eShofar as a Culturally Specific Live Electronic Performance System

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Live Electronic Performance Comes of Age

If John Cage's landmark composition *Imaginary Landscape* (1939) marks the genesis of live electronic music, that event initiated a field that is now approaching its 70th anniversary. The field began in earnest in the 1960s, with a goal of moving a studio-based discipline "out of the studios" (Chadabe 1997) and into concert and other performance settings. Pioneers included David Tudor; David Behrman, Alvin Lucier, Gordon Mumma, and Robert Ashley (the Sonic Arts Union); and Richard Teitelbaum, Alvin Curran, and Frederic Rzewski (Musica Elettronica Viva). Live electronic performance restored to musical expression, and expanded upon, important features that historically characterized performance: spontaneity, performer-audience engagement, and the association between visual elements (and, at times, cues) with sound. (Gluck 2005: 5) Revolutionary work using single-board computers in the late 1970s provided a next stage in development of live electronic performance. Mills College was an important center of activity for composers including David Behrman and several engaged in networked computer performance, among them John Bischoff, Jim Horton, and others (Chadabe 1997).

As live electronic music evolved, it soon became clear that a new definition of the instrument would be in order. Performers began to imagine new interfaces, means of engaging with circuitry, electronic instruments and eventually, computer hardware and software that would become the means of crafting and controlling sounds. The development of small-scale high-speed computing, the adoption of a standard protocol for the interconnection of devices, the exploration of haptic devices and the creation of new performance software helped translate these ideas into practice. See Puckette and Zicarelli (1990), Rowe (1993), and Winkler (1998 for examples.

Beginning in the 1980s and 1990s, Morton Subotnick, Peter Beyls, Richard Teitelbaum, Tod Machover, Jon Rose, Pauline Oliveros, Paniaotis and David Gamper, Perry Cook, Dan Trueman, Curtis Bahn, and others, began to combine electronics with acoustic instruments.

Electronic Music, Including Live Performance, as an International Phenomenon

While the origins of electronic music are largely Western European and North American, the field, in fact, became an international phenomenon as early as the 1960s. (Gluck 2005: 4) Most international composers during the 1960s and 1970s trained in Paris, Cologne, or at the Columbia-Princeton Center For Electronic Music in New York. Their work generally reflected Western aesthetics, sonorities and musical structures. Among notable exceptions are Halim el-Dabh (Egypt), Darius Dolat-Shahi (Iran), Slamet Sjukur (Indonesia), Alberto Villalpando (Bolivia), Ricardo Teruel (Venezuela) and Joaquin Orellana (Guatemala), and more recently, Yuanlin Chen and Dajuin Yao from China; Persian-American Shahrokh Yadegari; Jewish-American composers Richard Teitelbaum, Alvin Curran, and Robert Gluck; Koreans Don Oung Lee, Sung Ho Hwang and Jin Hi Kim; Peruvian-Israeli composer Rajmil Fischman (active in the United Kingdom) and Israeli composer Avi Elbaz, whose work is influenced by his Moroccan origins.

Among recent approaches to live electronic music performance has been the encounter between traditional non-Western instruments and electronic technologies. While it is not surprising that composers and performers from non-Western countries would draw upon instruments and musical traditions from their indigenous cultures, the phenomenon is relatively new. Possibly the earliest example of the engagement of new technology with traditional music is Adhi Susanto's *Gamelan Symphony* (1976) and *Gameltron* (1978), both designed for the performance of Indonesian gamelan music (Raharjo 2004). During that same era American composer Richard Teitelbaum's *Blends* (1977) combined the Japanese shakuhachi with live electronics. Composers have also incorporated electronic sounds on tape with traditional instruments, for example Persian composer Darius Dolat-Shahi's works for tar and sehtar, instruments in the lute family and electronics, and the music of Yualin Chen, whose work at times combines Chinese melodies, Western harmonies, and electronic sounds. The combination of Eastern and Western elements was first pioneered by Japanese composer Toru Takemitsu, whose work *November Steps* (1967) juxtaposed those elements, albeit without electronics.

