Common Sonic Entities in the Electroacoustic and Orchestral Music of Iannis Xenakis

James Harley

Introduction

At approximately the same time as Iannis Xenakis was penning his radical early scores such as *Metastaseis* (1954) and *Pithoprakta* (1956) that changed the history of orchestral music, he was embarking on his apprenticeship at what became known as GRM (Groupe de recherches musicales), producing his first electroacoustic work, *Diamorphoses*, in 1957. In his theoretical conceptions of music, as detailed in *Formalized Music* (Xenakis 1971), was the notion of "sonic entity", replacing traditional structures built from pitch and rhythm. The sliding string glissando textures in *Metastaseis* are reflected in the sliding "engine" sounds in *Diamorphoses*, and the pointillistic textures of *Pithoprakta* (knocking, plucking, bowing, etc.) are reflected in the granular "embers" of *Concret PH* (1958). The dense 8-channel textures of *Bohor* (1962) surrounding the listeners are mirrored in the swirling spatial densities in *Terretektorh* (1966) where the audience is interspersed amongst the musicians. With the *Polytope de Montréal* (1967), the highly textural score for four spatially-separated ensembles was conceived as an electroacoustic work, broadcast over loudspeakers as part of a multimedia installation. Other of Xenakis's electroacoustic works are created entirely from instrumental sources, more or less processed in the studio. Perhaps the most radical "crossover" of these works is *Kraanerg* (1969), with a live instrumental ensemble (23 players) performing together with pre-recorded material (equally substantial) produced from studio recordings of the same ensemble, divided between winds and strings, distributed amongst four channels surrounding the audience. Xenakis continued to use instrumental sonorities in his electroacoustic works until he turned definitively to computer-generated works with *Gendy 3* in 1991. Interestingly, in the 1990s his orchestral works moved away from more obvious sonic explorations, with glissandi and pizzicati giving way to modal melodies and less opaque vertical structures, as in *Dämmerschein* (1994). The common ontological conception of his music appears to

have to some extent bifurcated, with computer-generated sonorities bearing little sonic overlap with simplified acoustic sounds, but perhaps with conceptual connections.

Sonic Entities

Iannis Xenakis (1922–2001) completed his first significant composition, *Metastaseis* for orchestra, in 1954. His primary training was in engineering, and from 1947 he worked as an engineer and architect in the studio of acclaimed artist and architect Le Corbusier. In 1955, he began working in the studios of what has become known as the GRM. His first electroacoustic composition, *Diamorphoses*, was completed in 1957. This was a fertile period for Xenakis: he completed *Pithoprakta* for orchestra; and the Philips Pavilion (architect, project manager) for the 1958 World Fair in Brussels. Having striven to apply mathematical tools from engineering and architecture to music and sound, Xenakis also undertook a process of formalisation, integrating his ideas into a theoretical framework that was unlike any other. In his approach, which encapsulated his current sense of musical form, he outlined what he called "fundamental phases of a musical work". He listed them as follows:

1. Initial conceptions;
2. Definition of the sonic entities;
3. Definition of the transformations;
4. Microcomposition;
5. Sequential programming of 3 and 4 – the schema of the work in its entirety;
6. Implementation of calculations;
7. Final symbolic result;
8. Sonic realisation (Xenakis 1971: 22).

While some of his 'phases' are better exemplified through musical scores, and he definitely focused on notated scores in his discussions in *Formalized Music*, Xenakis included the possibility of electroacoustic conceptions. In his definition of 'sonic entities', he discusses "symbolism communicable with the limits of possible means (sounds of musical instruments, electronic sounds, noises, sets of ordered sonic elements, granular or continuous formations, etc.)" (ibid.). He also posits a definition of the transformations which these sonic entities must undergo in the course of the composition, and the arrangement of these operations in lexicographic time with the aid of succession and simultaneity. (ibid.: 23f.)

Crossovers: Acoustic–Electroacoustic

In *Metastaseis* for orchestra, Xenakis looked to sliding glissando textures (individual strings and trombones) as a core sonic entity, one he went on to use in numerous other works (Harley 1996). This entity is mirrored in the sliding 'engine' sounds in *Diamorphoses*. The pointillistic string textures built from stochastic (random) distributions – timing, pitch, density – of *Pithoprakta* for orchestra are reflected in the granular electroacoustic 'embers' of *Concret PH*. In both these works, density of events was a primary compositional factor, along with global boundaries of parameters such as register, dynamics, etc. The conceptual relationship between acoustic and electroacoustic materials was made most explicit in *Analogique A et B* (1958–59), which alternates pointillistic music for strings with electronic sounds attempting to model granular synthesis, which Xenakis had conceived of but lacked the technical resources to truly achieve at the time (Di Scipio 2005).

In 1962, Xenakis created his largest electroacoustic work to-date, *Bohor*, for eight channels of sound surrounding the listeners. The music is built from layers of contrasting, relatively noisy materials, immersing the audience in a composite aural experience. The intensity of the music is heightened in the final minutes by a dramatic increase in noise and volume. Some of the concerns of *Bohor*, the immersive sound and the layers of unusual sonic textures, were explored in the orchestral domain in *Terretektorh* (1965–66). This work places the audience amongst the musicians, the epitome of an immersive acoustic experience (Santana 2001). The music includes glissandi, even more varied than in *Metastaseis* (a notable addition being slide whistles), and granular textures such as distributed maracas and percussion. *Nomos Gamma* (1968) expanded the spatialised orchestra-audience by surrounding everything with seven percussionists who spin rhythmic pulses around the space in an acoustic representation of studio panning techniques.

