

Performance-controlled Sound Diffusion

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The concept of an orchestra of loudspeakers has been seen as an approach to performing music that is on a fixed medium. Many of the theories that have evolved on sound diffusion have been dependent on a specific type of repertoire and often for 'solo' acousmatic compositions. In this context, the interface adopted for sound diffusion has been the mixing desk and the 'fader' has become the diffuser's instrument. A distinct difference in aesthetics and performance practice exists between acousmatic music and live electronics. In acousmatic music there is a focus on textural nuance and timbral detail and the 'composition', where a preconceived musical structure is fixed on a medium; whilst in live electronics, gesture, a diversity of instrumental interfaces and spontaneity tend to shape the musical aesthetic.

This paper explores some of the creative possibilities of sound diffusion in an improvisatory ensemble, and the development of a new musical approach that combines the two clearly definable aesthetics of acousmatic music and live electronics. Issues such as gesture, 'spatial dynamics' - the theory of consonance and dissonance based on moving sound - and, performance-controlled sound diffusion - simultaneous sound diffusion and performance involving live electronics from a sound stage - are carefully considered. This paper also looks at how an improviser may respond and react to

physically moving sound and how sounds on a fixed medium may be re-interpreted through their spatialisation in a group improvisation. Many of the ideas covered in this paper came about through working with the ensemble kREEPA whilst resident at STEIM, Amsterdam in 2002.

In 2002, the ensemble kREEPA, Hilary Jeffery, Cesar Villavicencio, Gurikin Khalsa, and myself, were invited to STEIM (Studio of Electro-Instrumental Music) Amsterdam, as part of a research residency culminating in a performance¹. Part of the residency required individual members of the ensemble to focus on a particular area of research related to their own work that could in turn contribute to the overall sound and approach of the ensemble.

Being born in the 60's, my musical upbringing was somewhat schizophrenic. There were acoustic musical instruments that resided in front rooms at home and practices rooms at university, and there were studios and computers in specially designed and designated areas, often separate from the acoustic instruments. With the growth of electroacoustic music studies and music technology in subsequent years, this divide seemed to be exaggerated with the advent of computer labs: an environment more akin to an office that encouraged a separation with

¹ For more information on kREEPA refer to <http://www.kreepa.com>.

the world of acoustic instruments. Consequently, it is not surprising that many musicians and composers of my generation are skilled in playing both acoustic instruments and, generically, music technology. The work with kREEPA and the residency at STEIM offered a way to explore the two worlds open to me as a double bass improviser, and electroacoustic composer. My primary aim of the residency was to research the possibilities of controlling and diffusing sound whilst improvising on the double bass in an ensemble, thus enabling the bringing together of two performance practices that had previously been very distinct and separate activities. This approach would require researching new interfaces for sound diffusion, developing performance practice with loudspeakers, and considering the importance of gesture in the whole process. The term 'performance-controlled' sound diffusion, although all diffusion is performance, has been used to define the method of sound diffusion whilst simultaneously performing on an instrument. The diffusion is performance-controlled in that the practice is linked to other instrumental performance practices. Before the idea and approach of performance-controlled sound diffusion from the double bass is discussed, some issues regarding sound diffusion in general need to be considered.

Sound diffusion, as the words suggest, simply implies playing-back sound over loudspeakers and distributing, diffusing, the sound in a listening environment. In electroacoustic music and in, more particularly, acousmatic music (music composed in the studio and playback over loudspeakers), sound diffusion has become part of a sophisticated performance practice. Since the 1950's and the development of electroacoustic music, a strong tradition of sound diffusion has existed in organisations

such as GRM (Groupe de Recherches Musicales) with the Acousmonium, Groupe de Musique Experimentale de Bourges with the Gmebaphone, and Birmingham University with BEAST (Birmingham Electroacoustic Sound Theatre). Furthermore, the concept of an orchestra of loudspeakers has been developed as an approach to performing music that is on a fixed medium. Many of the theories that have evolved on sound diffusion have been dependent on a specific type of repertoire and often for 'solo' acousmatic composition. The term 'classical' sound diffusion has become known as a method of sound diffusion where a stereo signal (for example, from a CD) is split and sent to multiple outputs connected to different loudspeakers situated around a performance space. The loudspeakers often surround the audience to provide an enveloping listening experience. The diffuser is seated in a central position, often amongst the audience, to provide optimum monitoring of the sound. In this context, the interface adopted for sound diffusion has been the mixing desk and the 'fader' has become the diffuser's instrument. There is often a spatial link between the arrangement of the faders and the configuration of the loudspeakers: for example, faders on the outermost part of the mixing desk represent speakers positioned at the extreme left and right of the performance space. An advantage of the mixing desk as an interface for sound diffusion, is that independent use of the fingers enables the control of many loudspeaker levels: in essence the polyphony of the diffusion.

