A Choreography of a Spatial Sonic Disembodiment

Development of the Three Dimensional Data Interpreting Methodology (3*D*IM)

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Abstract

In dance performance sound still tends to be seen as mainly a 'time-rhythm' medium with space as an unobserved, and therefore, insignificant element of the sound. However, experiments with the spatial and thus choreographic elements of sound, have been undertaken by numerous instrumentalists and composers in the past (such as Stockhausen's *Gruppen* 1955-57, Cage's *Williams Mix 1952,* Boulez's *Répons* 1981).

This paper investigates a mapping methodology that emphasizes the sonic spatiality in an interactive choreography by describing the creation of a range of ChoreoSonic experiments that succeeds from both spatial perspectives. In an earlier paper I introduced the conceptual ideas behind an interactive transformation of the spatiality of dance movements into a real time 3-D spatial sound composition (Wijnans 2009). In order to further discuss the interdisciplinary possibilities, this article expands upon the development of the Three Dimensional Data Interpreting Methodology (3*D*IM) as the mapping procedure used in the creative process. Several spatial observations referring to movement theorist Laban (1966) and psycho-acoustic scientist Blauert (1997a&b) are reviewed and integrated in the 3*D*IM development.

The case studies described are realised with the application of two different wireless Radio Frequency/Ultrasonic dynamic positioning systems and the visual programming environment Max/MSP/Jitter. These tracking systems measure both the trajectory of the whole body in space plus the movements of the individual body parts as the starting point for a real-time generation of a spatio-temporal musical form. It is outlined that 3*D*IM makes it possible to design a virtual spatial sound body outside the dancing body: *'a Choreography of a Spatial Sonic Disembodiment'.*

1 The Three Dimensional Data Interpreting Methodology (3*D*IM)

3*D*IM[1] is a spatial mapping strategy that I have developed during my practical Creative Music Technology PhD at Bath Spa University, UK (to be submitted in 2009) to try to design a mapping methodology that enables the interactive creation of a *Choreography of a Spatial Sonic Disembodiment*. Before outlining the development of 3*D*IM, it seems wise to shortly discuss the origin of the nowadays much contested term 'disembodiment' as used in interactive dance performance.

Theodores[2] points out in her introduction at the 'Connecting Bodies' Symposium (Amsterdam, NL 1996) that: 'interactive immersive computer technologies extend and transform the shape of movement and choreography, and if digital media can penetrate the materiality of the body, then our perceptual and ontological notions of embodiment are profoundly affected (quoted in Birringer 1998, p. 125). Theodores points us to the frequently used term of 'embodiment' as the bodily relationship of the dancer to the world. The term 'disembodiment' is used in technical environments to refer to the 'ideal' relationship of humans to the computer that is one without any physical restraints. The term originated in 'cyberpunk', an anarchistic movement emerging at the onset of the Internet in the 1980s[3]. Cyberpunk was directed towards a complete disembodiment and total immersion in visual Cyberspace and Virtual Reality (VR) with the aim of escaping from the limitations of the physical body by creating cyborgs who move 'ever away from the somatic being to the digital spirit, and Nirvana' (Gordon 1999).

Considering this issue, Chrissie Parrott refers to the fact that technology can have a positive influence on the dancer's perception. She states that:

> '[T]he technology redefines the principles of space and time that we've always looked at as choreographers, and we will continue to look at that, but it helps us redefine them and it helps us redevelop those ideas.' (quoted in McKechnie & Potter 2005, p. 105).

She points out that dancers and choreographers are used to looking at space and time in certain defined ways. For example, the pelvis has been considered the centre of gravity and of the personal space of the dancer (Laban 1966, p. 11, see also 2.2). Parrott concludes that technology might be able to help to re-conceptualize the established movement aesthetics. Mark (1997) favoured a 'disembodiment' as a background-foreground relationship between the performer and the visual imagery with our bodies existing more in the background as we enter a digital environment. In an interactive sonic environment, Verstraete (2005) keeps this relationship closer to the body when he states that sound can add 'an auditory 'geography' like a second skin to the dancing body'. Verstraete mentions the interactive dance solo 'Mes Jours et mes Nuits' (by sound designer Todor Todoroff and dancer/choreographer Michèle Noiret in 2002[4]) and the interactive installation 'Sensuous Geographies' (Rubidge & MacDonald 2001) as examples of projects in which sound directly affects the choreographed movement. Both environments use a multi speaker set up to create interactive spatial sound[5]. Duerden interprets this sensation of the dance-sound relationship as follows:

> 'But suddenly, the music is 'shown' to us and, at the same time, the dance reveals its difference - the difference between the embodied and the disembodied, visual and aural - and we recognise the existence of parallel worlds.' (Duerden 2005, p. 28)

In this way, sound becomes an almost tactile and sensual experience for the dancer. 3*D*IM aims to create a sensitive, sensible, sensual and sensorial spatial mapping procedure. This creation should lead to the emergence of a real time ChoreoSonic[6] 'disembodied' entity.

