Registral Constraints on All-Interval Rows in Elliott Carter's *Changes*

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Initial Considerations

One of the most widely discussed features of Elliott Carter's pitch language is his use of registrally-ordered *all-interval rows*.[1] To illustrate, Example 1 displays the pitches that open Carter's *Night Fantasies* (1980) for piano. In addition to the symmetrical arrangement of complementary unordered pitch intervals shown below the staff, a striking feature of this row's pitch realization is the wide range it covers—5½ octaves.[2]

Much of Carter's music written since *Night Fantasies* features all-interval rows whose pitches span 5½ octaves.[3] As such, it should come as little surprise that most of the literature on Carter's use of these rows treats compositions whose performing forces can accommodate this range.[4] Indeed, Carter's own comments attest to the significance of this feature. He describes the motivation behind his use of rows (he calls them "chords") like that in Example 1 as "a desire to have chords that are spread over a large range and use all twelve notes," and further states, "the chords I used in *Night Fantasies* worked very well because they covered a broad range."[5]

However, the identity of all-interval rows in Carter's music seems to be so closely associated with the 5½ octave range that their presence in pieces for instruments that cannot accommodate this range has not been given full consideration. For instance, while

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[1] On Carter's use of all-interval rows, see Bernard 1983, Harvey 1989, Heinemann 2001, Koivisto 2004, Link 1994, Mead 1983–84; 1995, Sallmen 1998, Schiff 1998, and Scotto 1990. For general background on all-interval rows, see Bauer-Mengelberg and Ferentz 1965, Morris 2001, 151–153, and Morris and Starr 1974.

[2] Hereafter I use the following abbreviations: upi (unordered pitch interval); opi (ordered pitch interval); p-space (pitch-space); pc (pitch class); sc (set class); ic (interval class).

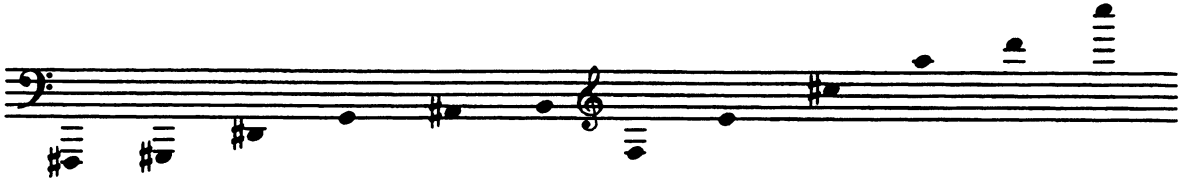
[3] Heinemann 2001, Koivisto 2004, 159, and Schiff 1998, 214 all make this point.

[4] Cf. the literature cited in note 1.

[5] The first quote is from an interview I conducted with Carter (New York, May 22, 1996); the second is from Restagno 1989, 82.

Example 1. Carter, Night Fantasies, *pitches in mm. 3–8.*

Range: 5 ½ octaves



Symmetrical arrangement of complementary unordered pitch intervals:

2 7 4 3 1 6 E 9 8 5 T

all-interval rows figure prominently in Carter's *Changes* (1983) for guitar, David Schiff describes the work as "*exclusively* based on hexachordal harmony."[6] And in addition to *Changes*, a number of works by Carter use all-interval rows without the 5½ octave range since the instrumental forces of these works cannot accommodate this range; these works include *esprit rude/esprit doux* (1984) for flute and B♭ clarinet and *Enchanted Preludes* (1988) for flute and 'cello.[7] Unfortunately, the literature on these pieces skirts a fundamental question: How does Carter alter the pitch realization of the rows to "fit" the smaller range at hand?

Changes, the focus of this article, provides an ideal opportunity to answer this question. Cast in one movement and only seven minutes in duration, Schiff singles out *Changes* as "an excellent introduction to the harmonic procedures which support Carter's later works."[8] This article gathers the five all-interval rows that appear in *Changes* and codifies the techniques that Carter uses to realize them in p-space, thus clarifying an essential component of his mature compositional style. In discussing the rows, I pay particular attention to their interaction with the piece's phrasing slurs and form.[9]

To frame the key issues that this paper shall explore, Example 2 reproduces an excerpt from *Changes*.[10] The aggregate appears in the form of a descending hexachord H1 = ⟨D, C, F, E, G, D♯⟩ followed by an ascending hexachord H2 = ⟨G♯, F♯, B, A♯, C♯, A⟩. By placing H1 first and retrograding H2, an all-interval row emerges, which I label Row 5 (because it is the fifth row to appear in the piece): ⟨D, C, F, E, G, D♯, A, C♯, A♯, B, F♯, G♯⟩.[11] Row 5 is similar to

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[6] Schiff 1998, 137; emphasis added.