Recent explorations integrating non-Western instruments and new technologies include Jin Hi Kim's electric komungo, a traditional Korean lute; Yoichi Nagashima's electronic performance system for sho, a traditional Japanese mouth organ; Robert Gluck's eSaz; Ajay Kapur's electronic tabla and sitar controllers; Alvin Curran's series of works for shofar, a traditional Jewish ram's horn, and electronics; and Dajuin Yao's digitally processed pipa, a traditional Japanese wind instrument.

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Expanding a Culturally Specific Instrument: Shofar Becomes eShofar

The author's work often integrates elements reflecting his Jewish-American identity. His live performance compositions have included works for interactive systems designed around instruments associated with particular historical Jewish cultural traditions such as music of the Ottoman Empire, and traditional Jewish ritual objects which are utilized as models for musical sculptures incorporated into multimedia installations (Gluck 2005: 1–2). *eShofar I* (2001) and *eShofar II* (2005) are comprised of a traditional Jewish ritual object around which live interactive performance systems have been designed.

The shofar is an ancient Jewish wind instrument whose general function is not strictly musical. In Biblical times, it was used to offer warnings in times of war and declarations of the arrival of the new moon, around which the calendar was based. Subsequently, including today, the use of the shofar is limited to ritual functions, especially during the Jewish New Year in the Autumn. See Figure 1.

Figure 1. Robert Gluck performs with a shofar. Photo by Deborah Blog.

The shofar blast in modern times is limited to its ritual function on the Jewish New Year. It consists of three types of sound gestures: a long, sustained blast (*tekiah*), three medium-length wailing, imploring sounds (*shevarim*), and nine staccato notes repeated in rapid succession (*teruah*). These series of blasts are understood as providing an alarm or wake-up call to self-reflection and repentance (themes of the ten-day long New Year season). They also reference core Biblical narratives, each of which emphasizes awesome power beyond human comprehension. The shofar is thus a particularly poignant instrument owning to its rich accumulation of symbolic associations, its connection with one of the major annual Jewish religious occasions, and the appeal of its dramatic, resonant presentation. Thus, the choice of the shofar at the center of electronic music performance systems is poignant for people familiar with Jewish ritual practice. The author drew upon many years of personal experience of hearing the shofar to conceptualize these interfaces and the performances for which they were designed.

eShofar Design Concepts and Features

Both performance interfaces for the shofar were designed with Max/MSP (Puckette and Zicarelli 1990). See Figure 2. A goal was to highlight the natural acoustical properties and inherent musical characteristics of the traditional instrument. Ancient traditions regarding the blast of the shofar focus on the experience of the listener, who is commanded to hear a series of shofar calls to fulfill a religious obligation for the New Year festival. In keeping with these traditions interface design was aimed at drawing the listener into the subtleties of the shofar sounds, the complexity of its sustained sonority, and the poignancy of its characteristic rhythmic/melodic performance gestures. The performer is also called upon to listen closely to the sonic output of the sounds as they are being digitally processed, shifting performance decisions upon the nature of the unfolding multilayered sound textures.

Figure 2. Robert Gluck performing Shofaralong (2001) with the Shofar I interface. Photograph by Pamela Lerman.

The eShofar I interface (2001) was crafted for an electronically processed shofar outfitted with a clip-on microphone and an I-Cube sensor glove controller. The shofar is held in one hand upon which the glove is worn. The glove tracks degree of finger tip and palm pressure exerted upon a surface, in this case, the shofar.

The performer plays long tones, breathy sounds, or rapid repeated note figures of which six-second clips are recorded in real time. Constant loops of these recordings are immediately replayed. Each of the two sound banks can be refreshed at will by re-recording new material in real time. The two sound banks are subject to multiple digital processing algorithms, each assigned to discrete channels. Processing algorithm parameters, some individual and some grouped, are controlled by the degree of finger pressure tapped on the instrument's body. The degree of pressure is mapped to an array of processor parameters, with an emphasis on filtering (high-pass, low-pass, and comb). Other processing algorithms include granulation and a harmonizer.

An additional algorithm (using Miller Puckette's `fiddle~` object) analyzes the audio signal of the real-time shofar sounds, detecting the frequencies of the first six strong harmonics, which are mapped to a series of sine waves, creating a phantom cluster of synthesized sounds. The final element in the system is a four-channel chorus of prerecorded cantorial (traditional liturgical singing) sounds that can be triggered by the playing of a rapid musical figure of repeated notes, one of the most common gestures within traditional shofar repertoire. See Figure 3.