A major consideration in building an interface to diffuse sound from the double bass was to directly link the spatialisation and movement of sound with musical gestures and the movement of the instrumentalist whilst performing; and, to tap-in to the nuances of a specific instrument

and the idiosyncrasies of the performer. In regards to myself, this is a performer from an improvisation and jazz background with a standing posture and predominantly pizzicato technique. My first idea for a method to diffuse sound from the double bass was to extrapolate data from the movement of the hands. However, although the aim was to closely link sound diffusion with double bass performance, sound diffusion is something that can exist 'outside' the acoustic world of an instrument. There also needed to be a degree of independence between the two activities: for example, when a double bass tacit occurred, the electronic sounds could still be diffused. On an acoustic instrument such as the double bass, the hands are predominantly involved in generating sound. They are intrinsically linked to methods of producing sound on the instrument. The tuning system of the instrument, the length of string and their thickness, and the size of the resonator (the body) all contribute to the hand positions and patterns. The hands, whilst playing the double bass, are in a microcosm of their own. To create an interface that would enable both simultaneous and independent control of sound diffusion and playing the double bass, the interface had to look beyond the hands. After having watched numerous videos of myself performing on the instrument, it was evident that there was considerable movement, not only of my hands, but also of my body and the instrument. It seemed that these movements and gestures would provide a good starting point for building a new interface.

Apart from the mixing desk, the joystick has historically been used for sound diffusion; and, the principle of the joystick was used to produce an interface that involved tracking the movement of a double bass's end-pin, an end-pin controller, when playing the bass

whilst standing. Essentially this turned the double bass into a giant joystick. The advantage of this interface was that it could be connected to the double bass without inhibiting the movement of the hands. Furthermore, movement of the double bass in relationship to the performer's body provided a clear matrix and whole new level of gestural information for sound diffusion. For example, slowly leaning the bass back into the performer's body and slightly to the left would move a sound at a corresponding speed and to that position in a room.

The research leading towards this new diffusion 'instrument' built on work previously undertaken at STEIM. MidiJoy, a program developed by Tom Demeyer, converts an input signal from a USB commercial computer game controller to MIDI data. The idea of using a joystick from a commercial game controller provided a cheap and partly-made hardware solution. A suitably robust joystick was sought to take the weight of the double bass, and a wooden peg was made to slot into the end of the double bass and connect to the joystick (Appendix 1a, 1b). In addition to the joystick control, a number of switches were also integrated into the design. The interface enabled the use of both foot switches and a switch pad situated on the shoulder of the double bass (Appendix 2a, 2b). These switches, for example, could be used for selecting different sounds to be diffused.

A sound spatialisation patch was written using Max/MSP to interpret the MIDI data from the joystick via MidiJoy. The initial prototype enabled the panning of a mono sound source in a traditional quadrasonic configuration with four speakers in each

corner of the performance space on the same plane.² A comfortable performance position – the bass leaning back into the performer’s body – was mapped to represent the centre of a quadraphonic configuration. The movement of the performer and the position of the joystick were then mapped to a sound’s position in a physical space represented by two coordinates (Appendix 3). One slight problem was playing the bass whilst moving the instrument forward. This was as much psychological as physical in that this movement seemed very remote from conventional double bass playing. The problem was overcome by adopting a playing technique that involved slightly shifting the feet forward or back. There was no amplitude scaling used in the diffusion patch. This was intended to occur naturally through distance cues resulting from loudspeaker positions. A volume pedal plugged into the switch sockets of the joystick was also used to further dynamically shape the diffused sound (dynamic contouring, amplitude shaping, will be discussed later in more detail). Once the interface was built, rehearsals began, both solo with the double bass and in the context of the ensemble, to explore the potential of the new interface and the resulting approach. As already hinted at, this approach combined the aesthetics of acousmatic music and instrumental performance practice, as well as, more generically, live electronics.

