

## SUMMARY AND CONCLUSIONS

In the *Foundations of Music History*, Carl Dahlhaus writes that there is, strictly speaking, no such thing as 'time' in the singular--a homogeneous medium binding events of various durations and rates of change--but only 'times' in the plural, the times of overlapping structures in conflicting rhythms.

(Dahlhaus 1977/1989: 142)

Dahlhaus points out the "non-contemporaneity of the contemporaneous" (p. 141) which characterizes the simultaneous co-presence of divergent compositional trends and artistic ideologies. This dissertation presents a similar plurality of the ideas of space in music, from constructs of pitch space to spatiality of performance and perception. Thus, it suggests that *the* "musical space" does not exist; this term may have many different senses which often reflect the meanings of space outside the musical domain. In Chapter I, I distinguish two large denotation areas of "space"--as a synonym and complement to time (section 1.1). The temporal senses of "space" associate this term with "measurement" and "distance," e.g. the Bergsonian "spatialization of time" (cf. section 1.5). When "space" relates to "area or extension" it denotes that which co-exists simultaneously. It may mean "an interval or distance," or "an empty place," or "the dimensional extent occupied by a body," or "the cosmic void," etc. Often, the various meanings of "space" are intertwined.

Classical philosophy and science (chapter I, section 1.2) separate time from space. Descartes and Newton envisioned an "absolute," three-dimensional, infinite and empty space, existing independently of time and matter. This image of space, accepted as a depiction of what space *really is*, has become a paradigm of Western culture. The development of mathematics (non-Euclidean geometry, topology; section 1.3) created conditions for the relativisation of the notion of space in modern philosophy of science. Since Einstein, it is possible to speak of a four-dimensional "spacetime" instead of separated space and time (section 1.4). However, scientists

and philosophers of science agree neither about spacetime's existential status nor about its structure. Some authors are convinced that spacetime is absolute, so that it may exist without any content; others regard spacetime as an attribute of matter (i.e. there is no spacetime, only spatio-temporal relations). The awareness of the historical evolution of the notion of space and of the current lack of scientific consensus about its nature provides the conceptual foundation for an analysis of the theories of space in music. Space cannot be separated from time neither in modern physics nor in "lived" experience--described by the phenomenology of Husserl, Merleau-Ponty and Heelan. The interconnection of space and time implies a change of the human self-image, from a supratemporal and disembodied consciousness into "body-subject" (term from Merleau-Ponty) living in a "Life-world" (term from Husserl and Heelan). This phenomenological "embodiment" has vital consequences for my critique of various concepts of musical space (Chapter II) and my presentation of different aspects of musical spatialization (Chapters III--VIII).

Chapter II outlines the history of the idea of "musical space" in the 20th-century and clarifies the relationships of the various theories of musical spatiality. I divide these theories into four large thematic areas. In the first area (section 2.1), the concept of musical space presupposes the "notion of a pure or disembodied sound" (term from Ihde 1976). This "space," perceived while listening to music without noticing the location of sounds in auditory space, includes pitch as one of its dimensions. I trace the history of this notion back to the writings of the German theoreticians of the 1920-30s followed by various European and North-American authors (up to the 1980s).

Hans Mersmann (1926) introduces geometric terminology for the two dimensions of music (the vertical and the horizontal) and posits the opposition of "space" and "force" (equated with the dichotomy of feminine--masculine, passive--dynamic).<sup>1</sup> Ernst Kurth (1931) considers musical spatial impression as an aspect of

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<sup>1</sup>Other definitions of spatiality (Nadel, Riezler) were proposed at the *Raum-Zeit-Kongress* of the *Gesellschaft für Ästhetik* (organized in 1930 by Ernst Cassirer).

inner, psychic processes. For him, music possesses three dimensions: pitch (height), time (width), and an ambiguous dimension of depth which has nothing in common with the physical dimension of distance. Albert Wellek (1934/1963) also distinguishes a three-dimensional sonic space from the auditory space of sound localization. He reserves the term "musical space" for the total perceptual experience in which all spatial aspects of music interact. Other authors continue to emphasize the "auditory-versus-musical" opposition. Langer (1953) considers space as "a secondary illusion," Ingarden (1958/1986) includes the "peculiar musical space" among the non-sonic components of the musical work, Lippman (1952) explains that the abstraction from spatio-temporal reality is a characteristic feature of romantic music which attempts to transport the listeners into realms beyond. Zuckerkandl (1957) construes musical space as a "place-less" and dynamic entity; he raises tonal relationships of the Western art tradition to the level of metaphysics. Finally, Clifton argues for the distinction "between being physically located in acoustical space and phenomenally located in musical space" (Clifton 1983: 142). He describes various spatial textures: lines, surfaces, surfaces with varying degrees of relief, and masses with different degrees of solidity. Clifton, Kurth, Langer, and others, perceive musical space as "heard" in temporal motion. This is a manifestation of the interrelationship of space and time, known from modern physics ("spacetimes" of relativity theory) and human experience. However, the image of a phenomenal musical space, including aspects of "lived" time but not "lived" space, ignores the spatio-temporality of music heard during its actual performance.

