Gesture-following Devices for Percussionists

Roland Auzet
84, rue du Cherche-Midi
75006 Paris, France
roland.auzet@wanadoo.fr

This paper is devoted to the question of writing and performing music for percussion and live electronics. Percussionist and composer Roland Auzet relates his own approach to and experimentation with specific devices designed at Ircam for two recent projects : *Le Cirque du Tambour [Drum Circus]* for percussion, live electronics, video and acrobats, premiered in January 1999 and *OROC. pat* for zarb and live electronics (1997), realized during the year-long Course in Cursus of Composition and Computer Music. Marie-Hélène Serra of Ircam's Pedagogy Department, served as the musical assistant for both pieces.

The Percussionist's Gesture

Non-European Musical Traditions

In numerous non–European musical traditions (notably African and Middle Eastern), the percussionist is also a storyteller or singer, simultaneously using his voice and playing his instrument.

The resultant relationship among voice, gesture and instrument, usually replete with onomatopoeias (as a counterpoint to the gesture–instrument connection), acts to convey a dramatic vehicle, itself in the service of a historical recounting or a poetic or philosophical tale. It is noteworthy in this regard that the instrumental gesture is tied to the pitches and timbres of the voice; sometimes it even sketches the same curve that the melodic line describes.

Often the gesture involves both hands, in various domains, whether as a function of instrumental technique or in "directing" the voice. Playing percussion, then, is a little like taking your left hand in your right in a sweeping movement, groping around, yet being restricted entirely to yourself.

The energy and surpassment necessary for the music depends on this simple gesture, a movement replicated by our eyes in the act of concentrating. In order to focus on a given point, the two ocular axes meet, recalling how the right hand seizes the left.

Thus, music, performers (in their multiple functions) and the public merge into a single comprehensive unit, making it possible for the artistic intentions to be expressed.

Contemporary Compositions

In the performance of 20th century works for percussion, the perception of rhythm is of course very different. The writing often suggests a quasi–melodic or even polyphonic profile. Rhythm, then, must be understood as the organization of time in space, not tarred by folklore's brush. It relies more on structuring harmonic degrees than on downbeats. In the marked presence of this internal voice, to find yourself "singing" the score during a concert is nothing unusual.

The contemporary percussionist employs distinctive gestures: in creating sound, the amplitude of the gesture does not have to correspond to the volume of the sound, given the variety of surfaces to strike and the multiplicity of accessories.

Interaction of Percussion and Electronics

Since the 1960's, percussionists have pursued a very narrow and sometimes quite uneasy relationship with the various tape media constituting most of the repertoire for percussion and live electronics, because of both aleatory synchroneity (occasionally due simply to concert hall acoustics) and the tyranny of a musical space which pays scant attention to the timing of a performance.

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Subsequently, diverse chronometers and counters have made for a better interaction, but the dream of Icarus persists: to take wing, to conduct an electronic score in real time while playing the instrument; to expand the performer's gesture with sound, conjuring the traditional percussionist-bard. With MIDI pedals and Force Sensing Resistors (FSR sensors) to trigger the electronic score events, and a gesture–following mechanism, the space before and after striking the instrument "sings." These are the reflections which inspired the innovative instruments designed at Ircam for the two recent musical works presented hereafter.

The Relationship of Instrumental Technique to Acoustic and Electronic Sound

Such a point of departure defines a new relationship between instrumental technique and acoustic and electronic sound. The percussionist acts as a kind of orchestra conductor, who must organize:

• the part for predefined electronics (usually sound samples), triggered by MIDI pedals or FSR sensors;

• the part for real–time electronics, performing the sound synthesis following instrumental gestures and the processing of the acoustic sound coming out of his or her own instruments;

• the purely instrumental part.

Thus we recognize the vision of the traditional percussionist-bard who modifies the performer's role to meet the exigencies of the dramatic structure.

Interaction Between Gesture and Sound Synthesis

How best can we absorb the complexity of the system, and particularly how can we organize this new instrumental polyphony? We must distinguish between the pure instrumental gesture, the gesture which directs the synthesis, and finally that gesture which includes both functions (real–time processing of played instruments).

Fig. 1. Excerpt from a performance of Le Cirque du Tambour. Roland Auzet (top-left) and acrobat with octagonal structure.

The work's structure and writing are modified through the relationship between the purely instrumental gesture and the movement–following that manages the synthesis. The piece overall must ultimately be seen as a hybrid of musical and choreographic composition, a sort of interactive form. The writing of music becomes spatial.