[7] On *esprit rude/esprit doux*, see Schiff 1988, 5; 1998, 139–141; and Truniger 1998. On *Enchanted Preludes*, see Roeder 2006, Schiff 1988, 12–13; 1998, 141–142; and Whittall 1997, 161–168.

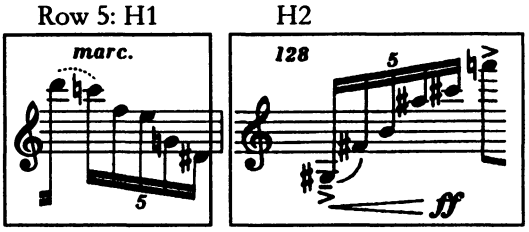
[8] Schiff 1998, 138.

[9] Following Kurth 1992, 188, I take phrasing slurs to indicate "distinct sections, usually several bars in length, in the music's large scale form."

[10] The guitar sounds one octave lower than written; references to guitar pitches employ concert pitch. Excluding harmonics, the range is forty-three semitones (E2–B5).

[11] Three aspects of Example 2 warrant discussion. First, if H1 or H2 is not retrograded, the row does not form the type of row under study. Second, an

Example 2. Carter, Changes, *mm. 127–128.*



H1 = ⟨D, C, F, E, G, D♯⟩
H2 = ⟨G♯, F♯, B, A♯, C♯, A⟩
H1 + R(H2) = ⟨D, C, F, E, G, D♯, A, C♯, A♯, B, F♯, G♯⟩ = Row 5

the *Night Fantasies* row in two respects: the discrete (non-overlapping) hexachords in both rows relate by T6, and each row presents a symmetrical arrangement of complementary upis. But whereas the pitches realizing the *Night Fantasies* row span 5½ octaves, the pitches realizing Row 5 span three octaves and a semitone. If H2 of Row 5 were to continue the descent started by H1, H2 would go beyond the lowest pitch of the guitar. Perhaps for this reason, H2 appears three octaves higher than it would had Carter continued the descent. A second distinctive feature of Row 5's pitch realization is Carter's use of open strings to facilitate large leaps. In H1, E4 and G3 separate F4 and D♯3, while in H2, B3 separates F♯3 and A♯4. These two aspects of Row 5's pitches—the pitch transposition of a hexachord to fit the range of the instrument, and the use of open strings to facilitate large leaps—are essential to Carter's pitch realizations of all-interval rows in *Changes.*

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equally plausible alternative analysis for this passage (and others in this paper) involves placing the retrograde of H2 (hereafter R(H2)) first, followed by H1. This yields the row ⟨A, C♯, A♯, B, F♯, G♯, D, C, F, E, G, D♯⟩. Likewise, one might place R(H1) first, followed by H2. This yields the retrograde of the latter row. Finally, an anonymous reader graciously pointed out that Row 5 can be described as a succession of two registrally ordered hexachords: H1 = ⟨D♯, G, E, F, C, D⟩ and H2 = ⟨G♯, F♯, B, A♯, C♯, A⟩. This eliminates the need to retrograde one hexachord and not the other. However, this retrogrades *both* hexachords and does not always reveal an all-interval row, as in Examples 5a and 7.

But before codifying these techniques, it is fitting to begin with a brief review of the all-interval rows that Carter employs.

RT6-Rows

The rows in Examples 1 and 2 belong to a family of eighty-eight all-interval rows that are invariant under retrogression followed by T6 (or T6 followed by retrogression). I refer to this type of invariance as *RT6 invariance.* Example 3 lists the interval succession (henceforth *INT*) for each RT6-row.[12] The first column lists the number of the INT as it appears in Carter's *Harmony Book.*[13] The second column gives the INT of the row. Every INT in Example 3 is invariant under retrograde inversion, and complementary upis occupy complementary order positions around a central upi 6. The third column provides the Forte number and prime form of the hexachord formed by the first five (or last five) upis of the INT.