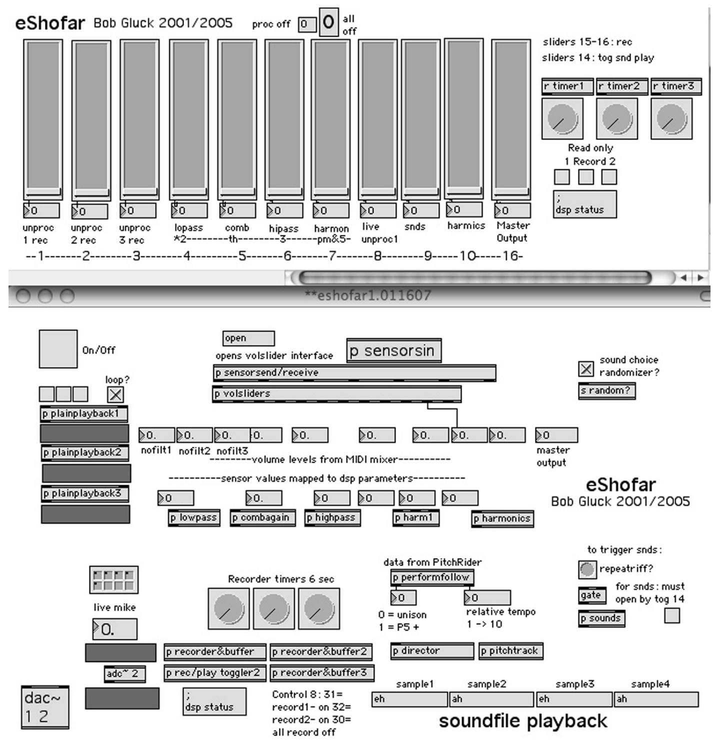

Figure 3. Screenshot of the main Max/MSP eShofar I patch with channel levels on top and processing algorithm subpatchers, below; names of current pre-recorded cantorial soundfiles are seen at the bottom.

The performer has at her or his disposal a hardware MIDI fader box, allowing the addition or subtraction of one to 12 discrete channels of sound, each corresponding to the audio output from one of the algorithms. As the performance unfolds, an evolving multi-level sound collage is thus created. Sound examples of eShofar I in performance may be found on the compact disc *Electric Songs* (EMF Media, EM151) and on the web.

eShofar II

eShofar II (2005) is built upon an entirely different concept. While eShofar I resulted in highly determined improvisations, eShofar II is designed to allow the performer to influence the behavior of a relatively chaotic system that draws upon real-time, as well as live recorded, shofar sounds. While the focus of eShofar I was on accumulating digitally processed sounds, the focus of the second is on close attention to the natural sounds of the instrument, from which emerges processed sounds. Digital signal processing allows the listener to hear microstructural element of the shofar as the performer explores timbral dimensions of the recorded material. See Figure 4.

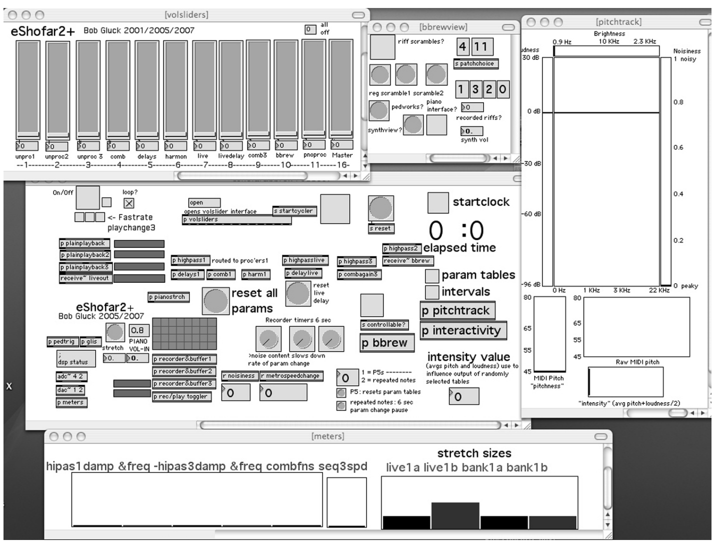

Figure 4. Screenshot of the main eShofar II patch. Intensity parameters are tracked on the right and values currently mapped to particular processing algorithms are at the bottom.

