The Solid Melody: Expression of an Organic System

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Abstract

This conference highlights a compositional approach recovering and developping the hypothesis of an organic principle of the melody. Unlike the usual methods, which differentiates the organization of notes and rhythm, this principle is characterized by a strong structuration binding the notes and their respective locations in time. Its application reveals a representation of melodic objects in a geometrical space, objects called *solid melodies*, by analogy to the visual space. Thus, melodic objects can be observed and manipulated by mathematical transformation tools which respect their internal structures or, on the contrary, break them. One of the most interesting function taking advantage of this musical material, preventing any damage to it, is rotation. Its interest is multiple in composition: first, it generalizes the four symmetrical forms used in traditional counterpoint, second, it allows a meticulous understanding of melodic objects, facilitated by the simplicity of the processes used. Finally, this function allows a *musical kinematics* with succession of images obtained by rotations of an unique basic object. The comparison between visual space and sound space becomes a fertile source for the construction and the manipulation of new sound buildings.

Keywords: melody, organic systems, rotation, symmetry, kinematics.

1 Definition and Approach of an Organic System

Melody has developed an ambiguity during its history which makes it difficult to characterize. It should be underlined that the melody is balanced between the predominance of two trends: a harmonic trend, in which the choice of the notes is dominant, and a rhythmic trend, at first strengthend by the spoken language. The Classical and Romantic periods carried harmony and counterpoint to the height. Melody remained the cohesion element of the musical system. This cohesion has been eroded since the links between the two axis systems (time axis and pitch axis) — which are the true supports of this cohesion — lose their strength. The spoken language, like the traditional musical language, integrate this cohesion. The melody, considered only as resultant of the use of a rhythm on a note set, has difficulties of being, except by reference to its two projections on axes. Reduced to a *projective materialization* it does not have any more reason to exist by itself. The risk of developing independently harmonic structures and rhythmic structures is to lead to a lack of homogeneity, to a global inconsistency. The melody is not only the intersection of a note set and a rhythm set: it is a *note/duration* entity, united and interdependent, which must be considered and used as such. The links between the notes maintain the relationships which get it stronger in its structure and give it a coherence beetween its parts. This coherence gives it its integrity. We here put the finger on the essence of the melody, such as we conceive it, and which reveals *a principle of organicity.* This principle is characterized by the consciousness of a strong structural entity between the notes of a melody, integrating its specificity, its character, its richness. In this conference, we will deal with an application of this principle to the intimate structures of the melody and not to its macroscopic relationships to the musical form.

It is not, as one could think too quickly, in the pitch and tonality neutralization that the destruction of the principle of melody can be seen. Indeed, the progressive generalization of the harmonic system, which took an accelerated turn since a hundred years, should result in a new state of balance between the pitches. The fact that the relationship between the notes is not a battle of wills — hierarchical relationships — does not deteriorate the existence of the melody: they are two events, related to the concept of tone row developed by the second school of Vienna, which have taken of its intrinsic qualities. On the one hand, it is the consideration and the independent processing of pitches and rhythm. The series is not a string of twelve pearls which are fingered at a certain time: it is a raw material made of balls uniformly arranged in a transposition table. The rhythm — serial or not — is imposed on the pitches. It is independent of them. Its link with the pitches can be *logical* and built also on the row, but it is never *organic.* It does not maintain close relationships with the notes. In addition, to vary its interest, the series of notes permits the transposition of its pitches independently from each other. However, the octave transposition of a note transforms the intervals of the notes which surround it. So the series is not any more the original series: its structure is different. As for the series of intervalls, it allows a greater freedom, which can wander more from a reference structure: only the numerical unity is preserved. In other words, under the pretext of drawing aside any reminiscence of tonal composition, and by using the unifying principle of the series, we implement not one, but several basic materials, derived from the original. Relationships between the pitches established with the basic series lose its interest: the positions in time are not organized in any rigorous way.

The data-processing techniques and the tools we lay out also take part in a loss of flavour of the principle of melody. Indeed, the MIDI coding, used by most musical computers, draws us aside from the traditional symbolic notation and imposes an independent mathematical coding for pitches and durations. The processings of the musical objects then take place often in an autonomous way for rhythm and pitch. Admittedly, composers preoccupied by generalization often apply the same technique to all the parameters, but it is generally not an overall technique which includes all the links between the elements.