Acousmatic music has a curious yet very important relationship with gesture. The term acousmatic, deriving from the Pythagorean cult of mathematicians who presented lectures from behind a screen, is more specifically used to define a method of

working with sound where the cause of the sound is not always apparent. This is further emphasised where a sound may be created or recorded and played back in a new context over loudspeakers. Because the cause of the sound may be unknown, this does not diminish the importance of gesture. The gestural information is passed on in the form of a gestural blueprint in the recording or sound generation process. An important technique of electroacoustic composition is the manipulation of, not only the sound, but also the gestural information. Denis Smalley in “Spectromorphology: explaining sound-shapes,” highlights how gestures may be viewed and shaped in acousmatic music. His idea of gestural surrogacy, where a gesture may be adopted or imposed on other sound material either by the composer or the imagination of the listener, has important considerations in regard to sound diffusion.

The performance of acousmatic music through sound diffusion also brings to light some very important issues concerning gesture. A key aspect of sound diffusion is the ability to give the illusion of moving sound. This illusion has evolved from early experiments with the panoramic, pan control – a means to manually shift a signal from one loudspeaker to another by relative amplitude scaling - and work undertaken by pioneers such as John Chowning to simulate moving sound sources, to automated spatialisation in multi-loudspeaker playback environments, such as ambisonics or Dolby 5.1. From the premise of moving sound, a ‘spatial dynamic’ tied to energy trajectories can be established: consonance and dissonance generated through sound diffusion. For example, quick random panning movements between loudspeakers would create a sense of tension, whilst the slowing down of this movement and the perception of a sound coming to rest at a static position would imply a resolution.

² The Max/MSP spatialisation patch was a modification of a quad pan written by Johan van Kreijl that used x, y coordinates to represent sound on a two-dimensional plane.

Alistair MacDonald in “Performance Practice in the Presentation of Electroacoustic Music” states:

Speed of movement and regularity and shape of motion, too, are important factors in the characterisation of space. Fast motion expresses energy; slow movement may imply passivity; regular motion suggests something mechanical; angular, irregular motion may convey hesitancy or uncertainty.³

The patterns of movement created by sound diffusion are in their own right gestures: they affect the behaviour of sound. Aside from movement, sounds propagating from a fixed point can also imply gesture. The loudspeaker configuration in a performance space can be used to set up a hierarchy of physical positions from where sound is perceived. A sound can propagate from the front, side, distant rear, in and out of auditory focus, and even off-stage. This is where the ‘theatre’ begins, and spatial ‘posturing’ can be used to gestural effect.

In acousmatic composition, sound diffusion offers a way to interpret and reinterpret a composition in performance. Jonty Harrison remarks that:

... the same type of physical gestures (reinforcing a *sforzando* by ‘nudging’ the potentiometers [faders], enlarging a ‘sweep’ to travel the full width of the listening space) that were used to shape material during the process of composition should be used again in performance to enhance further the

articulation of the work’s sonic fabric.⁴

Therefore, Harrison is suggesting that diffusion should be used to emphasise the gestural information that already exists in the composition. But there are obvious situations where this approach would be inappropriate, for example, in the ensemble kREEPA where the sound material and music is improvised. This poses the question ‘How can an improviser approach sound diffusion and could diffusion be used in its own right to generate gestures’?

The envelope of a sound, the amplitude of a sound over time, can dramatically influence how that sound is perceived. This is integral to sound diffusion and may occur through using the physical performance space (for example, if a sound quickly moves from near to far in a relatively large performance space, there will be a perceptual difference of loudness as the sound moves further from the listener); or, by using an interface such as the mixing desk to modify the signal levels sent to the loudspeakers.

Consequently, even the most inanimate sound material can be given a ‘new’ behaviour. Therefore, irrespective of the sound material, sound diffusion can be used to create a significant musical gesture.

Perhaps one of the more exciting considerations of the research with kREEPA at STEIM, was that the gestures created by sound diffusion influenced the improvisation. Instead of the practice of sound diffusion being predominantly ‘reactive’, to sounds on a fixed medium or the acoustic properties of a performance space, the emphasis was shifted towards the practice being much more interactive where the composition/improvisation could also be

³ Alistair MacDonald, “Performance Practice in the Presentation of Electroacoustic Music,” *Journal of Electroacoustic Music*, 11 (1998) 22.