To be able to develop and test 3*D*IM, the research- and development (R&D) project uses two wireless Radio Frequency (RF)/ Ultrasonic (US) tracking systems. In the beginning of the project a prototype system was developed by V2lab[7] and SurroundAV[8] called the 'Cricket' system. Later in the project the Low Cost Indoor Positioning System (LCIPS) as developed by Randell *et al.* (2001&2002) was applied. The sensors from one of these systems are attached to the dancer's body and send 3-D positioning data to a receiving sensor grid on the ceiling that communicates with a Macintosh computer. The real time data derived from the RF/US system are mapped according to 3*D*IM to a spatial interactive surround sound environment programmed in the visual programming environment Max/MSP/Jitter[9] using ambisonic surround sound tools[10].

As a starting point for the description of the development of 3*D*IM it is helpful to simplify the mapping possibilities in the ChoreoSonic trajectory. This simplification leads to four broad parameter categories:

- Raw movement input data of spatial movement events [first derivate].
- Deduced movement parameters [second (algorithmic) derivate].
- Sonic output of the first and second movement derivates (first mapping process).
- Sonic spatial structure (second mapping process).

This starting point for the development of 3*D*IM is displayed in figure 1.

In the following these four categories will be outlined and extended leading to the development of 3*D*IM, hence this figure is called '3*D*IM implementation chart no. 1'.

2 Raw Movement Input Data

Each RF/US sensor unit of the tracking system measures the X (horizontal), Y (height) and Z (depth) position of a moving object, person or body parts in the sensitive space in six degrees of freedom: left-right, up-down and front-back. As will be seen in the next two sections, one sensor unit is able to measure full body spatial motion whereas a combination of five of these units is additionally able to measure the spatial limb movements within the dancer's bodily space.

2.1 Full Body Motion Data

The position of the sensor in relation to the dancer is of major importance for the movement choreography. Considering this issue, throughout his book Laban (1966) proposed that movement of the body is made up of pathways in which the movement phrase changes bodily positions as well as the combined relationships and connections within the structure of the body. He proposed the pelvis as the centre of movement within the dancer's body (Ibid, p. 11). However, in contrast to Laban choreographer Forsythe considered the body in space as a 'geometric construct' (in Spier 2005, p. 358) in which the centre of movement did not necessarily have to be the centre of the body. In this way the impetus for the movement was relocated (Forsythe 1999).

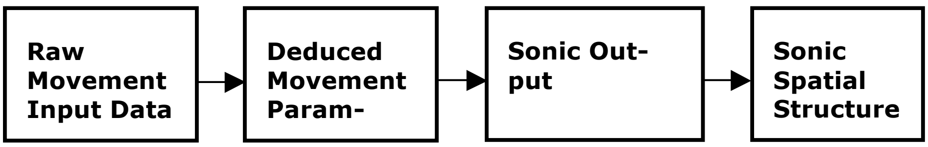

Figure 1. 3*D*IM implementation chart no.1: the four broad parameter categories.

Case Study 1 'Scanning the Sonic Space'

In a preliminary AHRC research project at the University of Chichester[11] (2006) exploring the technical possibilities of a prototype of the Cricket system (Rubidge & Wijnans 2008), the dynamic 3-D positioning data of one sensor in the dancer's hand were sufficient to be able to measure the spatiality and dynamic positioning of the dancer's pathways in space. The position of the sensor is the mobile centre of the dancer's movement (paralleling Forsythe's ideas) and not the pelvis as the centre of the body (Laban).

In 3*D*IM different sounds were allocated to various spots on the floor in the sensitive space to enable for the viewer to audibly follow the geometric pathway that the dancer shaped in the ChoreoSonic space. In this way the dancer is creating an interactive linear sonic composition determined by the dancer's pathways in the sensitive space and the distribution of the sounds in geometric space.

The nearest trigger spot to the position of the dancer activates the allocated sound. In the case of improvised body movement the spatial path of the dancer will never be exactly the same. The temporary passing of a sound trigger point implies that the sound composition is dependent on the direction from which s/he approaches the trigger point that is activated by the proximity of the dancer. In other words, the sound composition depends on the proximity of the dancer's movement path to the sound trigger spots. Figure 2 visualises this compositional strategy.

Movement path 1 of the dancer is represented by the thick black line in figure 2. Moving down this pathway the dancer sequentially activates the trigger spots no. 1, 5, 2, 4, 3, 8, 5, 9, 8 and finally 7.

