# Visualizing Sound, Hearing Diagrams: On the Creative Process of Syrmos by Iannis Xenakis

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[Preprint version, no images embedded]

**Abstract.** A salient feature of Iannis Xenakis' compositional practices was the use of several concepts and techniques borrowed from architectural design and from scientific fields. He sometimes drew complete graphic scores preluding the transcription of his fair copy of conventional musical notation. I discuss the diagrammatical features of Xenakis' graphic score for *Syrmos*: although disparate representations depend on shared image schemata and cross-modal correspondences, their respective compositional logics are dissimilar.

**Keywords:** Science-based composition · Sketch studies · Cross-modal correspondences · Material anchors · Iannis Xenakis

## 1 Introduction

In *Syrmos*, a piece for string orchestra for eighteen players, Iannis Xenakis achieved a synthesis between compositional perspectives he developed during the 1950s. He implemented extra-musical ideas in compositional processes mainly borrowed from architectural design, mathematics, and physics. When playing *Syrmos*, the musicians and the conductor are supposed to read a score with standard notation on their respective music stands. A first and diagrammatic version of *Syrmos* is kept in the composer's archives. It was written on graph paper in order to transcribe the data it contains as accurately as possible. Among its numerous pages, one of them displays a kind of hyperbolic envelope surrounded by a seemingly unpatterned cluster made of little crosses (see Fig. 1).

Henceforth, I will only focus on this page, as a paradigmatic case in which both graphical elements, line segments and dots, are confronted. I will prove that, although both elements are immersed in the same diagrammatical space and share therefore common features, their underlying compositional logics are quite different. For that purpose, I will summon arguments from the fields of experimental psychology—mainly based on studies of cross-modality [3,8]—and cognitive linguistics—particularly those coming from image schemata of the conceptual metaphor theory [7] and from the conceptual blending theory [4].

## 2 Music, Notation, and Cross-modality

We can imagine any Western musician quickly grasping the kind of information that Xenakis was providing on the graph paper. After all, the implicit axes of his diagrammatic notation are consistent with those of the standard musical notation. Both the symbolic and the graphic systems of representation share image schemata: PITCH RELATIONSHIPS ARE RELATIONSHIPS IN VERTICAL SPACE and TIME FLOWS FROM LEFT TO RIGHT. This strong relationship is not however an equivalence: pitches across the staves are not uniformly distributed; also, the rhythmic notation is sequential but rarely spatially proportional.

The aforementioned image schemata are not universal. For instance, research on time conceptualizations has shown a lack of universalism of the left-to-right image schema [5]. Concerning pitches, a large variety of conceptualizations spreads across different cultures. In spite of this diversity, empiric research points to some cross-modal correspondence: individuals subjected to verbal expressions or visual representations of pitches tend to provide responses which are consistent with the Western image schema from other cultural frames [1,2].

Xenakis was not the first composer putting forward a proportional representation of pitches and durations. His choice is aligned with notational needs based on technological developments, from the piano rolls of the late 19th century to current MIDI protocols [9]. Nevertheless, Xenakis' approach in *Syrmos* was not devised as a graphical system for interpreting his music. Quite the contrary, he explored and exploited a visual space in order to facilitate several compositional choices that were further rewritten with a conventional notation.

## 3 Linear vs. Dotted Representations

One year before the composition of *Syrmos*, Xenakis published a short article summarizing the main extra-musical influences that had proven to have an impact on his creative mind. He described three main categories, namely the "numbers parable", the "space parable", and the "gas parable"[1].

In the paragraph devoted to the space parable [10, p. 17], Xenakis highlighted that, "[i]n music, the most sensitive straight line is the constant and continuous variation of pitch"— i.e. the *glissando*[2]—as an elemental constituent for "building sonorous surfaces (or volumes)". This link between geometry and sound reveals a blended conception of music that enabled Xenakis to somehow ductilize the image schemata for managing time and pitches. He exploited massive *glissandi* for the first time in his orchestral piece *Metastaseis*; the sketch for one of its passages is equivalent to some architectural drafts he designed when working with Le Corbusier [11, pp. 3, 6–7]. The choice of the hyperbolic envelope for *Syrmos* in Fig. 1 follows the same logic. In doing so, the cross-hatching pattern became a material anchor for conceptual blends [6], because Xenakis projected the two-dimensional image schema onto a preexistent visual form.

In the paragraphs devoted to the gas parable [10, p. 18–19], Xenakis made the "punctual sounds" match with gas molecules. Instead of focusing on the "individual movement of sounds", he was interested in unfolding "mass effects" via the laws of gas kinetics. This time, the recurrent expression "sound clouds" in Xenakis' writings is the key to grasp his blended conception, as an attempt to aurally interpret the scatterplots—*nuages de points* in French—in statistics. Xenakis had already written three instrumental pieces guided by statistical laws—*Pithoprakta*, *Achorripsis*, and *Analogique A*—before *Syrmos*. A comparison between some charts in his essay on *Analogique A* [11, p. 101] and a sketch for *Syrmos* (see Fig. 2) proves the recycling of previous ideas for managing the musical "density"—i.e. the number of events per unit of time. It seems that Xenakis freely distributed his crosses—standing for *pizzicati* and *col legno*[3]—on the graph paper: consequently, they should not be regarded as material anchors.

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[1] All translations are mine.

[2] String players obtain *glissandi* by sliding a finger of the left hand along the pressed string while the right hand normally bows.

[3] A *pizzicato* is obtained by plucking a string; *col legno* is a technique in which the bow is reversed for hitting with its wooden part.

## 4 Overview

Through the case study I have provided, three important features of the compositional practices related to diagrammatic extramusical sources have been detected. First, cross-domain correspondences and the habit of Western musical notation tend to root the adoption of privileged image schemata for managing pitch and time. These schemata may facilitate new conceptual mappings with other fields during composition. Secondly, these schemata can host both prescriptive patterned figures—acting as material anchors—and stimulate prospective ideations, via dissimilar cognitive strategies. Third, composers sometimes develop auxiliary technology in order to mitigate some cognitive effort related to their tasks. It is the case for instance of a pitch ruler made by Xenakis (see Fig. 3) for the transcription from his graphic score to the conventional one.

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