The implementation of geometrical spaces in composition expresses a double interest. The first interest lies in the respect of the structural integrity of the melody: the representation of notes by points guarantees the cohesion of the melodic structure, the solidarity between the notes. The second aspect consists in the facility with which we can carry out usual transformations, so that the result of the processing remains foreseeable. The object of our processing is above all to implement tools which permit a visual approach, nearly *tactile*: we will observe our musical objects as we manipulate real objects with our fingers, rotating them to appreciate every facet.

As a preliminary, let us advance a general definition of melody, which reconciles it — if needed — with contemporary considerations. The traditional representation of a melody is done using a symbolic notation whose structured alphabet allows a relative precision of the parameters: pitch, duration, intensity, timbre. Any musical work will lead to this kind of representation (not inevitably in usual coding, but according to a coding which results from it). This usual musical notation is still today the most widespread and the most adapted. We will speak about the *symbolic space,* the integrated representation space of pitches and durations, according to symbolic notation. We will then name *dynamic melody* any series of notes, or generally any series of groups of notes (series of chords from 1 to N notes), within the symbolic space. In this system, each group of notes follows a well defined trajectory on the time scale: the notes have a duration, which means a starting point and an ending point. To basically take into account the structural aspect of our melody, it is necessary to describe it in another space than our symbolic space — a geometrical space — in which each point is compared to a note. The solid melody is characterized by a geometrical object constituted by points (that we will call incorrectly *notes*), whose structure develops in a space in dimension K. We use the term *solid* in order to facilitate the correspondences with our visual space, in dimension 3. The solid melody proceeds of musical components (duration, pitch) extracted from symbolic space (several dynamic melodies in dimension 2). For example, in dimension 3 :

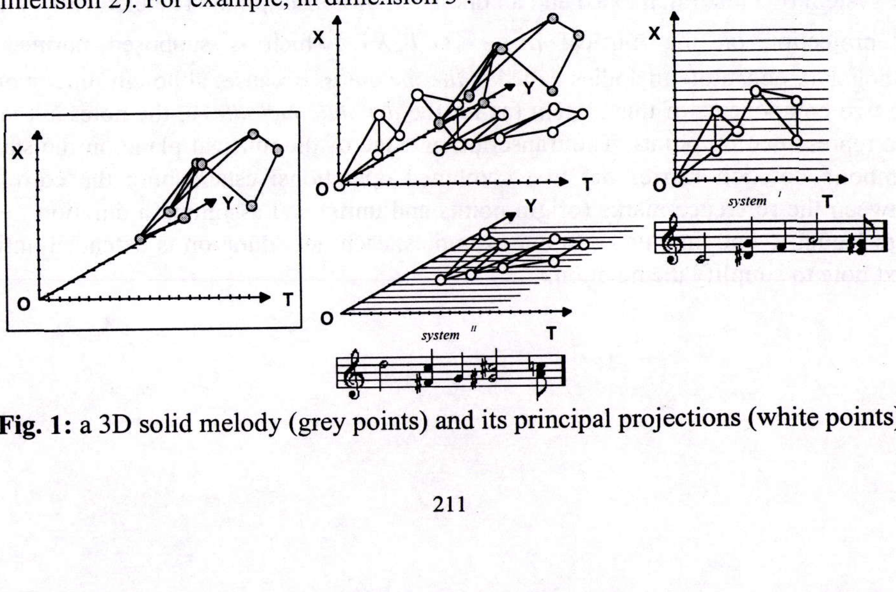


Fig. 1: a 3D solid melody (grey points) and its principal projections (white points)

The solid melodies being purely geometrical objects, it is useful to resort to referential forms which enable us to represent them mentally. If one works on a solid melody, it is practical, from a musical point of view, to find through its projections in reference planes, the elements which musically speak to us, i.e. which expresse the musical planes of the dynamic melodies. In our example, the planes $(O,\vec{T},\vec{X})$ and $(O,\vec{T},\vec{Y})$ restore elements which are musically identifiable. In this representation, each note exists by its precise position in time and in the pitch space. The lines joining music notes do not have any real existence: their function is to point out the correlation links between the notes which emphasizes the organic principle of melody. These links are distinguished from those, chronological, joining the notes of the Schoenberg's row by the fact that, in our case, each note positions is compared to the note which precedes it and the one which follows it, *in the respect of their structural relationships.* One cannot permute nor transpose the notes without basically modifying the integrated structure of the melody. It is necessary to see in this representation a geometry which can be connected with the representations of the structures of molecules used in organic chemistry.