Movement path 2 of the dancer is represented by the thin black line in figure 2. Moving down this pathway the dancer sequentially activates the trigger spots no. 4, 5, 6, 2, 3, 4, 6, 8, 6, 5, 9, 8 and finally 7.

As can be seen, the irregular geometric distribution of the sounds in space in combination with the dancer's improvised movement path avoids a 'Mickey Mouse' effect[12] in the ChoreoSonic composition.

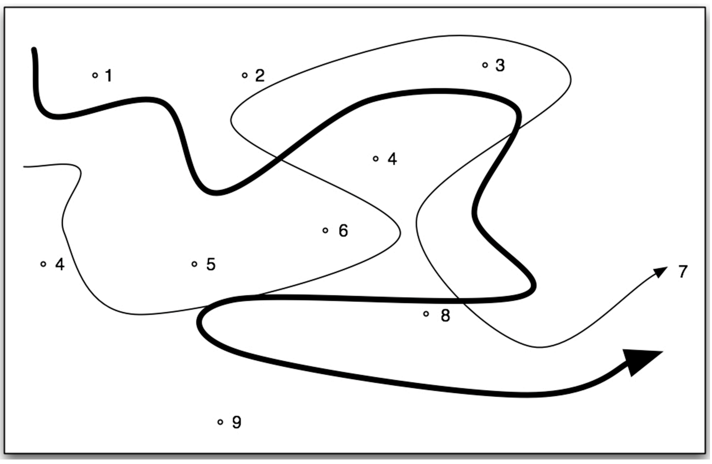

Figure 2. Diagram of composition strategy 'Scanning the Space'.

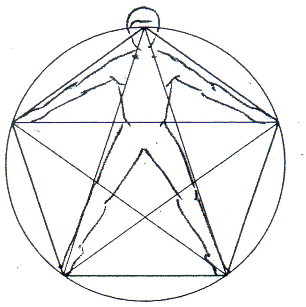

Figure 3. A flat Pentagonal Pose of the Body (Laban 1966, 19).

Figure 4. Dancer Sasha Spasic with 5 sensors of the LCIP System

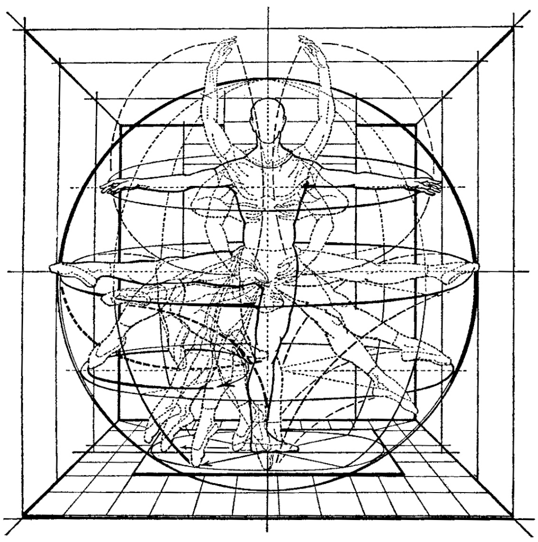

Figure 5. Space Modules of the Arms and Legs I (Kirstein *et al.* 1953, p. 2).

2.2 Kinespheric Movement Data

At a later stage of the research (2007) it was possible to use 5 electronic sensors of the LCIPS as an experiment (the LCIPS was originally developed with just one active sensor).

Laban (1966) considers the fact that limbs are only able to move in certain restricted areas of the kinesphere (the so called body 'zones'). The kinesphere as the space around a dancer's body that is limited by the maximum space that the limbs can reach is defined as:

> 'The sense of invisible boundaries around an individual body and separating one from others, the encroachment of which may cause anxiety.'[13]

The sphere around the body that a dancer can easily reach while standing still and that moves with the person's traceform in space (Laban 1966, p. 10).

The centre of the kinesphere is the pelvis, defined as the dividing point of the three possible movement directions: height, breadth and depth (Ibid, p. 11). Using Laban's division of the body as a pentagonal structure with the head, the two extended arms and two extended legs (figure 3), a sensor was placed on the head[14] and two in the hands and on the feet (figure 4). This configuration created 'space modules' of the movement of the two legs and the two arms (Kirstein *et al.* 1953) that Max/MSP could identify as the basic principle for the mapping strategies in 3*D*IM (figure 5).

Thus, this configuration is able to measure the movement within the kinesphere, i.e. the individual spatial positions of the limbs in relation to the pelvis (limb sensors), in addition to measuring full body motion in space (head/pelvis sensor). In this way, a very simple innovative Motion Capture system was constructed (Wijnans 2009). The five separate sets of X-Y-Z coordinate data are added to the 3*D*IM implementation chart (figure 6).