The second section of Chapter II presents views of those theoreticians and composers who consider space as the epitome of stasis and claim that the "spatialization of time" is an important feature of contemporary music. These ideas relate to Schoenberg's concept of "the two-or-more-dimensional space" (1941/1975) as well as to Adorno's critique of Stravinsky's music as "pseudomorphosis to painting" (1948/1973). Eimert and Ligeti (1960/1965) connect the spatialization of time to serialism. Others (Kagel, Cage) equate the two-dimensional plane of a page of notation with the two-dimensional space of pitch and time. Space also means

"temporal stasis" for Rochberg (1963) and McDermott (1966) who propose the "spatial image" as a paradigm of modern music. Bayer (1987) assumes that the notion of sonic space is a key to explaining the evolution of contemporary music as a whole, while Morgan (1980) deplors the ubiquity of static spatiality in new music.<sup>2</sup> Despite these claims that the existence of a "spatial image" is an exclusive characteristic of modern music, spatial representation of musical structures is possible regardless of musical style.

In section 2.3 of Chapter II, I discuss the identification of space with pitch, frequent in compositional and analytical theories. Pitch is spatial either as a set (mathematical space) or as an analogue to the spatial dimension of height.<sup>3</sup> According to Duchez (1979), the ubiquity of the cognitive model of pitch-height caused the emergence of a "conceptual perception" in music. The vertical representation of pitch has become an attribute of pitch itself and a condition for the creation and perception of music as well as theoretical reflection about both. The parallel between pitch height and the vertical dimension of height is used in musical notation, in which the direction towards the top of the staff means an ascent in pitch and the direction towards the right side of the page denotes a progression in time. This concept of a two-dimensional spatiality is deeply rooted in Western art music; the notation of pitch and time provides music with an unchangeable skeleton which ensures its survival beyond one, unique performance. The existence of the pitch/time space allows for the visualization of music as well as for the introduction of graphic analytical methods (e.g. McDermott, Bernard, Brinkman and Mesiti).<sup>4</sup>

However, the graphic representation of music on the two-dimensional plane of pitch and time has many limitations. One problem is with the one-dimensional,

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<sup>2</sup>Morgan also introduces a notion of space related to Schenker's theory.

<sup>3</sup>Similarly, the musical framework of pitch and time may be spatial in a geometric sense (on a plane) and in a mathematical sense (as the realm of sets).

<sup>4</sup>The use of two-dimensional spatial images is current in music analysis, cf. the "wedge-shaped linear motion" discussed by Bo Alphonse (Alphonse 1994).

vertical image of pitch. As has been said, pitch and pitch-class coexist in music as two co-dependent dimensions. Another difficulty arises from the fact that musical time may also be regarded as a multidimensional phenomenon (Kramer 1988, Pressing 1993). Nonetheless, the two-dimensional image of music has important advantages, such as simplicity, (otherwise it would not have persisted). The representation of music in pitch/time space allows for the visualization of the temporal relationships of simultaneity and succession. Such a geometric image of music on one spatial plane is useful if all the elements of music belong to one "stream" (e.g. parts in tonal polyphony). If not--as often occurs in spatialized compositions--the two-dimensional representation of simultaneous musical layers falsifies (instead of clarifying) their relationships.

Mathematical notions of space (space as a set of points with some specified structure) appear in theory and composition of serial or atonal music (Boulez, Morris, Xenakis). These generalized or formalized theories of space have emerged simultaneously with the "spatialization of time" in new music. Boulez (1963) creates a taxonomy of potential pitch-spaces of a very high degree of generality while Xenakis (1963/1971) introduces two-, three- and multidimensional spaces into his compositional theory. The introduction of abstract, multidimensional sound-spaces isolating various "parameters" of sound (frequency, time, duration, spectrum, etc.; e.g. Cage 1957, Carapezza 1961) occur in the context of the avant-garde's efforts to rupture the continuity of musical tradition and create a new objectivity in music.

Finally, a conceptual transformation of "musical space" leads to the association of this term with the space in which music is performed and heard (section 2.4 of Chapter II). Here, "musical space" relates either to the enclosed space providing the acoustic environment for music (Brant 1967, Bräm 1986, Hoffman-Axthelm 1986), or to the space delimited by the presence of the performers and listeners (Bielawski 1976). The meaning of "musical space" as the space of sound localization is current in the domain of electroacoustic music (Smalley 1991).

Chapter III opens the second part of the dissertation and presents the historical development of the idea of "spatialization" in the theory and practice of contemporary

music. In section 3.1, I precede this review with a consideration of three general aspects of the relationship of music and the performance space: (1) the link between the acoustic environment and the instrumentation (sound quality), (2) the dispersion of sound sources within performance space (polychorality), and (3) the "lived" bodily-spatial experience of the listeners and performers (religious rituals).