The parameters used by the transposition function are pitch and time. The use of other musical parameters (like the intensity, the instrument choise, the musical form, etc) — in the way that geometrical space approaches it (which means in a complete equivalence) — seems entirely without meaning insofar as these components do not have the same weight in a musical context. The pitch and the time are dominant and present a sufficient coherence: they are united by sound physics (frequency is an number of periods per second). The construction of a system starting from other parameters is theorically possible, but it can be only incongruous for it introduces an inhomogeneousness into the choice of the components.

From a solid melody, the traditional notation in symbolic space is obtained by the association of two elementary operations: a projection of the geometrical space in dimension K on the *musical plane* (indicated by the representation plane, according to the system of Time/Pitch axes) and an operation of transcription. The elements obtained by projection on the musical plane $(O,\vec{T},\vec{X})$, which is supposed normed and orthogonal, constitute melodies called *static melodies,* because, although time is one of the two components of this system (as for the *dynamic melodies*), the notes are virtual and represented by points. The transcription stage of the musical plane on the staff, in symbolic notation carries out two combined operations: establishing the correlation between the reference marks (origin points and units) and assigning a duration to each note (equal to one time unit). In our examples, each note duration is extended until the next note to simplify the notation.

2 Manipulations in Space of a Solid Melody

Once the solid melody is made up, we have geometrical tools to manipulate it, to present it under its various aspects or to make form transformations. These functions can be classified in two categories:

* the nondestructive transformations: they operate on musical material by preserving its internal structure. These functions are divided into two groups:

- *the manipulation functions* (translations, rotations, symmetries). These functions allow to take fully advantage of our material: they move the objects from a place to another, or position them under different angles. They are obtained by the isometries: the links between the notes are respected.

- *the deformation functions* (compression, extension, torsion), which, although maintaining structural cohesion (within critical thresholds), distend the rigid structure of our melody.

* the destructive transformations: they carry out the deterioration of the melodic structure, by a rupture phenomena (interpolation functions between two structures, proliferation functions, algebraic or combinative functions, etc). Although they are generating innovation, these transformations present the disadvantage of destroying our object and its basic structure.

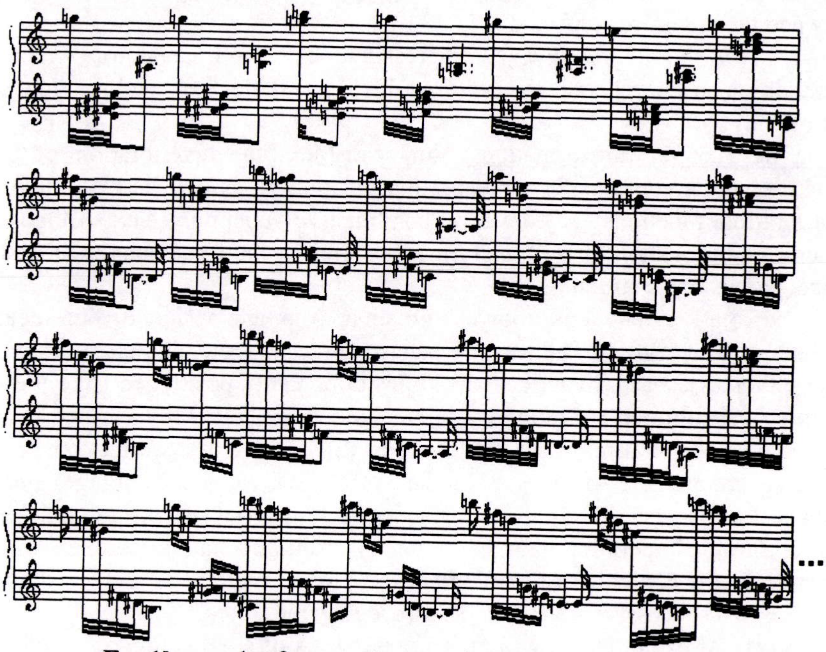
The rotation functions allow to obtain a complete vision of our melody; all its angles can be explored. The rotatory states lead to new melodic elements which can be used either as a basic material for composition, freely positioned (like the elementary symmetrical counterpoint motives), or, positioned one following another, in a controlled process. In the second case, it describes progressive transformations of the basic material, comparable to the use, in the visual field, of the 25 images per second of cinema. In this case, one is in the presence of a material which gradually changes (on the condition of operating with small angles) from one state to another, whose interest depends on the contents of the material itself. If the angles are greater, the relationship between two successive states can be unrecognizable.