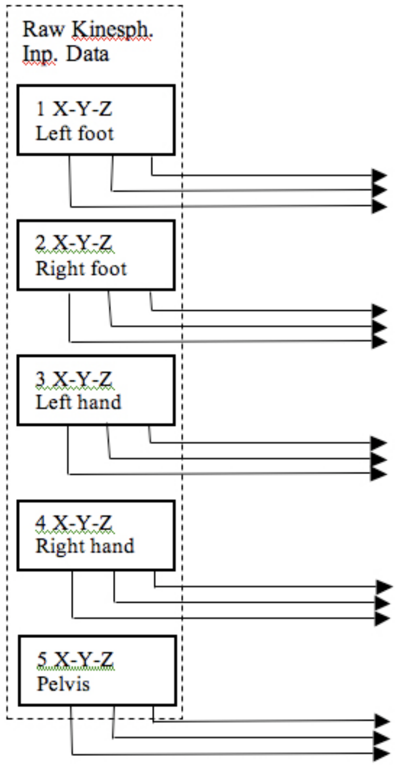

Figure 6. 3*D*IM implementation chart no. 2: raw input data.

3 Deduced Spatial Movement Parameters

Deduced spatial movement parameters are the second derivatives of the raw X-Y-Z movement input data from each sensor of the tracking system. These deduced movement parameters are needed to trigger the sound parameters that facilitate change in the spatial perception of the sound (see section 5).

In the created ChoreoSonic performance area these spatial bodily parameters are classified as:

- Proximity (distance)
- Speed
- Direction
- Rotation (wave-ing)

3.1 Proximity

Proximity, or relative distance in the performance space, is an important spatial movement parameter that influences the energy of the dancer. As Winkler states:

> 'The stage, room, or space also has its boundaries, limiting speed, direction, and maneuverability. Psychological intensity increases or decreases with stage position, as the audience perceives more energy and focus as the performer moves upstage. Apparent gravity pulls the performer downstage with less effort, in a way similar to the very real pull of vertical downward motion. Intensity may also vary with the amount of activity confined to a given space.' (Winkler 1995)

Similarly the personal space within any performance can feel smaller when there is something/somebody in proximity of the dancer. Proximity to a wall, an object or another dancer can limit or obstruct the speed and freedom of a dancer's movement. In the research presented in this paper, proximity (distance) could only be measured when two or more sensors were available (i.e. at least two positional data streams are required to be able to measure the distance between two 'objects'). This type of spatial movement was measured within the kinesphere of the dancer him/herself by defining the relative distance of the different body parts to the pelvis.

3.2 Speed

Speed defines the tempo and duration of the movement phrases. Laban (1966, p. 87) points out that speed is a spatial and temporal parameter that has an impact on the spatial bodily perception of a dancer:

> '[I]t seems that if we [the dancers] direct our attention towards the end of a trace-form or path, we are more easily able to produce a quick movement, than when concentrating on the beginning of a trace-form, which seems to delay the flow.'

He suggests that this consideration is evidence of time as a spatial function.

Another observation relating to speed is that tempo (rhythm) is experienced differently by a dancer than by a musician due to the fact that the two artists count time and mark structure in a different way. This is mainly due to the fact that the dancer counts sequences of movement phrases 'each of which may have a specific, intrinsically physical timing' (Stiefel 2002, p. 6) whereas the musical person counts musical rhythm in bars and beats.

The derived speed parameter is used to emphasize sonically this temporal dynamic of the movement path. It will be shown later that speed in the audio realm (of the frequency of a sound, sample playback or delay) can influence the perception of spatial sound.

3.3 Circular Movement, Distance and Rotation

A circular movement path has a distinct spatial feature as it means that a five-meter pathway of the dancer can actually span a bigger distance by not moving five meters in a straight line but in a rotational fashion. A circular movement path involves rotation around the body axis that changes the orientation of the dancer in space. Whereas rotation in geometric 360º is possible for full body movement by movements such as rolling on the floor or making a somersault, this is beyond the anatomical capabilities of the human limbs. Considering this issue, Longo notes:

> 'Gestures are wavelike in nature. This is because muscles always operate in pairs. One muscle pulls in one direction, while the other controls the motion by pulling in the opposite direction.' (Longo 1996)

Therefore, the term 'wave-ing'[15] will be used during the research instead of 'rotation' for a movement of the limbs within the kinesphere of the dancer.

In the research undertaken for this paper measuring full rotation proved difficult with the ultrasonic systems used due to the fact that the sensors must point upwards to the receiving sensor on the ceiling to be seen by the system. Therefore, downside turns of the sensor could not be measured. However, in the next section it will be shown that it is possible to measure limited circular and wave-like movements in combination with movement direction.