I subdivide 20th-century theories of spatialization into four domains: (a) spatialization as an extension of polyphony, i.e. music of simultaneous, spatially separated layers (Mahler, Ives, Brant; section 3.2); (b) spatialization as the "reification" of musical material, i.e. music built from sound objects projected into space (Satie, Stravinsky, Varèse, *musique concrète* and electroacoustics; section 3.3); (c) spatialization as a new "parameter" manipulated compositionally, in Darmstadt and beyond (Stockhausen and Boulez, section 3.4); (d) spatialization as conceptual experimentation with performance rituals and their contexts (Cage, Lucier, and Schafer; section 3.5).<sup>5</sup>

The separation of performers into groups has preceded other notions of musical spatialization, especially those advocated by the Darmstadt avant-garde. I begin its 20th-century history with Gustav Mahler, who stated that true polyphony arises from the total spatial distribution of contrasted material. An example from the finale of Mahler's *Second Symphony* (1894) illustrates his ingenious use of off-stage groups, the association of different musical layers with spatial locations, and the illusion of sound movement (changing distance) created through dynamics. Charles Ives explored the musical independence of simultaneous layers with two orchestras which perform musical material differing in its harmonic, melodic and rhythmic features (e.g. the second movement of the *Fourth Symphony*). He imagined, but never realized a *Universe Symphony* with contrasts in pitch space, the type of material and spatial locations. He considered spatial separation of performers as a means of clarifying textures and realizing the inner content of the music (Ives 1933). He was particularly

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<sup>5</sup>All four domains include manipulations of the physical and perceptual aspects of space; however, the specific techniques and philosophies differ in each area.

interested in enriching music with aspects of perspective and distance. Finally, he described the active type of perception in which the listener's attention shifts from one musical layer to another.

Ives's reflections about musical spatiality influenced Brant, Schafer and Cage. Henry Brant (1967, 1992) is convinced that Ives's *The Unanswered Question* presented "the entire twentieth-century spatial spectrum in music" (Brant 1967: 225). His spatial music shares this work's features: contrasts of widely separated layers of sound and the absence of rhythmic coordination between these layers. Brant's writings on "the use of antiphonal distribution in composing" (1955) and the "essential role of space in music" (1967) outline the principles of his approach to musical spatiality. In particular, Brant points out that separation in space allows for the differentiation of musical strands in a complex texture. In descriptions of his spatial experiments, Brant claims that vertical height creates an impression of higher pitch. He notices the effects of *a wall of sound*, *spill* and *filling up* in which musical sounds tangibly occupy segments of physical space. He discusses positive aspects of the absence of strict rhythmic coordination and reveals an interest in a total perceptual experience, rather than a preoccupation with the detailed planning of isolated features of musical sounds.

The second conceptual area of spatialization involves a "reification" of musical material (section 3.3). I identify the origins of this approach (fully articulated by Edgard Varèse) in Satie's *musique d'ameublement* (1920) and Stravinsky's concept of the *musical object* (1924). Satie's "furniture or furnishing" music fills in a space for a time; it should not be consciously listened to, it is not Art. It belongs with other physical objects endowed with concrete physical dimensions and a definite spatial location. Stravinsky's notion of musical objects possessing a solidity of material things expresses his anti-romanticism, not an interest in spatialization; however, this notion influenced Edgard Varèse (Mattis 1993). The projection of sound-masses (i.e. musical objects) into space is a fundamental feature of Varèse's vision of spatial music (1936/1967). Since in this music sound-masses are in motion, time is not static; in this respect Varèse differs from younger avant-garde composers who proclaim the

staticity of time.<sup>6</sup> Musical objects (*sound-masses* or *zones of intensities*) evolve, expand and contract, yet they have clearly defined boundaries which are articulated by differences in tone colours and dynamic levels. Thus, Varèse relates spatiality to timbre and dynamics. He also envisions the spatio-temporal movement of sound objects in *spatial projection* (Varèse 1936/1967). The notion of *projection* is quite ambiguous; one of its definitions (i.e. the distribution of sound sources into various locations in space) has been accepted in the domain of electroacoustic music. Varèse's realization of spatial music in *Poème électronique* (1957-1958) includes the design of *sonic trajectories* of sound movement. He borrowed this notion (as well as the term *spatial relief*) from Pierre Schaeffer, the founder of *musique concrète* which involved composing with pre-recorded sound objects and the use of electroacoustic sound projection.<sup>7</sup> During the early concerts of *musique concrète*, multi-loudspeaker systems allowed for the creation of effects of *static relief* (dispersion of sound sources in space) and *kinematic relief* (sound movement in three-dimensional space).<sup>8</sup> Recently, the notion of "space" has become the paradigm of electroacoustic music.

However, the terminological framework of electroacoustic "spaces" is not clearly defined. Chion (1988) distinguishes *internal space* (compositionally predetermined) and *external space* (articulated during the work's performance). Risset (1988) notices the fragility of the *illusory space* designed by the composer and presented in the *real space* of performance. Smalley (1991) enumerates different types of space in electroacoustic music, e.g. the *composed space*, the *listening space*, and a *superimposed space*. He points out the inseparability of space and sound, of virtual environments and their contents.

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<sup>6</sup>Cf. Chapter II, section 2.2 and Chapter III, section 3.3.