For the show *Le Cirque du Tambour,* the relation between gesture and sound synthesis is organized metrically in counterpoint to the acrobatic choreography, executed on a structure in the form of an octagon. The score comprises the instrumental line, the prepared electronics line (vocal sampling), the line of real–time electronics (instrumental processing) and the choreographic parallel of the acrobat on a structure. The music becomes the shadow of the movement (see Figure 1.).

Configuration of Percussions for the Gesture-Following System

The specific system designed for movement-following is based on ultrasound detection. The transmitter, on a glove,lies on the percussionist's right wrist. Set on a stand, a right–angle isosceles triangle with one receiver at each of its angles is positioned above the percussionist's right hand, creating a triangulation system (see Figure 2. See also the elaboration of this system described in Emmanuel Fléty, "3D Gesture Acquisition Using Ultrasonic Sensors", in this volume.)

The movements of the right hand (whose outside follows the acrobat's choreography), when tracked, furnish the left hand (on the "inside") with material for the acoustic counterpoint to the choreographic score. The percussion instruments for this mechanism are:

- 2 bongos

- 2 woodblocks
- 1 reco reco
- 1 high–pitched conga
- 3 congas
- 2 double-bass drums
- 1 symphonic bass drum

Fig. 2. Roland Auzet playing percussion. Gesture-following system (triangle top-right). The triangle above the right hand holds three ultrasonic receivers. The percussionist's right wrist holds the transmitter.

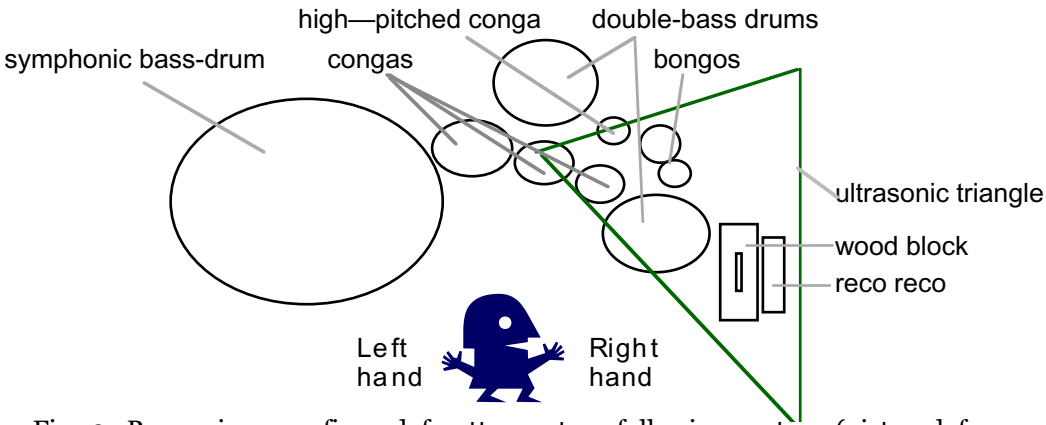

Fig. 3. Percussions configured for the gesture-following system (pictured from above).

Ways to Play the New Instrument and New Ways to Play Prompted by Synthesis

Learning and Transmission

A novel instrument demands a period of research and apprenticeship to develop ways of playing it. Because of the concatenation of instruments, triggering and gesture-following, the percussionist's body is moved in a radically different way. So the percussionist must master the musical and corporal space, in light of the fact that the performer's movements are informed by numerous functions, in multiple directions.

Thus the playing modes that arise are prompted by the combination of real–time processing and granular synthesis of vocal samples (harking back to the percussionist-bard). The interest of granular synthesis lies in the rich material it offers for accompanying percussion.

Gesture following, together with real–time processing of the instruments being played, oblige the percussionist to use "dead strokes" (in which the mallet stays on the head). This more successfully integrates into processing modules and requires that the percussionist shed those gestures ingrained in Western instrumental practice.

The musical dynamics (*ff* or *pp*) bear no relation to the amplitude of the gesture advancing toward or retreating from the instrumental contact; otherwise, it would be impossible to animate an "interactive" project with the acrobat. We must exploit to the fullest the use of material offering percussive surfaces. Further, gesture and its impact are two quite different events which sometimes imply inverted dynamics.

Essentially, the triangulation system covers the right hand and thus a portion of those instruments located to the percussionist's right (see Figure 3.). It is impossible to imagine having only high–pitched instruments under this cover. So low– and high–pitched instruments are allocated to the right and to the left, creating a polyphonic organization between two equal groups of instruments. Once again, it will be necessary to overcome the automatic gestures ingrained in the Western instrumental approach.