3.4 Direction

Direction of movement path and spatial dimension are important elements in dance because, firstly, the dancer can only fully 'scan' the spatial environment by changing his/her orientation either in a rotational movement fashion and/or by including height transitions (jumps) and secondly because a *direction* within the kinesphere is limited by certain body constraints unless a rotational body movement is involved. As Winkler stated above, direction towards certain spatial elements such as boundaries of the stage, room, or space can influence the speed or comfort of the dancer's movement. In line with this view, Laban (1966, p. 122) states: `[R]etardations and accelerations as well as the increase of intensity depend on directional intricacy'. Therefore, direction is an interdependent element that can only be fully incorporated as a spatial movement element when also taking other movement parameters (orientation and speed) into account. As noted, a ChoreoSonic effect can develop based on the circular and wave-like movements combined with the movement direction. It would, for example, be possible to define and change the direction and length of a sonic pathway through using the spatial distance of the movement path in the interactive environment as a parameter.

In figure 7 the four deduced parameters, proximity, speed, direction and rotation, are added to the 3*D*IM implementation chart.

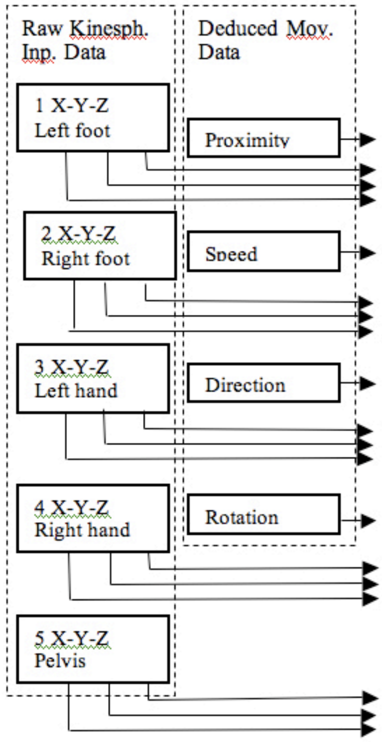

Figure 7. 3*D*IM implementation chart no. 3: deduced movement parameters.

Case Study 2 'Kinespheric Composition'

In a collaborative research project at the University of Bath Spa[16] using the LCIPS (2008), a sound sample was allocated to each of the four sensors attached to the hands and feet of the dancer. The proximity of these sensors to the pelvis triggered changes in pitch and determined the spatial positioning of the sounds in 3D space according to the earlier mentioned 'space modules' (p. 6). Speed of movement of each body part changed the volume of the four individually allocated sounds. In this way a ChoreoSonic relationship emerges in which the sound emphasizes the kinesphere of the dancer's body.

4 Sonic Output

The next two sections present a discussion that focuses on compositional mapping strategies that are designed for sonic interpretation of the first and second movement data derivates. The number of possible movement phrases is as numerous as the number of sonic possibilities. This implies that, even if it is possible to define a spatial movement phrase with a limited amount of sensors (as is the case in this research) a rich spatial sound composition relating to the space change of the body might still arise. When referring this issue to the Digital Musical Instrument (DMI) design field, Garnett & Goudeseune remark:

> 'One might [then] think that all the instrument builder needs to do is supply as many controls into the synthesis as possible. However, this can lead to a cognitive overload problem; an instrument may have so many controllable sonic parameters that performers cannot attend fully to all of them at once: they need a mental model simpler than brute-force awareness of every detail.' (Garnett & Goudeseune 1999)

In line with Garnett & Goudeseune, Rovan et al. also note from a choreographic point of view that:

> 'The dramatic effectiveness of a dance, however, invariably depends on myriad factors—movement dynamics of body parts and torso, movement in space, location on stage, direction of focus, use of weight, muscle tension, and so on [...] what we perceive in dance is highly filtered and often illusory—the choreographer and dancer work hard for this effect. Indeed, the quality of flow at one moment may dominate our perception of a phrase so much so that individual shapes of the body go unnoticed.' (Rovan et al. 2001, p. 44)

These quotations point us to the fact that adding a multiple dimension of trigger parameters will not necessarily result in a satisfactory ChoreoSonic composition. For this reason, only two sonic output forms were chosen in the research experiments undertaken:

- Additive Synthesizer
- Vocal and abstract samples

4.1 Additive Synthesizer

In 2007 I developed an elementary real time interactive synthesizer in Max/MSP to give the dancers the freedom to design timbres of the (digital) sounds with their movements. Wessel (1979, p. 46) defines:

> '[I]n the additive model for sound synthesis, a tone is represented by the sum of sinusoidal components, each of which has time-varying amplitude and frequency.'