<sup>7</sup>Schaeffer, Henry and Poullin formed the Groupe de Recherches de Musique Concrète in Paris in 1951.

<sup>8</sup>Perceptual experiences at these concerts of *musique concrète* played a formative role in the development of Stockhausen's and Boulez's interest in spatialization.

Theories of the Darmstadt composers, Stockhausen and Boulez, exemplify a speculative approach to spatialization (section 3.4). In "Music in space" of 1959, Karlheinz Stockhausen links the dispersion of music into space with the spatialization of time and musical material; he also argues for the *serialization of direction* as the best compositional option. In his hierarchy of the tone-characteristics in Western art music, *location (topography)* occupies the final, lowest place. Stockhausen composed his first spatialized works in the mid-1950s, after Brant, Schaeffer and Berio. In *Gruppen für drei Orchester* (1955-57), he introduced the effect of virtual sound motion (successive entries of orchestras with the same sustained pitches and overlapping dynamic patterns of crescendo--decrescendo). Stockhausen's approach to spatialization evolved through the years of his experience with electroacoustics; he moved towards the "mainstream" of spatialization involving the co-existence of distinct layers (1971/1989).

Pierre Boulez followed a similar trajectory away from the speculative theory of spatialization that he formulated in 1963. In *Musikdenken heute*, he distinguishes two types of *spatial distribution*, static and mobile (also called *static relief* and *dynamic relief*--as in *musique concrète*). Mobile distribution can be realized by *conjunct and disjunct movements*. Boulez expresses a preference for a fixed spatial lay-out in which he could explore various types of symmetry and asymmetry (relating spatialization to timbre and volume). The composer realized this interest in symmetry in *Rituel in memoriam Made:na* for eight orchestral groups (1974-1975). Recently, Boulez expressed a conviction that the main function of space in music is to clarify polyphonic textures (Boulez 1992).

Due to the strength and persuasiveness of the Darmstadt generation, spatialization became an important characteristic of new music in different countries. Gradually, though, the emphasis shifted from considering spatial location as an additional "parameter" of an abstract design to constructing the experience of the listener in the concert hall or elsewhere. This shift of focus to a social or "ritualistic" use of space originated with John Cage who challenged the assumptions of both the musicians and the listeners. From 1939 he advocated "making music with its

materials" and rejecting the primacy of pitch (Cage 1939/1961). He claims that indeterminate music develops in the physical space of the performance and occupies a segment of the physical time (Cage 1958/1961). Cage proposes to "juxtapose the dissimilars" and separate musicians in space in order to ensure their full musical independence. He takes music beyond the concert hall and allows the listeners to cherish an autonomy that they seldom enjoyed elsewhere. Cage's music includes indeterminate forms, diverse materials and simultaneous presentation of unrelated sound events. *Variations IV* (1964) illustrates how spatial location becomes an element in a randomly controlled network of relationships. *0'00"* (1962) allows for a transformation of everyday life into art.

One of Cage's associates and followers, Alvin Lucier, reduces music to sound matter, and reveals a preoccupation with the acoustic peculiarities of space unprecedented among composers (Lucier 1985). He involves the listeners-performers in processes of discovery of the acoustic properties of rooms, objects, instruments, etc. Lucier abandons "composing" in the traditional sense of this term without parting with the notion of the "work." R. Murray Schafer's theatre of confluence connects all the arts in a new form of "confluence" and, thus, imitates life itself (Schafer 1966, 1991). The Canadian composer shares Cage's concern with the perceptual experiences of the listeners and has attempted to affect their lives with his art.<sup>9</sup> Thus, he gives a new twist to Cage's idea of uniting art with life. Schafer's theatre is a form of artistic ritual which requires unconventional performance spaces and the involvement of the total spatio-temporal corporeality of the listeners-participants.

This review of compositional writings about spatialization (illustrated with musical examples) demonstrates the lasting importance of the notion of "musical work" in contemporary music. In Chapter IV, I present a phenomenological interpretation of this concept (Ingarden 1958/1986) and point out ways in which spatial features of sound may be incorporated into "the work." A description of a

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<sup>9</sup>Schafer's cycle of musical/theatrical works, *Patria*, is still unfinished (Mackenzie 1992).

series of imaginary perceptual situations (listening to the motive "B-A-C-H" in various spatial arrangements) alerts the reader to the multiplicity of ways of perceiving music. When the physical spatiality of sound is taken into account, the presence of the listeners, as well as their spatial locations and orientations becomes essential. Spatialized music presupposes an idealization of the listeners, who should be endowed with perfect hearing abilities and located in optimal positions in space. The extent of this idealization varies, but the listeners may be required to hear what is inaudible. In order to present the musical potential of spatiality of sound I briefly review Blauert's study of spatial hearing (1983) and Bregman's theory of auditory perception (1990).