To master this novel instrument requires extensive practice. Moreover, exchanges among numerous percussionists remain the only way to move forward in realizing such a project. After the dream the apprenticeship; after concretization and theorization, transmission is desirable to encourage other dreams.

Zarb and Real-time Electronics (Origins of the OROC.pat Project)

For *OROC.pat*, written for zarb and real–time electronics, preliminary work was undertaken with sensors, to offer the triggering (FSR sensor) and the following (tactile fader) of real–time processing of instrumental sound. These two sensors were placed on the instrument's body because the playing position excludes the use of MIDI pedals.

Fig. 4. Zarb equipped with the sensors

Zarb

The zarb, previously known as the tombak (or the chalice drum) is a single–head drum, whose large, squat cylindrical body shrinks sharply into a slightly bell–shaped foot at its base. The attached membrane is of lambskin. The instrument is held horizontally, the player's left forearm resting on its body and maintaining it on the left knee, while the instrument's head is struck with both hands.

The zarb seems to have been employed for centuries, but in light of the various meanings of the word, we have not established whether it is the same instrument evoked in poetry, for example in Môlavi's verse, "O God, grant the musician fingers of spun sugar and for the zarb, a hand of steel.[1]"

The use of diverse variants of *tombak* to designate the zarb is well–attested. *Tombak* has two possible origins:

1. the two syllables correspond to the two principle strikes, tom and bak.
2. the diminutive *khonbak* (or *khombak*, or *khomak*), little *khom*. The *khom* is a clay vessel for the vinification of grape juice.

Zarb is Arabic for *to hit, similar, multiplication* (in the arithmetic sense). It was the Persians who gave it the meaning *rhythm,* in a general sense, *time* of a musical measure, or *tempo*. *Dombak* is considered vulgar, and even in the usage *tombak*, the term remains tainted by the pejorative sense heretofore attached to it. Hence we use *zarb*, a term of greater distinction.

The technique for this instrument is remarkable. The zarb demands extreme wrist flexibility, digital virtuosity and intense use of the fingerpads. It allows a vast array of attacks, carried out not only on the membrane but also on the edges of the drum or even on its wooden body and along the length of its grooves. Rolls, ornaments, effects, even melodies: because of the diverse pitches obtained by applying pressure to different points on the head in the course of playing, the instrument affords numerous possibilities.

1. The Farsi expression *sugared playing* means to play in a very expressive, very seductive way.

FSR Sensors

For the piece *OROC.pat,* an FSR sensor was positioned on the zarb's body, close to the membrane. It was meant to be hit by the thumb or the index finger, sometimes while playing on the instrument's membrane. The use of the FSR sensor allowed for various triggering configurations (subsequently reworked for the *Cirque du tambour*) that had to be integrated as fully as possible into the instrumental playing.

- Triggering "on the note," in order to transform the sound of the acoustic event. To avoid clicks, it is necessary for the percussionist to open the signal input to the digital signal processing engine several milliseconds previously.
- Triggering a sound sample. This is for sound file playback, whether before, during or after the instrumental phrase, or for transformation of the instrument's timbre by a prepared electronic source.
- Triggering "in silence" (between notes). Incursion of a new sound sample or a new set of parameters for sound processing into an instrumental phrase (which implies "playing" the FSR sensor as if it were a note, in order to ensure the continuity and flow of the musical discourse).
- Triggering "after the note." For generating material to be used in a delay line.
- Triggering "by a double instrumental event." Simultaneously playing a note and the FSR sensor (with both hands). This technique is employed when the note's attack is not required for sound processing.

Tactile Fader

A tactile fader was put on the zarb's body near the FSR sensor, for continuous parameter control of sound synthesis and processing. As with the FSR sensor, several musical situations were selected for their compatibility with instrumental playing. Controlling vibrato through the fader was one of the notable results of this experiment.

Conclusion

As a composer and performer, I have been led to profound reconsideration and renewal of my vision of musical gesture through my experiences in making music for percussion and live electronics.

A thorough analysis of the percussionist's practice and thought prepared the way for using gesture-following devices. From this perspective, it was essential to imagine a new conception of gestures, in order to find an approach unifying the acoustic and electronic in this new music. Habitual gesture-sound associations were redefined, and their new interrelations progressively integrated in the body of the performer.

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