In the preliminary Max patch, the additive synthesizer consisted of eight partials (the sinusoidal components). The number eight is not sufficient to create naturalistic sounds, but was chosen to equal the eight speakers in a cubical form that were needed to achieve full sphere spatial sound. In this way it was possible to research the change of the sound timbre when applying real time 3-D spatial movement to the eight partials.

The additive synthesizer parameters are: basic frequency of the total timbre and modulation frequency, modulation depth and duration/tempo for the sonification[17] of the eight partials in the additive synthesizer. In section 5 it will be outlined that these parameters have an effect on the perception of spatial sound.

4.2 Sound Samples and Effects

A wide range of samples with either an organic characteristic (vocal samples) or an abstract character[18] (ranging from machine, gaming, synthesizer, ticking sounds etc.) had been chosen for basic sound generation. Samples were preedited in Logic Express[19] to prepare the sounds for looping and further effects processing in Max/MSP. For reasons of clarity, the parameter changes of the samples that influence the spatial perception of the sound will be listed in the next section. Therefore, in the 3*D*IM implementation chart of this section (figure 8) only the choice of sample (organic or abstract) and the possibility to change samples with the addition of manipulative effects are listed.

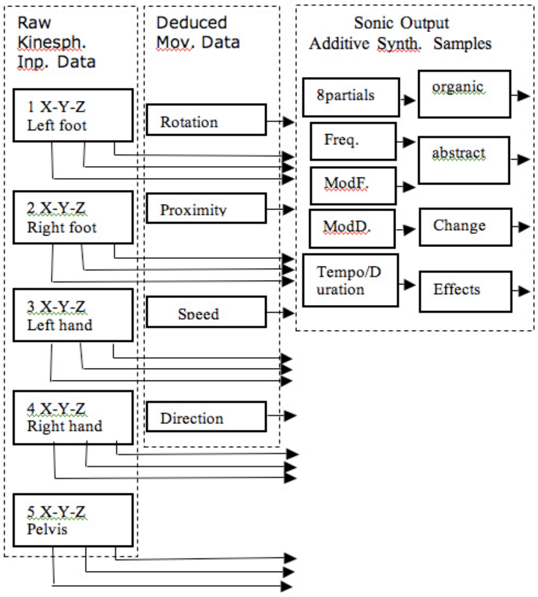

Figure 8. 3*D*IM implementation chart no. 4: samples and effects

Case Study 3 'Effect Manipulation'

In a collaborative research project at the University of Bath Spa[20] using the LCIPS (2009) the dancer manipulated the parameters of a sound effect with her position in the performance space. At this stage, the dancer was not exactly aware of the relationship between her spatial position and the changes in effect to stimulate a movement improvisation that is inspired by unexpected changes in sound. In the interactive domain, the ChoreoSonic relationship is challenged due to the fact that both art forms stop to exist in a clearly observable time-based domain, i.e. music/sound is motivating and directing the movement phrases in a 'traditional' way (Stiefel 2002). This implies that a dancer is, figuratively speaking, moving 'backwards in time' to the sound, i.e. the movement happens not in response to the sound but creates the sound real time. In this way the dancer is only able to react to a sound that was created at an earlier moment. This mode of creation of the sonic environment eliminates the issues that arise when dancers and musicians count time and mark structure differently (see 3.2).

5 Sonic Spatiality

In this section the different sound parameters that influence the spatial perception of sound according to generally accepted or scientific features are categorized. The aim of this part of the research is to be able to incorporate the observed spatial sonic elements into the development of the 3*D*IM mapping strategy so as to allow the modulation of both the texture, direction and sonic reach of the interactive environment.

The scientific spatial sonic parameters are defined as:

- Volume (Loudness) & Panning
- Frequency
- Reverb
- Delay, echo and reflections

5.1 Volume (Loudness) & Panning

Volume or loudness and panning are two features that have generally been accepted as having an impact on spatial perception. For example, in the MSP manual it is stated that:

> 'All other factors being equal, we assume that a softer sound is more distant than a louder sound, so the overall loudness effect created by the combined channels will give us an important distance cue...panning must be concerned not only with the proper balance to suggest direction of the sound source; it must also control the perceived loudness of the combined speakers to suggest distance.'[21]

In an acoustic context Blauert (1997b, p. 108) states: '[S]paciousness increases sharply with increasing sound level'. When the volume of an orchestra increases the sound space is extended accordingly in the horizontal (left - right), median (forwards - backwards) and frontal (up - down) planes (figure 9).

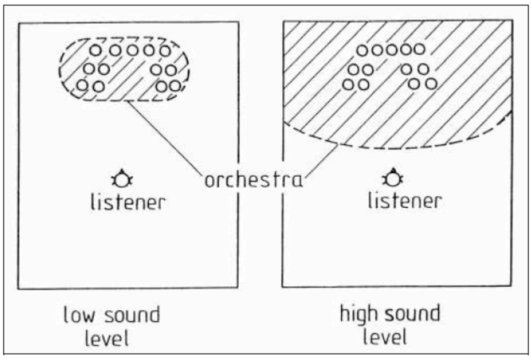

Figure 9. To explain the effect of auditory spaciousness (Blauert 1997b, p. 109).