Blauert suggests that sound localization, spaciousness of the hall, etc., characterize sound images not physical sounds. This separation of "the perceptual" from "the physical" is important for my notion of spatialization. Blauert contrasts free-field perception (i.e. in anechoic chamber) with perception in enclosed spaces (i.e. the concert hall) and describes a number of specific features and effects, including directional and distance hearing, the loss of locatedness in diffuse sound fields, and the *spaciousness* of auditory events in enclosures (the apparent extent of sounds in space). Spatial location plays an important role in the current psychoacoustic theory of "auditory scene analysis" (Bregman 1990). For Bregman, position in space is one of the main criteria for the segregation of incoming stimuli into "auditory streams." He argues that it is difficult to isolate spatiality from timbre and dynamics, and that the "what" and "where" are interrelated.

In section 4.3 of Chapter IV, I turn towards Ingarden's definition of the musical work which divides the work's ontological basis into the score and the performance. The work is schematically defined in notation and imperfectly realized in real sonorities--it is an "ideal boundary" of both the score and performance, an object of compositional and interpretative intentions. Moreover, Ingarden notices that each performance splits into a number of unique "concretions" heard by individual listeners. While the work is an intentional object, the performance is a process occurring at a determined spatial and temporal location. Ingarden believes that musical works consist of pure sounds (sound-constructs), yet he claims that these

works include sonic and non-sonic components (the latter group comprises quasi-temporal structure, movement, aesthetic values, etc.). His theory reveals how music has lost its spatio-temporal reality in order to gain a supratemporal existence in the form of intentional objects, musical works.

Regardless of its historical and social limitations (pointed out by Lissa and Goehr), Ingarden's theory may serve as a basis for the inclusion of spatialization among the features of the musical work. I expand his concepts of "sound-construct" and "quasi-spatial structure." The first notion resembles the concept of virtual sound image discussed by Bregman (1990). I argue that many composers intend to create complex sound images ("sound-constructs") and imperfectly approximate these images in notation by analytically isolating their features. Ingarden's notion of the "quasi-spatial structure" serves as a model for my definition of a fixed *quasi-spatial structure* in music.<sup>10</sup> Weak, *latent quasi-spatial structure* exists in most music for solo performers and in compositions for larger, standard ensembles without any spatial specifications. Chamber and orchestral music may have a full *quasi-spatial structure* when the composer requires a certain acoustic environment for the performance, includes a seating plan in the score, divides the musicians into groups dispersed in space, etc. *Spatialization* of music means, precisely, this introduction of the *quasi-spatial structure*. The term *spatialized music* refers to music with a quasi-spatial structure defined by the composer in the score or in another medium of sound coding (digital or analog recording, specific software).<sup>11</sup> This quasi-spatial structure can assume different forms, including ensemble dispersion, the movement of sounds, performers or audience, and the juxtaposition and interaction of real and virtual sound sources. This definition relates to the composed space of the musical work. "Spatialization" may also refer to the addition of spatial characteristics to music during performance; thus, any work of music may be "spatialized."

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<sup>10</sup>*Spatial design* and *spatial organization of sound* are synonyms to *quasi-spatial structure*.

<sup>11</sup>Here, I repeat the definition from chapter IV verbatim.

Here, I support Ingarden's thesis that the work is identical neither with the score nor with a performance. I claim, however, that the work consists of a series of idealized aural images that are approximated in the score and instantiated in performance. Therefore, the spatialized work contains quasi--spatio-temporal sound-constructs organized within a quasi--spatio-temporal framework. (The sonorous, i.e. psychoacoustic, reality of music is always spatio-temporal, not quasi-spatio-temporal).

The ontological schema of "musical works" includes five stages: (1) the compositional process (idea), (2) the score (notational representation), (3) the performance (action), (4) the results of these actions (physical sounds), (5) the perception and cognition (auditory images and ideas). Music may be spatial at all these levels, involving imaginary, symbolic, geometric, acoustic and auditory types of space. Theories of "musical works" often limit music to non-spatial ideas and their notations (levels 1-2). The expanded definition of the spatialized work indicates structuring of the spatio-temporal reality of performance, sound, and perception by the composers (levels 3-5).

In the analytical portion of the dissertation (Chapters V--VIII) I attempt to stress the unity of time and space by focusing on the perceptual and temporal aspects of musical spatiality. This has not always been possible, because many composers and theoreticians consider "space" as a synonym of "stasis." Therefore, I document the composers' interests in the geometric and mathematical spaces, e.g. various non-temporal designs (circles, sets).

**Chapter V** contains a survey of spatial designs in contemporary music and a new classification scheme for spatialized works illustrated with many musical examples. The classification of spatial designs includes three aspects of music in space: (1) acoustic environments, (2) types of sound-space (real with vocal-instrumental sources, virtual with electroacoustic sources, and mixed), (3) categories of mobility (static and mobile performers and audiences). In addition, I list a number of (4) selected designs in real sound-space (from two ensembles in dialogue to total dispersion) and (5) selected designs in virtual sound-space (from one to many loudspeakers).