Three streams of real-time shofar sounds are processed using a high-pass filter and can each be recorded separately to create three available banks of recorded sounds. High-pass, low-pass, and comb filters and a series of harmonizer algorithms and a cluster of time-stretch (using Topher Lafata's Max/MSP `stretch~` object and multi-tap delays independently treat each of these sound streams. Unlike the eShofar I interface, however, the discrete parameters governing the algorithms are not subject to direct control by the performer. Rather, changes in each parameter are governed by one of ten pre-drawn graphs of values unfolding on a timeline. The assignment of a particular graph to a specific parameter is governed by a random decision, which is periodically altered. The rate of change of parameter values is related to the analysis of the degree of noise elements in the performed shofar sounds. A noise quotient is assessed using an analysis algorithm designed by Tristan Jehan as a Max/MSP object called `analyzer~`. More noise (i.e. breathiness) slows down the pace of the timeline.

In place of direct control over processor parameters, the performer has more indirect influence over the shape of a particular instance of the work. An algorithm tracks the performer's degree of "intensity," determined by the average pitch plus one half of a loudness factor (both determined by the `analyzer~` object. Thus, performances that consist of an averaging of higher frequencies and/or higher amplitude will result in a determination of greater intensity. High-pitched quiet sounds or loud, lower-pitched sounds can offer similar results. The intensity rating is randomly assigned to a discrete processor parameter or a cluster of parameters. Thus the performer can to a limited degree determine what processor is being influenced by the real-time performance gesture. Figure 5 shows, at the bottom left, the two main performance gestures that trigger global changes—these may be viewed and sent to their destinations. At the bottom right, performance features that are tracked are clustered to determine intensity values and sent to their respective control algorithm destinations.

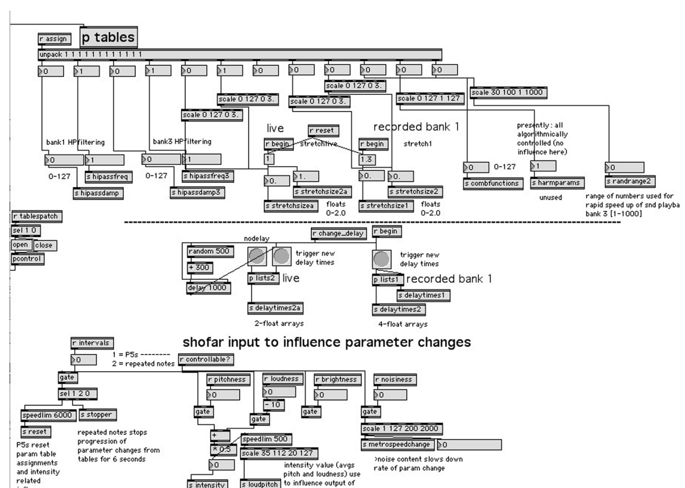

Figure 5. Screenshot of the interactivity subpatch of eShofar II.

At top of Figure 6 is one of the pre-drawn graphs that will be randomly assigned to a processing algorithm and used to determine its respective control values. On the right of the Figure is the algorithm that sets the current assignments of graphs to a particular processing parameters. At the top, the randomly assigned sets of values are sent to their current respective processing algorithms. Assignments are sent to their respective destinations in the center and bottom.

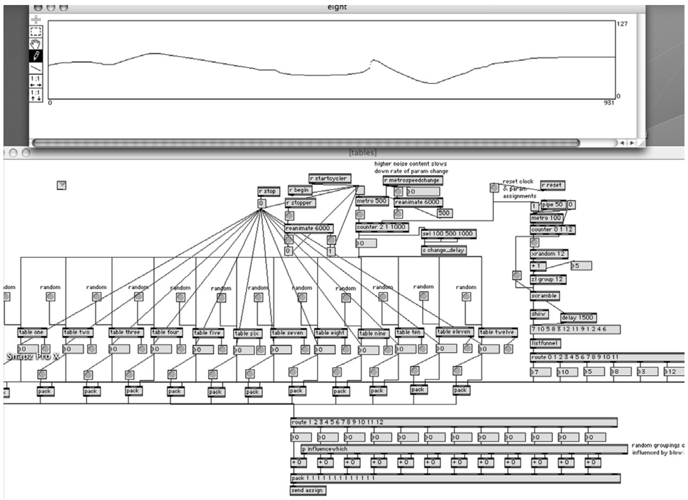

Figure 6. Screenshot of a subpatch within eShofar II.

