belfast, 2005 (Jonathan Impett on right.)

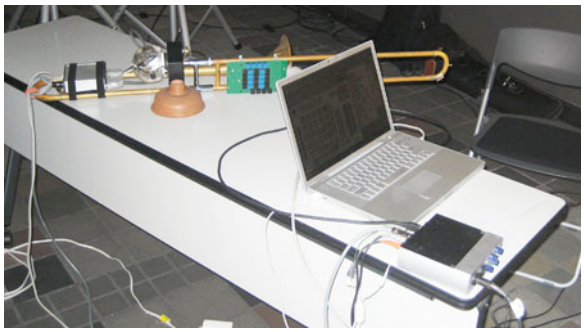

**Figure 14:** Complete setup for trombone rev. 3, showing loaded trombone, mute, Powerbook, multi-channel audio interface. Tokyo, 2008.

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[1] For more information on my work with feedback see Nicolas Collins, "All This And Brains Too – Thirty Years of Howling Round." *Resonance* Magazine, Vol. 9 No. 2 (2002). Available at http://www.nicolascollins.com/texts/allthisandbrains.pdf.

[2] On Nicolas Collins, *Let The State Make The Selection*. Lovely Music LP, 1984

[3] On Nicolas Collins, *Devils Music*, Trace Elements LP, 1985. Re-released with new material as a double LP and double CD by EM Records, 2009. For more information on the history and technology of *Devil's Music* see Nicolas Collins, "Some Notes On The History Of *Devil's Music*", the notes from EM Records re-release; available at http://www.nicolascollins.com/texts/devilsmusichistory.pdf.

[4] For information on the history of Ursa Major and their products see http://www.sevenwoodsaudio.com/UrsaMajor_Documents.htm
[5] For more information on the Commodore 64 see http://www.c64.com/.
[6] Nicolas Collins, "Low Brass – The Evolution of Trombone-Propelled Electronics." *Leonardo Music Journal*, Vol. 1, 1991. Available at http://www.nicolascollins.com/texts/lowbrass.pdf.
[7] On Nicolas Collins, *It Was A Dark And Stormy Night*, Trace Elements CD, 1992.
[8] On *Imaginary Landscapes*, Nonesuch CD, 1990.
[9] Nicolas Collins, *100 of the World's Most Beautiful Melodies*, Trace Elements CD, 1989.
[10] *Shotgun* combined the acoustic properties of the trombone-propelled electronics with the musical vocabulary of hacked CD players, with which I had been working for several years. See Nicolas Collins, "Hacking The CD Player" (2009), (unpublished, available at http://www.nicolascollins.com/texts/cdhacking.pdf.)
[11] See http://www.steim.org/steim/sensor.html.
[12] See http://www.tube-tester.com/sites/tsr24/tsr24-main.htm
[13] Nicolas Collins, *Sound Without Picture*, Periplum CD, 1999.
[14] Peter Cusack and Nicolas Collins, *A Host, of Golden Daffodils*, Plate Lunch CD, 1999.
[15] See http://www.steim.org/steim/lisa.html.
[16] See http://www.ewi-evi.com/intro.htm.
[17] See Neal Farwell. "Adapting the trombone: a suite of electro-acoustic interventions for the piece *Rouse". Proceedings of the 2006 International Conference on New Interfaces for Musical Expression (NIME 2006)*. Paris, France.
[18] See http://www.glui.de/
[19] See http://bryston.com/2blppro_m.html.
[20] See http://www.qub.ac.uk/sonorities/old/2005/index.htm