The analytical examples range from Bartók's *Music for Strings, Percussion and Celeste* (1937) to Boulez's *Répons* (1981-88) and illustrate several aspects of spatialization: (a) the spatiality of the orchestra on the stage, (b) the compositional use of apparent sound movement through dynamics, (c) the varied approaches to the movement of performers and audiences, (d) the spatial characteristics and effects of electroacoustic music, (e) the composing of perceptual experiences rather than detailed "works." The spatially extended textures on the stage are exemplified with Bartók's work and Krauze's *Folk Music* (1972) for 21 orchestral groups. In addition to exploring various patterns of movement of performers and audiences, composers create effects of virtual sound movement with stationary sources surrounding the listeners (Stockhausen's *Gruppen für drei Orchester*; works by Xenakis discussed in Chapter VII). The movement of performers in front of a static audience occurs, for instance, in Boulez's *Domaines* for clarinet and six instrumental groups (1961-1968), and Berio's *Circles* for female voice, harp and two percussionists (1960). The listeners are invited to wander around in Cage's *HPSCHD* (1967-69), and are taken for a musical elevator ride in Schwartz's *Elevator Music* (1967). Both works are indeterminate in many respects, which is characteristic of conceptual experimentation.

In more traditional types of instrumental music, the simplest form of spatialization involves the interaction of two groups of performers on the stage (e.g. Carter's *Piano Concerto* of 1963-65 and *Double Concerto* of 1961). The spatial dialogue may also be composed for the performers, rather than for the audience who witness a musical contest (Andriessen's *Hoketus* of 1975-1977). The idea of surrounding the audience with sound has been realized with symmetric patterns of 4, 6, 8, or 12 groups. Spatial designs from Stockhausen's *Carré* for four orchestras and choirs with four conductors (1959-60) inspired Dobrowolski's *Muzyka na smyczki i 4 grupy instrumentów detych* (1964). Here, spatial organization is linked to timbre; this seems to be an important characteristic of the Polish school of "sonorism" (e.g. Serocki's *Epizody* of 1959).

In the virtual space of electroacoustic music, spatial features of sound are only partly articulated through loudspeaker arrangements. Nonetheless, the classification

follows the plan from one to multi-loudspeakers systems. The abundance of electroacoustic designs reflects the vastness of available sound material; each plan of loudspeaker placement involves a different set of possibilities. New technological developments continue to transform the spatial potential of basic sound projection systems (e.g. spatializers expanding the two-dimensional stereo image into sounds surrounding the listeners; or Chowning's program for virtual sound movement in a quadrophonic space, 1970). I mention just a few examples from the rich repertory of electroacoustic music: Chowning's *Turenas* (1972), Reynolds's *Archipelago* (1980-1982), Dhomont's *Espace/Escape* (1989) and Krauze's *La rivière souterraine* (1987).

Boulez's *Répons* (1981-1988) for six instrumental soloists, an instrumental ensemble of 24 musicians and live electronics provides an example of mixed sound-space (section 5.5 of Chapter V). This work includes responsorial dialogues between the individual soloists and the ensemble, between the instrumental sounds and their electronic transformations. The sounds of the soloists are amplified or processed and projected from two sets of 6 loudspeakers surrounding the performance area. The audience, located in-between the soloists and the central ensemble, is immersed in the music--this is an essential feature of the concept of this work. I discuss the role of technology in *Répons* and focus on two sections presenting the interaction of instrumental and electronic sounds. In rehearsal no. 42 (the "wallpaper") the soloists' sounds trigger a response of synthetic sonorities. In the coda (rehearsal no. 91-95), the soloists' arpeggios rotate in space and shift in frequency at the same time.

The compositional use of spatial distribution is often inspired by geometric, geographic or architectural shapes, or an intent to portray or evoke mythical, ritual or imaginary spaces. I conclude the review of spatial designs in Chapter V with three such examples. Gavin Bryars's *The Sinking of the Titanic* (1969-1975) recreates an impossible situation of the ship's refloating. It surrounds the music, which supposedly had been played on board while the *Titanic* was going down (live musicians), with a halo of musical glosses and associations (pre-recorded sounds). In Brian Ferneyhough's *Transit* for six solo voices and chamber orchestra (1975), the seating of the orchestra on the stage (four semicircles) represents the four spheres of the

Universe (an image from the Renaissance woodcut, the inspiration for this composition). In John Tavener's *Ultimos Ritos*, dedicated to St. John of the Cross (1972), the location of musicians within the space of a cross-shaped church as well as spatial sound movement participate in the religious symbolism of the music.

The third part of the dissertation (Implementations) presents three different approaches to spatialization. Here, I include brief analyses of many compositions which have not been studied before; in this research I use compositional sketches and other unpublished material, as well as my interviews with the composers.