In way of example, we will present an extract of a collection of seven preludes for piano written starting from a single solid melody which will be transformed by rotations. In this extract, the melody, made up of chords, seems to gradually disaggregate by the combination of three rotations by an angle of 2° around the three axes. Given that the choice of small angles, each note undergoes a progressive displacement in pitch and position spaces: the dynamic melody arises in increasingly disturbed states compared to the initial motif. The required precision is of the thirty-seconth note, which allows the small displacements of the solid melody to be perceptible. The rotation centre is located on the concert A, in position 5 (at the fifth time unit). At the end of 45 rotations — i.e. for angles equal to (90° 90° 90°) — the chords recomposes itself in the system *II,* in its retrograde inversion. The solid melody is illustrated by the following projections:

System *I*: $(O, \vec{T}, \vec{X})$ System *II*: $(O, \vec{T}, \vec{Y})$

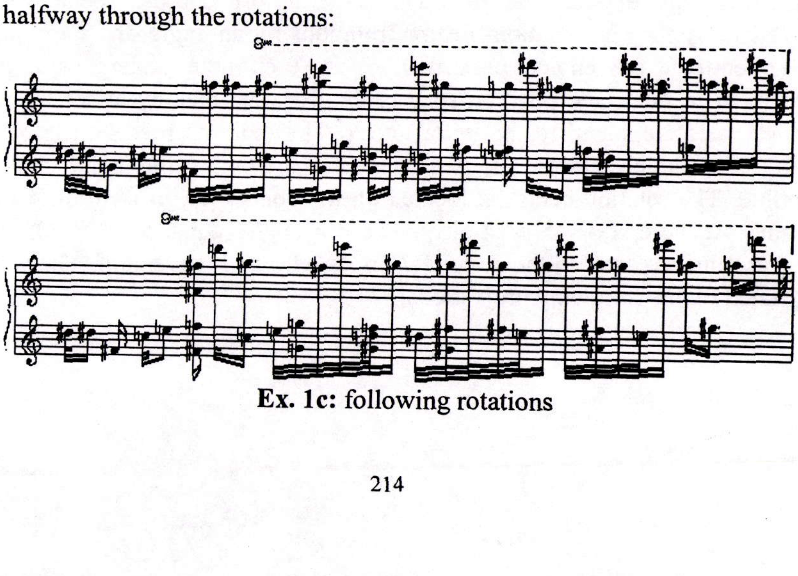
Ex. 1a: basic motives for rotations

Here the beginning of the transformation:



Ex. 1b: result of successive rotations (measures 2 to 5)

... then halfway through the rotations:



Ex. 1c: following rotations

The original motives are unrecognizable here. The transformation continues until the recombination of the inverse chords of the system *II.* This example shows a rather strict *musical kinematics* application. It is possible to develop free applications taking advantage of the following parameters: the three rotation angles, the rotation centres, the pulsation defined as basic unit and the desired pitch precision (semitone, quarter-tone, etc).

3 Conclusion

The solid melody, such as we defined, to be perfectly musically controlled, should not be thought like an ordinary mathematical object. It is necessary to perceive the solid melodies, represented in their geometrical space (in which the axes are equivalent), as *virtual objects* that we can manipulate using data-processing tools and for which the image projected on the musical plane is a simplified representation. The object, by itself, is much richer than its dynamic representation. We have to take advantage of it by the choice of varied visualization states. Indeed, a solid melody, in dimension 3, can already get a quasi-infinity of dynamic representations. This potentiality is inherent in the constitution of the solid melody: the musical composition, in its two dimensions, is a reduced object compared to the virtual object on which we work. It takes into account only a negligible part of it. The manipulation of solid melodies allows to observe our geometrical object under various angles, to feel and emphasize a certain roughness of the material, to accentuate the study of the sides which interest us more particularly, to show its hidden sides, to develop subtle transitions between several visualization states. The rotation functions are presented in the generalization of the counterpoint elementary operations of symmetry. Unlike the traditional counterpoint, in which planar symmetries were limited to four, the multiplicity of the forms obtained by rotations allows to provide more than pre-compositional elements: it opens the specific developments doors, through processings like *musical kinematics*, built on a single basic motif. The kinematic approach, which simulates the movement of melody in the geometrical space, takes part in the evocation of an internal interpolation of its components. One is in the presence of a musical object whose each entity, each note, follows a circular trajectory which seems individual, but which actually moves in a complete and coherent whole.

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