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*Atonal "Modulation" Based on the Diatonic Set*

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Abstract

The present paper proposes a hypothesis that, when we listen to atonal music, we try to refer every pitch-class set to a certain diatonic set. If this hypothesis is correct, it would be possible that calibrated probabilities are assigned to distances, or transpositions, between pitch-class sets on the circle of fifths according to some probabilistic model so that what Richmond Browne calls POSITION FINDINGS are systematically controlled in atonal contexts. In my piece *Dum veneris*, a "modulation" (transposition) of trichords or tetrachords occurs every measure in accordance with Poisson distribution.

key words

## *Atonal "Modulation" Based on the Diatonic Set*

The present paper proposes a hypothesis that, when we listen to atonal pieces, for instance, Igor Stravinsky's *Variations*, we try to refer every pitch-class set, or pc-set for short, to a certain diatonic set.[1] I am aware that this may be a too bold sweeping assumption. Joseph Dubiel (1991), however, suggests: "... a pitch-class-set analysis of any reasonably complex tonal piece ... would be bound to involve a distinction between the diatonic collection as *presented* and the diatonic collection as *referred to*. The possibility of making such a distinction in non-diatonic contexts should be kept in mind." I am not saying that *Variations* is tonal music, but I feel that, even when no diatonic sets are *presented*, they are *referred to*, and both tonal and atonal music share some resources to a certain extent.

Richmond Browne (1981) argues that, when we hear tonal music, we try to FIND OUR POSITION (Metaphorical expressions will henceforth be capitalized) in a particular diatonic set with the help of rare interval classes such as 6 and 1. Since the interval vector of the diatonic set [013568A] is <254361>, that is, "... The six interval-classes occur from one to six times, and each of them a unique number of times [this is called the unique multiplicity property]. This constitutes a full spread of possibilities from 'rarity' to 'common-ness' -- a maximum possible hierarchization.... When one hears a tritone, or a minor second, one's tonal 'knowledge' offers a greater sense of the possible 'places one may be in' than when one hears a relatively common interval (like a fourth or a major second) which could hold any one of a number of 'places' in the diatonic field (Browne, 1981: 6-7).

According to David Butler and Helen Brown (1981) , because of the unique multiplicity property of the diatonic set, we need as few as three pitch-classes to perform POSITION-FINDING. Butler (1989) proposes a Theory of Intervallic Rivalry: "... Any tone will suffice as a perceptual anchor--a tonal center--until a better candidate defeats it. The listener makes the perceptual choice of most-plausible tonic on the basis of style-bound conventions in the time ordering of intervals that occur only rarely in the diatonic set; that is, minor seconds (or enharmonics) and the tritone." In other words, even when we hear a collection of pitches not all of which belong to one diatonic set, if it contains a tritone and another pitch class occurring throughout a certain time span, we may be able to FIND OUR POSITION in a diatonic set *referred to*.

It seems, therefore, that in atonal music, too, we try to find OUR POSITIONS in diatonic sets *as referred to* with the aid of, especially, tritones and minor seconds. While in tonal music we try to find OUR POSITION or DIRECTION in which we are lead to OUR POSITION always with respect to the tonic, which is the absolute referential point and the distance from which can be measured with relative ease because of the unique multiplicity property, in *Variations*, for example, we might find OUR POSITIONS or DIRECTIONS through relative distances among diatonic sets as referred to.

The distances between diatonic sets referred to could be measured by those between the tritones on the circle of fifths, for "... because of its distribution of intervals, the diatonic set provides the fullest possible range of rare and non-rare pitch intersections

[1] Please refer to Rahn (1980) for pitch-class set theory and related music-theoretical terms.

[on the circle of fifths] with which to hierarchize the various transpositions of the set, which thereby hierarchizes nearly relatedness.... the various transpositions are hierarchically related to the referential set by their various common-tone distributions (Browne, 1981: 10)."

Analyzing Stravinsky's *Variations*, let me illustrate next how atonal pitch-organization is related to POSITION-FINDING. Although Stravinsky employed twelve-tone techniques for *Variations* and systematically derived twelve-tone series from the prime series form, he changed some pitch-classes in the series. Example 1 shows the original twelve-tone series used for Section 1 of "Variation 1" and the changed pitch-classes enclosed in boxes.

Prime series form *P*: {D,C,A,B,E,A#,G#,C#,D#,G,F#,F}

| | Chord #: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $r_0RT_0P$= | { | F, | F#, | G, | D#, | C#, | G#, | A#, | E, | B, | A, | C, | D | } |
| $r_BRT_1P$= | { | F, | F#, | D, | C, | G, | A, | D#, | A#, | G#, | B, | C#, | E | } |
| $r_ART_AP$= | { | F, | C#, | B, | F#, | G#, | D, | A, | G, | A#, | [C], | D#, | E | } |
| $r_9RT_2P$= | { | F, | D#, | A#, | C, | F#, | C#, | B, | D, | E, | G, | G#, | A | } |
| $r_8RT_4P$= | { | F, | [C], | D, | G#, | D#, | C#, | [E], | F#, | A, | A#, | B, | G | } |
| $r_7RT_9P$= | { | F, | G, | C#, | G#, | F#, | A, | B, | D, | D#, | E, | C, | A# | } |