In Chapter VI, I discuss Henry Brant's spatial music, from *Antiphony I* for five orchestral groups, through *Western Springs* (1984) for 2 orchestras, 2 choruses and 2 jazz combos, to *500: Hidden Hemisphere* (1992) for 3 concert bands and an ensemble of Caribbean steel drums. Brant's music has close ties to American vernacular styles and experimental tradition (Ives), not to the European avant-garde. *Antiphony I* (1953) consists of five independent layers with different timbres, motivic materials, rhythms, tempi, and keys. Here (and in all his later works), the spatial distribution of musicians serves to reinforce the musical contrasts and clarify the work's complex texture. *Millennium II* (1954) has a detailed plan of the positions of musicians; this plan is necessary for the realization of spatial effects such as sound travel along the walls of the hall. In *Voyage Four* (1964), eighty-four musicians are dispersed in a "total antiphonal distribution" throughout the auditorium, from below the floor to the highest balcony. The music presents a number of unusual spatial effects (spill, sound travel, wall of sound, etc.). Brant often juxtaposes simultaneous layers in distinct styles, e.g. jazz band, Javanese gamelan and West African drumming group in *Meteor Farm* (1982) or bands, choruses, carillons, street organs and four boatloads of flutes floating down the canals of Amsterdam in *Bran(d)t aan de Amstel* (1984). The latter piece of site-specific music involves the whole city in a grand-scale outdoor celebration. Brant's spatial music calls for active listening, in which the listeners choose what they want to pay attention to. The composer creates the conditions for this choice through the simultaneity of various musical processes taking place at different points in space.

Chapter VII presents the technique of spatial sound movement in the instrumental music of Iannis Xenakis, from *Pithoprakta* (1955-56) to *Alax* (1985). The evolution of stochastic sound masses in *Pithoprakta* is linked to a rudimentary form of motion of sound on the stage. *Eonta* (1963-64) explores performer movement and the directional quality of brass instruments (e.g. change of timbre through axial rotations of the players). In *Terretektorh* (1965-66) for orchestra scattered among the audience, apparent sound motion is constructed by means of Archimedean, logarithmic and hyperbolic spirals. The musicians are interspersed among the public also in *Nomos Gamma* (1967-68) where sound placements and movements are structured by means of mathematical group theory. The climax of *Persephassa* (1969) consists of several superimposed layers of sound, rotating simultaneously in different directions. *Alax* (1985) for three identical ensembles, presents spatial canons, sound planes, etc. Xenakis's original use of spatial sound movement in music juxtaposes technical sophistication with an overwhelming forcefulness of expression. The adoption of "space" as a compositional tool enables Xenakis to structure spatial sound locations and motions with mathematical means. His music is spatial on many levels at once.

Finally, in Chapter VIII, I turn towards the Canadian composer R. Murray Schafer and his explorations of spatial soundscapes and rituals, in compositions ranging from *North/White* (1979) to *The Princess of the Stars* (1981-84). In *North/White* for orchestra with a large array of percussion instruments, including a snowmobile, Schafer brings the soundscape of the Arctic into the concert hall in an ecological protest against its destruction. *The Princess of the Stars*, prologue to his musical/theatrical cycle, *Patria*, takes the performers and the audience outdoors, into the soundscape of a mountain lake. This environmental ritual is synchronized with the sunrise and includes close interactions with the natural soundscape (echoes, birdsong). Here, and in *Music for Wilderness Lake* (1979) for 12 trombones placed around a small lake, Schafer uses the acoustic properties of the surface of water (carrying sounds at large distances). Schafer's works for more conventional performance spaces, such as the *Third String Quartet* (1981) and *Apocalypsis*, a two-part monumental music drama (*John's Vision* and *Credo*, 1976-1977) reveal his

involvement in various pursuits of the contemporary avant-garde. In *Apocalypse Part Two: Credo*, Schafer juxtaposes electroacoustic and acoustic sound sources in a virtual sound world. He also articulates geometric patterns by the spatial placement of sounds and enlivens static textures with sound movement and dynamics. The formal design of the *Third String Quartet* includes detailed plans of performer location and movement so that the spatial position and musical material are closely coordinated. Schafer's music, whether integrated with wildlife sounds, or found within the concert hall, as all art, transcends the reality of ordinary human existence.

#### Selected topics for future research

In conclusion, I would like to point out some areas for future studies, areas which are merely outlined in this dissertation. The history of space and spatialization lays out the conceptual framework by identifying the principal denotations of these terms, and describing their evolution in the theory and practice of spatialized music. However, this account encompasses over 50 years of the Western music tradition in one narrative. Little attention is paid, for instance, to regional differences or to the subtleties of temporal evolution. These lacunae should be filled before a comprehensive history of spatialized music is written. The basic research should widen the geographical base of the study of spatialization to include compositions from Asia and countries outside the Northern hemisphere (this dissertation contains only examples from North America and Europe). The collection of precise chronological data about works and performances could reveal the waxing and waning of the interest in spatialization in different countries. The realization of this project requires the international cooperation of a team of scholars (perhaps under the aegis of UNESCO). Since this may not be easy to accomplish, research should concentrate on what is feasible: the study of repertoires within smaller spatio-temporal limits.

Particular socio-cultural conditions may influence different visions of spatialization so that composers from one country may have more in common with each other than with their contemporaries abroad. My postdoctoral research will

concentrate on contemporary Polish music in the study of "Spatiality, 'sonorism' and the Polish avant-garde (1956-1976)."<sup>12</sup> In this project, I will attempt to discover links between the compositional concerns for space and for sonority, and to delineate differences between, and similarities to, the ideas of the avant-garde in Western Europe (e.g. Xenakis, Boulez, Stockhausen). The institutionalization of "contemporary" music in the Polish People's Republic (e.g. obligatory membership in Composers' Union; relatively few, large state-funded festivals such as the *Warsaw Autumn*) allows for an unequivocal demarcation of the field of study. Similar projects could be undertaken for other East European countries and major centres such as the Darmstadt New Music Courses in Germany. I have pointed out the speculative character of two theories presented at Darmstadt; it would be interesting, for instance, to write a fuller history of the role of space in the ideology of the "modernist" avant-garde, and to trace the dissemination of theories of spatialization in various countries.