⁴ Jonty, Harrison, “Sound, space, sculpture: some thoughts on the ‘what’, ‘how’ and ‘why’ of sound diffusion,” *Organised Sound*, 3:2 (1998) 118.

created and shaped based on the diffusion. The sudden movement of the double bass linked to the end-pin controller and used in conjunction with the volume pedal, would, for example, produce a quick panning effect and a dramatic crescendo. This gesture would obviously have a bearing on what followed in the improvisation.

The design of the end-pin controller also played a major role in influencing the spatialisation of sound and the resulting gestures. The joystick principle of the end-pin, as previously suggested by the design of the Max/MSP patch, encouraged an approach more akin to traditional quadraphonic spatialisation. In this loudspeaker environment, the opportunities to use pin-point sources (sound propagating from one specific loudspeaker) are limited. Consequently, positioning a sound in a performance space is heavily reliant on phantom images (for example, if the front loudspeakers are at equal amplitude, the sound will appear to propagate from a central point between them). Single joystick diffusion also implies only one sound trajectory, path. Although this would seem limiting in comparisons to the polyphonic spatialisation capabilities of the mixing desk, in light of improvising and performing on the double bass the simplicity of the sound diffusion assisted the performance. The end-pin controller and the size of the double bass also encouraged specific spatial patterns and gestures. The more common patterns and gestures resulting from the movement of the double bass linked to the controller were simple linear, rotational, and more random zigzags.

Monitoring the diffused sound whilst playing the double bass in the context of an ensemble has important considerations. This is perhaps a topic in its own right, and only a few issues will be covered here. The very

fact that instrumental ensemble playing predominantly takes place on a stage, more generically a position in front of the audience, makes listening to sounds propagating from the rear of a large performance space and the affect of the spatial gestures difficult to gauge. Where the size of a performance space becomes too large to monitor diffused sound accurately and a simple loudspeaker configuration is used, for example, a quadraphonic set-up, on-stage monitoring could be used to replicate the loudspeaker and spatialisation configuration of the 'audience' space.

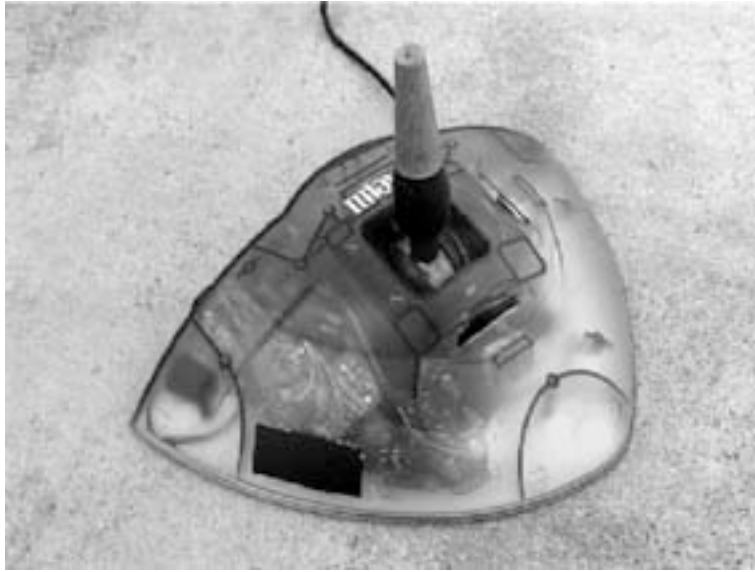
Being experienced in 'classical' diffusion techniques, diffusing sound from the double bass in the context of kREEPA resulted in a very different experience. The level of gestural information was much greater than diffusing an acousmatic composition using a mixing desk; and diffusing sound from the double bass presented huge scope for gestural interplay and surrogacy within the ensemble. Sound diffusion took on a new life where it could be linked to gestures derived from: the double bass, either through a musical gesture - for example, the cause of tension and release through the use of harmonic and melodic conventions - or the physical gestural movement of the body either linked to a musical gesture or not; triggered concrete material and the other sounds generated by the ensemble, electronic and acoustic; and finally and more importantly, 'spatial-gesture', gestures resulting from sound diffusion alone.

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Appendix 1a, 1b

1a



1b



Appendix 2a, 2b

2a



2b