Therefore, the overall loudness created in the spatialisation software should give the listener an important distance cue and the applied panning should provide the required volume balance between loudspeakers.

5.2 Frequency

It was shown in several experiments by Blauert (1997b) that the frequency spectrum is not only significant for the timbre of the sound but also for spatial sound perception. In a sound source that is normally composed of a frequency spectrum of different highs and lows, the different frequencies might be perceived as coming from different spatial locations. For example, von Hornbostel reported in 1926 that 'the song of a bird constantly changes position, though the bird may not' (quoted in Blauert 1997a, p. 43). Blauert states:

> 'Low frequency signals are perceived as being particularly present and forward oriented', signals in the midrange (centered around 1 kHz) 'sound rather diffuse in space and sometimes even sound as if they are coming from behind the listener' and 'signals with strong components around 8 KHz lead to auditory events above the horizontal plane under a greater or smaller angle of elevation' (Blauert 1997b, p. 106).

Music and sound in an artistic environment will consist of a varied and dynamic frequency spectrum. It is important to realise that when frequencies already move by themselves, a precise manipulation of the spatial sound by applying frequency manipulation is hard to achieve. Concerning this issue, please note that a precise and 'naturalistic' fidelity of spatial sound perception is not a major issue in my research. However, it is useful to be aware of the scientific findings in order to be able to manipulate the spatial sound perception with the spatial movements of the dancer.

5.3 Reverb

Although reverberation contributes to the spaciousness, Blauert notes that

> '[A] too strong and too long reverberation leads to a smearing of the sound signals in time and thus to a loss of sharpness in articulation and clarity' (Blauert 1997b).

I tested this statement in several research experiments (2006-2009) to see if and to what extend reverb would disturb the perception of the spatial sound. I concluded that adding reverb emphasizes the perception of the spatiality of the dancer's 'space modules' (p. 6). However, in line with Blauert's statement, the ability to localise the sounds in space was more difficult to achieve.

Therefore, reverb should be applied with caution unless a widening of total space is desirable.

5.4 Delay (Echo and Reflections)

This parameter is another important element that helps the brain to locate sound. Blauert showed that with zero to very short delays (up to 1 ms) 'the percept drifts off to the earlier sounding loudspeaker' but with longer delays (over 80ms), an echo towards the earlier sounding loudspeaker is perceived (Blauert 1997b). It was concluded that

> '[O]ne factor that contributes to the spatial impression is the characteristic temporal slurring of auditory events that results from late reflections and reverberation' (Blauert 1997a, p. 348).

Delays and echoes originating from reflections from the walls and ceiling can also diffuse the perceived sound signal direction[22].

As shown above, directional hearing is dependent on certain parameters of the sound that might sometimes be difficult to localize. Therefore, how we perceive the sound direction depends on volume, panning, frequency of the sound and delays/echoes. I decided that these four influential elements should be added as spatial sonic parameters to 3*D*IM (Figure 10).

Case Study 4 'ChoreoSonic Space'

In a research project at the University of Bath Spa[23] using the LCIPS (2009), the dancer added more or less reverb to a sound that was triggered by her full body position (in the same way as in Case Study 1, p. 4). The amount of reverb was determined by her dynamically changing kinesphere. In this case the dancer triggered short abstract sounds because it showed that the long decaying vocal sounds limited the perception of auditory space in the same way as the decay of reverb (see p. 11).