The dissertation presents a glimpse of the current state of new music by including studies of recent works (e.g. Brant's *500: Hidden Hemisphere* of 1992) and excerpts from interviews with composers (conversations with Boulez, Brant, Xenakis, and Schafer, all from 1992). Various aspects of the music by the three composers discussed in the third part of the dissertation (Brant, Xenakis, Schafer) merit further study. Henry Brant's oeuvre could be re-examined with more attention paid to his use of musical borrowing, and to the relations to his predecessors, contemporaries, and students (i.e. Seeger, Cage, Linda Bouchard). Studies of Xenakis's music could concentrate on the spatio-temporal architecture of his large-scale, complex compositions such as *Terretektorh* and *Nomos Gamma*. In Chapter VII, I investigate Xenakis's use of sound movement; his designs of static distributions in instrumental

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<sup>12</sup>This study constitutes the first part of my Postdoctoral Fellowship from the Social Sciences and Humanities Research Council of Canada. The second year of my Fellowship will be devoted to a study of the music and social position of Polish women composers (who, albeit not less active compositionally, have not become as famous as their male colleagues). I will work on these two projects at McGill University in cooperation with the University of Warsaw (in the years 1994-1996).

music and the spatiality of his electroacoustic works are equally fascinating. Schafer's theory and practice of the theatre of confluence "asks" for ideology critique; in addition, more of his spatialized compositions for the concert hall merit a detailed examination. Many other compositions mentioned or described in this dissertation could become topics for further research. For instance, published studies of Boulez's *Répons* (Nattiez, Deliège) indicate the existence of a sophisticated pitch design in the work's instrumental introduction. A detailed analysis of pitch coherence in the whole composition should include an examination of relationships between instrumental and electronic sounds (e.g. frequency shifts in rotating arpeggios).<sup>13</sup>

The history of the concepts of "space" in music (outlined in Chapter II) could also be perfected, perhaps by the addition of a comprehensive classification of notions of space: e.g. physical, acoustic space, perceptual space (with visual, tactile, and aural modes of perception), abstract space, imaginary/visionary space, cognitive space, etc. However, the introduction of such an all-embracing classificatory scheme causes difficulties of a philosophical nature.<sup>14</sup> Which spaces are real, which are ideal or intentional? Is it possible to separate the notions of musical, sonic and auditory spaces into well-defined categories? The answer depends on the researcher's epistemological stance, scholarly methodology and personal belief system. A plethora of intentional, "musical" spaces may emerge, spaces that are neither real nor ideal, but intersubjectively shared by communities of musicians, composers, and musicologists. Scholars of phenomenological orientation would focus on different types of musical spatiality (e.g. intentional, phenomenal spaces of experience) than researchers who embrace the mindset of logical positivism (e.g. abstract spaces of pitch, pitch-class, geometric spaces). The musical *Lebenswelt* of Western culture is far from being uniform and coherent.

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<sup>13</sup>This study requires the knowledge of technical data, such as details of frequency shifts, delays, etc. Therefore, it could be realized only in collaboration with the composer and his technical staff at IRCAM.

<sup>14</sup>For this reason, the dissertation does not contain such a generalized scheme, but a review and a description of various *existing* theories and conceptions of space.

In this dissertation, I have limited the area of research into issues of musical spatiality to "contemporary music." It would be advisable to transcend these limitations historically and stylistically, and to re-consider the role of spatial features of music in different periods and repertories. For instance, spatiality of sound is an important element in the American tradition of Sacred Harp singing:

Sacred Harp music is traditionally sung in a 'hollow square' with each voice part taking one of the four sides and facing the center. The song leader stands in the center, beating out the rhythm and delighting in the surge of voices and blending of sound from all four sides. Newcomers are often encouraged to 'stand in the middle' to experience the full power and exaltation of the music.  
(Grayson 1994)

Finally, musicological research into issues of space and spatiality may benefit from closer ties to acoustics and psychoacoustics. Assuming that the human hearing system has not been radically transformed during the past millennium, current psychoacoustic knowledge might illuminate studies of music from different historical periods (e.g. Bregman's theory of auditory stream segregation might explain many aspects of polychorality).

As the composition and performance of music continues, all studies proclaiming that they deal with what is "contemporary," invariably concentrate on music of the recent past. To paraphrase John Cage: "How can we possibly tell what contemporary music is, since now we're not listening to it, *we're reading a book about it*, and that isn't it." (adopted from Cage 1958/61: 44). By knowing and interpreting the past we predict and shape the future. This dissertation, examining a full range of topics relating to musical spatiality, creates a space for space.