There are exceptions to this rule, including the performance of a perfect fifth or a series of rapidly repeated notes, both common traditional shofar sound gestures. Repeated note figures freeze the movement of the timelines so that all values remain at a constant state for six seconds. This allows the performer to work with a relatively steady-state system for a brief period, renewable by reasserting another repeated note figure. Perfect fifths reset all parameter values and change the assignment of value graphs to processor parameters. The performer can toggle off the algorithm that tracks repeated notes and perfect fifths, to allow the playing of these figures without influencing the state of the system. See Figure 7.

eShofar II is thus a relatively chaotic system that draws upon performer gestures and is to a limited degree influenced by specific types of user interaction. When the performer plays, not only do the performance gestures become the sonic material, attributes of the performance are utilized by the system as information to guide its decisions.

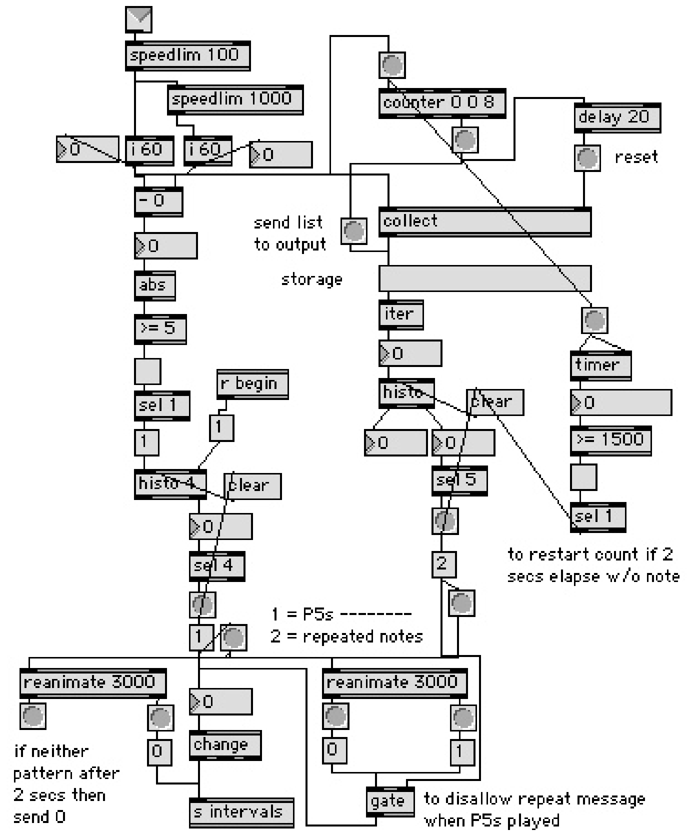

Figure 7. Screenshot of the interval tracker within eShofar II.

Processing Decisions

In the case of eShofar II, decisions about the type of audio processing to utilize were based upon close listening to the sounds of the shofar. This instrument is limited in its performance possibilities, including note selection, types of articulations, and subtlety of dynamic range and harmonic coloration of sounds. It is possible to articulate a range of notes, but only the unison, octave and perfect fifth can be played with precision and dependability. Thus, this interface highlights the ability of the shofar to create long tones, rapidly repeated individual notes, breath sounds, and perfect fifth intervals (created by slightly over-blowing the fundamental). Long tones can be accentuated through the use of granulation, delays and time stretching. Harmonic detail can be highlighted by the use of hi and lo-pass filtering. The breath element in sounds can be reinforced with comb filtering. Additionally, variable delays and time stretching can craft complex gestures from short bursts of repeated notes. The limits on a performer's control over the traditional instrument suggested working with a relatively chaotic system that is capable of running largely on its own, yet open to performer interaction.