Incorporating Acoustic and Electroacoustic Entities

In *Polytope de Montréal*, Xenakis undertook his first multimedia project after his work on the Philips Pavilion in 1958, creating an installation of numerous angled cables stretched from ceiling to floor through a five-storey atrium space. The cables (forming patterns reminiscent of the string glissandi in *Metastaseis* which were conceived graphically before being turned into sound) had hundreds of flashbulbs attached to them that were triggered to form sequences of dynamic

visual patterns. These were intended to be experienced in tandem with music that was scored for instruments but was presented during the installation at the French Pavilion at the World Exposition in Montreal (running for several months in 1967) as recorded material. The music was conceived for four identical ensembles, in the end projected through four channels through loudspeakers on each level of the atrium. Xenakis followed *Polytope de Montréal* with *Kraanerg*, where a live ensemble alternates with recorded segments on four channels of the same ensemble (23 players, winds and strings). The studio-produced segments are subject to a degree of signal processing but are clearly based on similar material as is presented by the acoustic instruments. The recorded elements are heard surrounding the audience while the musicians are onstage (or in the pit, as the commission was for a dance work) (Harley 2015).

Acoustic Sources for Electroacoustic Works

Xenakis followed these 'mixed' works with *Persephassa* (1969) for six percussionists surrounding the audience, and *Hibiki Hana Ma* (1970) for recorded sounds originally produced on 12 tracks to be projected over hundreds of loudspeakers. In this electroacoustic work for the 1970 World Fair in Osaka, Xenakis used entirely instrumental sources, but there is a great deal of studio manipulation applied, even while some sonic layers are easily recognisable as fragments from string orchestra, Japanese biwa, etc. (id. 2004: 67). Some of the more extensively developed sonorities Xenakis produced for *Hibiki Hana Ma* were recycled and elaborated in further electroacoustic works: *Persepolis* (1971), *Polytope de Cluny* (1972) and *La Légende d'Eer* (1978). At the same time, similar sonic entities are heard in his instrumental music, including string glissandi (numerous works from orchestral to chamber formations), clarinet multiphonics (*Synaphaï* for piano and orchestra, 1969, and *Antikhthon* for orchestra, 1971), low-register complex textures (*Antikhthon*).

Graphic Sources

With the establishment of a computer music research facility in Paris in 1966, operational in 1972, the CEMAMu (Centre d'Études de Mathématique et Automatique Musicales), Xenakis added computer-generated sounds to the layers of sonic entities in *Polytope de Cluny* and *La Légende d'Eer*. These digital textures were mostly remote from instrumentally-derived sonorities, but Xenakis explored conceptual relationships between them, primarily through graphic

design. With the introduction of his computer music graphic interface system in 1978, the UPIC (Unité Polyagogique Informatique CEMAMu), he was able to transfer graphic designs into sound directly, notably with his computer-generated work, *Mycènes alpha* (1978). Since his earliest compositions, such as *Metastaseis* and *Pithoprakta*, Xenakis had 'composed' music based on graphic designs. With *Anémoessa* (1979) for choir and orchestra, he transcribed sketches used for *Mycènes alpha* into music notation for instruments and voices. The timbres are very different in these two works, but the generative process is the same, at least in part. In a similar way, identical 'arborescent' designs (branch-like shapes) are transcribed into string glissandi and into discrete textures played by the solo piano in *Erikhthon* (1974) for piano and orchestra. In the first section of *Jonchaies* (1977) for orchestra, the strings outline a slowly-unfolding wavelike design. Rather than mapping the shapes through glissandi, as in *Erikhthon*, Xenakis not only transfers the graphic design into discrete notes, he filters them through a pitch 'sieve', where only selected pitches are used, not the full chromatic complement (Harley 2012).

Focusing Inward

From *Jonchaies* on, Xenakis began to pay closer attention in his acoustic music to concerns of pitch: melodies, counterpoint, harmonies and clusters. As a consequence, instrumental textures became more focused, less reliant on the elements that had been predominant in earlier scores, such as glissandi, noisy complexity, etc. On the electroacoustic side, after the graphic-designed UPIC pieces – *Mycènes alpha*, *Pour la paix* (1981) with narration and choir, *Tauriphanie* (1987), *Voyage absolu des Unari vers Andromède* (1989) – Xenakis focused on extending his earlier compositional algorithms ("ST"-series, 1956–1962 and later) into the domain of generative sound synthesis (Hoffmann 2004). There is a great deal of variability in many of the compositional parameters, but the waveforms, eschewing curves in favour of straight-line segments, somewhat limit the timbral range. The algorithmic process was the primary concern. Xenakis produced two works generated in this way: *Gendy 3* (1991) and *S.709* (1994).

Conclusion

In his later works, Xenakis could be understood as following separate, rather than complementary, musical concerns, especially with regard to the limited timbral or textural palettes he explored in his electroacoustic and instrumen-

tal-vocal works. Where the computer-generated music implemented the earlier "phases" down to the level of sample values, his acoustic music concentrated on sonic density, often leaving aside glissandi, noisy timbres (such as percussion), layering of heterogenous textures. Rather than focus on the sonic entities themselves, though, might it be worthwhile considering the composer's concentration on generative processes? Xenakis became fascinated by the interior qualities and relations of dense but relatively controlled entities. The degree of contrapuntal activity in an orchestral score such as *Dämmerschein* could perhaps be compared to the number of 'voices' active in a section of *Gendy 3*. If so, perhaps there is a unity in his later works after all, one that is less obvious when comparing sonic entities directly. The concentration of all these works comes from the narrowing of sonic entities in order to focus on the inherent material qualities of the entities Xenakis chose to use, and the architectural design of the music overall.

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