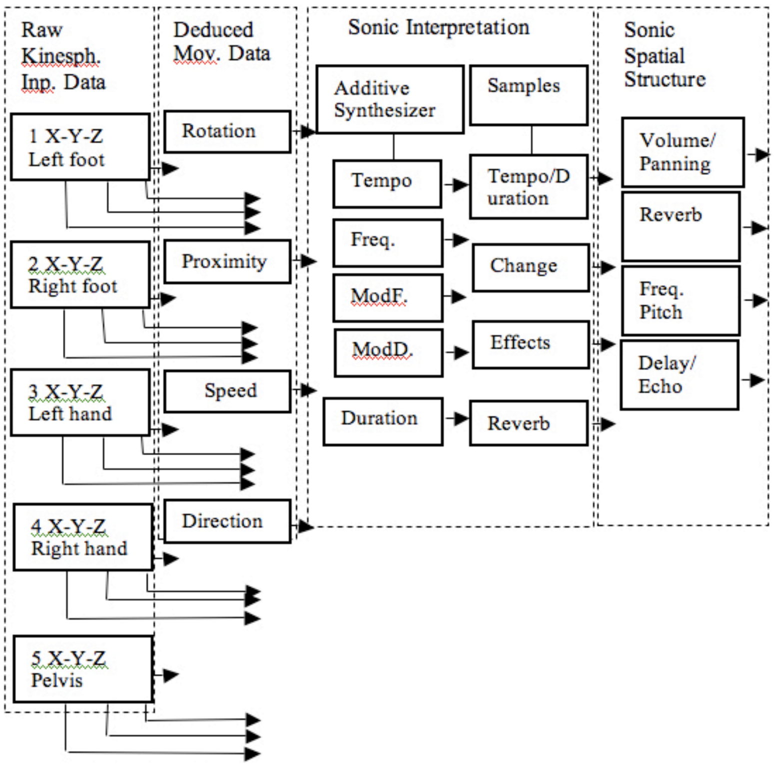

Figure 10. 3*D*IM implementation chart no. 5: sonic spatial structure parameters

6 Summary 'A Choreography of a Spatial Disembodiment'

In this paper the creative options for mapping spatial body movement parameters to spatial sound parameters have been described. To realize a transformation of dance movements into interactive spatial surround sound, 3*D*IM was developed as the mapping strategy that was applied in the described Case Studies. The following 4 movement and sound parameter categories were defined:

- Raw movement input data.
- Deduced spatial movement data.
- Sonic output of the first and second movement derivates.
- Sonic spatial structure.

The development was step-by-step illustrated by 3*D*IM implementation charts.

The technology and 3*D*IM software development enable a wide choice of artistic possibilities in the ChoreoSonic environment, only some of which have been shortly described in the 4 Case Studies. It is envisaged that a full exploration of the possibilities offered by 3*D*IM will be implemented in a wide variety of interactive ChoreoSonic performances that will be developed in the future.

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[1] The italicisation of the character 'D' in 3DIM hints at a third dimension.
[2] At the 'Connecting Bodies Symposium' (Amsterdam, NL 1996) D. Theodores coined the term 'technography' as a way 'to help focus on the mutually informing processes of technology and choreography'. See: http://art.net/~dtz/diana.html [accessed 12/12/08].
[3] See: http://project.cyberpunk.ru/idb/virtualreality.html [accessed 01/10/08].
[4] See: http://www.michele-noiret.be/index.php?page=bios_m [accessed 12/12/08].
[5] Please note that the spatial sound in these environments is applied as a horizontal (2D) moving element with the speakers set up horizontally around the audience.
[6] A term coined during a research collaboration between Prof. S. Rubidge and the author in 2006.
[7] In V2lab (Rotterdam, NL) soft- and hardware for multi-media and interdisciplinary artworks is developed see: http://www.v2.nl/ [accessed 07/03/07].
[8] Surround AV (London, UK) is a company specialised in ambisonic sound see: http://www.surroundav.co.uk/homepage.htm [accessed 15/06/07].
[9] See: http://www.cycling74.com [accessed 17/01/09].
[10] These tools have been developed by the Institute for Computer Music and Sound Technology (ICST) see: http://www.icst.net [accessed 07/08/07].
[11] The project took place in collaboration with choreographer Prof. S. Rubidge and dancers C. Whitaker and G. Adams from Lila Dance Company.
[12] A term that defines a predictable and therefore unexciting reaction of the interactive system.
[13] From: http://dictionary.reference.com/browse/personal%20space [accessed 07/04/09].
[14] Note that the sensor had to be placed on the head due to the upward direction of the data communication to the receiving grid on the ceiling. However, this sensor is the trigger for the position of the pelvis by subtracting the distance between head and pelvis from the derived data.
[15] The term 'wave-ing' is used here to make a distinction from 'waving' as the image of the 'hello/goodbye' wave.
[16] The project took place in collaboration with Dr. C. Randell & dancer C. Whitaker.
[17] The term 'sonification' is used here in the context of enabling or enhancing a translation of input data into sound in order to find relationships in those data, in this case specifically between movement and sound.
[18] Freely downloaded from: http://www.freesound.org [accessed 19/12/08].
[19] See: http://www.apple.com/logicexpress/ [accessed 26/09/08].
[20] The project took place in collaboration with Dr. C. Randell & dancer Yuyu Rau.
[21] From MSP manual Tutorial 22 'Panning for localization and distance effects' [online] available from: http://www.cycling74.com/docs/max5/tutorials/msp-tut/mspchapter22.html [accessed 10/08/08].
[22] Please note that reflections of the walls in the studio hall used for the research experiments will not be considered in this section as this acoustic factor is beyond the scope of this research.
[23] The project took place in collaboration with Dr. C. Randell and dancer S. Spasic.