Discussion

eShofar I and eShofar II represent two conceptually distinct approaches to a single instrument. eShofar I was designed to encourage the performer to finely chisel sound elements building and dismantling multilevel collages of shofar sounds. eShofar II invites the performer to contribute raw sonic material in the form of shofar blasts to an unfolding drama over which he or she has limited control. Both interfaces represent differing sides of the nature of the traditional shofar. The first interface articulates the idea that the shofar is a searing, probing and highly controlled sound that implants itself upon the imagination of listeners, imploring self-reflection. The second interface portrays the unstable and at times overwhelming sound of the shofar as a metaphor for the limits of human beings to fully control their world. While it is possible for a listener to experience eShofar performances as collages of neutral sound sources, the unique, raw qualities of the instrument, visually and sonically, suggest something more complex.

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How do the eShofar works compare with other culturally specific music for acoustical instruments and electronics? Like Dajuin Yao's *endless frustration* (1999), in which strummed sounds of the pipa are transformed into a dense sound cloud, traditional characteristic sonic qualities of the shofar are highlighted and exaggerated. Like Jin Hi Kim's electronically expanded komungo, the earthy acoustical sounds of the shofar are approached with a traditional understanding that the instrument's function is primarily meditative. On the compact disc *Komungo*, (O. O. Discs #70) Kim's performance draws upon the simple sound gestures traditionally associated with the instrument. Notes are repeated with rhythmic precision, the distinction between notes being a matter of subtle timbral changes or articulations. The raw sonic material performed in eShofar works is similarly simple, largely limited to a handful of characteristic traditional motifs, with the addition of breath sounds. Distinctions between notes focus on repeated notes and simple intervals (unison, perfect fifth, octave), and subtle timbral variety, especially degree of noise content and elements of sonic intensity. In contrast, Darius Dolat-Shahi's Sama, for tar and electronics, features an ornate, filigreed tar solo is elaborated above a simple electronically generated pulse and rhythmic tar figures. However, the simple pulse remains at the core of the work.

In each of these cases, the dominant aesthetic is simplicity and respect for the elemental qualities of the acoustical instrument. Electronics are used to emphasize and expand upon sonic elements inherent in the nature of the acoustical instrument and that instruments' traditional performance practice. eShofar remains, in its sonic and performance practice, essentially a traditional shofar. The use of electronics reflects and encourages close listening to the acoustical qualities of the instrument, traditional performance practice, meditative nature, and accumulated symbolism.

eShofar I and eShofar II draws upon interface designs found in the broader field of live electronic performance. The haptic element of eShofar I follows a design approach pioneered by Perry Cook, Dan Trueman and Curtis Bahn, among others, of acoustical instrument expansion (Trueman and Cook 1999, Bahn 2005). Both interfaces also belong in a lineage of systems that may be traced to Oliveros, Panaiotis and Gamper's Expanded Instrument System (EIS), (Oliveros and Panaiotis 1991, Gamper 1998) designed to support and encourage spontaneous improvisation based upon close listening to the acoustical instruments played by its members, and to the acoustical spaces in which performances take place. (Dempster 1998)

eShofar remains distinct from EIS in focusing on a particular instrument, its performance traditions, distinctive sounds, ritual nature and culturally specific qualities. It also differs from Dan Trueman's eBow and Curtis Bahn's Sbass, which can function not only to expand the sounds and technique of the violin and bass, but as controllers quite independent of the sounds and techniques of those instruments. EBow and Sbass are more flexible and dynamic performance systems than eShofar, offering a far wider range of sonic and aesthetic possibilities. The power of their complex and richly imaginative sounds lies in the performers abilities to connect any physical gesture with any sound and the listener's inability to identify their source.

The construction of eShofar II completes a four-year project (encompassing eShofar I, eSaz and eShofar II) of performance interfaces based upon non-Western acoustical instruments. It is also part of a larger project that explores musical interfaces within a context of traditional ritual. These interfaces have offered the author the opportunity to explore his cultural tradition from a sonic perspective and on a level where physicality and sound are intimately connected. eShofar has shown how a relatively primitive instrument can serve as an expressive element within live electronic music performance in a manner that remains respectful of inherited traditions while part of a new and unfolding creative endeavor.

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