**Example 1**

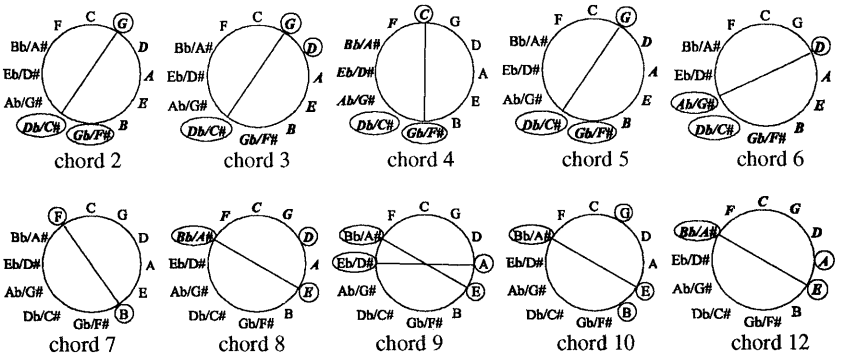
As a result of the change, special emphasis is placed on tritones as shown in Example 2. For example, {C} in chord 2 in the original series is moved to chord 1 so that there remains only one tritone in chord 2. Note the prominent 3-5s and their tritones, that is, {G, C#} in chord 2 and chord 3, {F#, B#} in chord 4, {G, C#} in chord 5, {G#, D} in chord 6, and {A#, E} in chord 12. Paul Schuyler Phillips (1984) points out the parallel motions of tritones {B, F}, {A#, E}, and {A, D#} in mm. 2-4. It should also be noticed that at least one of the pitch-classes in each dyad, except for that in chord 10, is placed in outer voice.

| Measure: | 1 | | | | | | 2 | 3 | 4 | 5 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chord #: | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Tn/TnI: | | 4-z15 | 5-16 | 5-29 | 5-14 | 4-8 | 5-15 | 5-26 | 6-z38 | 5-z36 | 5-11 | 5-29 |
| Subset: | | 3-5 | 3-5 | 3-5 | 3-5 | 3-5 | 3-5 | 3-8 | 3-5 | 3-5 | 3-1 | 3-5 |
| | | | | [C#] | C# - D | | | | | | | |
| | [C] | F# | D | B# | F# | A | B | D | E | B | B# | E |
| | F | C# - G | | F# | G - G# | | [F] - E - | | D# | E | C# | A |
| | | G - C# | | | | | B - A# | | A# | A# | | A# |
| | | | | | | | | | A | G | B | |

**Example 2** [2]

[2] Names of Tn/TnI type pc-sets are taken from Forte (1973).

Example 3 illustrates that, in Section 1 of "Variation 1," those tritones given special salience appear one after another and the diatonic collections referred to by the tritones, which are in boldface and underlined, quickly change, or are transposed or "modulated." Especially, after two conflicting tritones {A, D#} and {A#, E} in chord 9, chord 12 sounds to imply C scale on F, because of tritone {E, A#} in outer voices and subsequent low C in measure 6.




**Example 3**

Section 1 of "Variation 1" is certainly not tonal. However, not only Stravinsky's atonal music but also those of such composers as Anton Webern and Béla Bartók exhibit similar pitch-organization with respect to tritone so that diatonic sets can be referred to and some directed motions, or POSITIONS TO BE FOUND, are felt. In tonal music, because of the unique multiplicity property, "the various transpositions [or "modulations"] are hierarchically related to the referential set [in the tonic key] by their various common-tone distributions" (Browne 1981). In some kinds of atonal music, diatonic sets referred to are, of course, not related to a single referential diatonic set, but neighboring ones in time are related to each other only in terms of their relative distance on the circle of 5ths. For example, the transpositional relations $T_7$ between {C#, G, D} in chord 3 and {G#, D, A} in chord 6 and $T_0$ between {G, C#, F#}s in chords 2 and 5 are easily audible.

Thus I would like to regard the chromaticism in this piece as quick transpositions, or "modulations," of pc-sets each of which consists of one tritone and different accompanying pitch-classes, or sub-collections of a diatonic set determined by a tritone plus some notes. In the case of Section 1 from Stravinsky's *Variations*, prominent 3-5s, which are deliberately arranged by Stravinsky and contain one tritone and another pitch-class that constitutes a minor second, may be able to help us find directions and positions.

Consequently, if the proposed hypothesis is correct, DIRECTED MOTIONS, or DIRECTIONS we follow while hearing, in Stravinsky's piece might be due to implications of POSITIONS TO BE FOUND. As the preliminary analysis has demonstrated, in "Variation 1," different tritones such as {E, A#} and {D, G#} appear one after another and are given special prominence. Therefore, the diatonic sets referred to by those tritones differentiate those pc-sets or pitch-classes that would enhance the

directions towards the diatonic sets from the others that would cause redirection. As Browne suggests, because of the unique multiplicity property, the degrees of this change in direction , or change in subjective probability, vary according to distances between these two types of pc-sets or pitch-classes on the circle of fifths. It seems, therefore, possible that calibrated probabilities are assigned to distances between pc-sets on the circle of fifths according to some probabilistic model so that our POSITION FINDINGS are systematically controlled in atonal contexts.

In my piece *Dum veneris*, a "modulation" (transposition) of trichords or tetrachords occurs every measure in accordance with Poisson distribution, $P(x)=e^{-h}h^x/x!$ for x=0, 1, 2,..., where h is the mean and x is a random variable. The mean is altered every section. In addition, the velocity of modulation (the number of modulations per section) is also changed in some sections with negative, 0, or positive accelerations so that those trichords and tetrachords exploit throughout the entire piece various relationships on the circle of fifths and induce various ways of FINDING POSITIONS.

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