All RT6-rows exhibit three main properties.[14] First, they arrange pitches symmetrically such that the first and twelfth pitches form an ic6, as do the second and eleventh, third and tenth, fourth and ninth, fifth and eighth, and sixth and seventh. Second, as a result of this arrangement of ic6s, the discrete hexachords of every RT6-row must belong to a sc that contains every ic *except* ic6. Four scs satisfy this property: 6-1[012345], whose interval vector is ⟨543210⟩; 6-8[023457], whose interval vector is ⟨343230⟩; 6-14[013458], whose interval vector is ⟨323430⟩; and 6-32[024579], whose interval vector is ⟨143250⟩.[15] I shall refer to these four scs as the *Collection 1 scs* (hereafter *C1 scs*). Third, because each upi from 1 to 11 appears once between adjacent pitches of an RT6-row, and

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[12] The INT lists the successive upis between adjacent pitches in the row (Morris 1987, 40). Heinemann 2001 and Carter 2002, 54, show that Carter treats the INTs in Example 3 as upis, not as pc intervals.

[13] Carter 2002, 57.

[14] The following paragraph is based on Mead 1995, Morris 2001, 152, and Morris and Starr 1974.

[15] 6-1, 6-8, and 6-32 are all-combinatorial hexachords, but Carter does not exploit this property in *Changes.*

Example 3. The INT for each RT6-row.

Carter #	INT	Forte #
1	274316E985T	6-14[013458]
2	134726T589E	6-14[013458]
3	274916E385T	6-14[013458]
4	194726T583E	6-1[012345]
5	4523E619T78	6-8[023457]
6	19T7864523E	6-8[023457]
7	4529E613T78	6-14[013458]
8	13T7864529E	6-14[013458]
9	589T16E2347	6-14[013458]
10	1T98567432E	6-14[013458]
11	583T16E2947	6-1[012345]
12	1T38567492E	6-1[012345]
13	347216ET589	6-8[023457]
14	127436985TE	6-8[023457]
15	385TE612749	6-1[012345]
16	127496385TE	6-1[012345]
17	3T7816E4529	6-14[013458]
18	187T369254E	6-14[013458]
19	3254E6187T9	6-8[023457]
20	187T963254E	6-8[023457]
21	529416E83T7	6-14[013458]
22	1492567T38E	6-14[013458]
23	523416E89T7	6-32[024579]
24	1432567T98E	6-32[024579]
25	3E8726T5419	6-32[024579]
26	278E369145T	6-32[024579]
27	3145T6278E9	6-14[013458]
28	278E963145T	6-14[013458]
29	491726T5E38	6-8[023457]
30	27194683E5T	6-8[023457]
31	431726T5E98	6-14[013458]
32	27134689E5T	6-14[013458]
33	4137T6259E8	6-14[013458]
34	259E864137T	6-14[013458]
35	4197T6253E8	6-32[024579]
36	253E864197T	6-32[024579]
37	413526T79E8	6-14[013458]
38	2531468E97T	6-14[013458]
39	419526T73E8	6-32[024579]
40	2591468E37T	6-32[024579]
41	4E5326T9718	6-14[013458]
42	235E468179T	6-14[013458]
43	4E5926T3718	6-14[013458]
44	295E468173T	6-14[013458]

Carter #	INT	Forte #
45	45E926T3178	6-14[013458]
46	29E5468713T	6-14[013458]
47	45E326T9178	6-14[013458]
48	23E5468719T	6-14[013458]
49	497126TE538	6-14[013458]
50	217946835ET	6-14[013458]
51	437126TE598	6-8[023457]
52	217346895ET	6-8[023457]
53	358126TE479	6-14[013458]
54	218536974ET	6-14[013458]
55	374ET621859	6-1[012345]
56	218596374ET	6-1[012345]
57	538ET621497	6-14[013458]
58	214976538ET	6-14[013458]
59	598ET621437	6-32[024579]
60	214376598ET	6-32[024579]
61	4791T62E358	6-14[013458]
62	2E35864791T	6-14[013458]
63	4731T62E958	6-1[012345]
64	2E95864731T	6-1[012345]
65	479E26T1358	6-14[013458]
66	2E97468531T	6-14[013458]
67	473E26T1958	6-1[012345]
68	2E37468591T	6-1[012345]
69	4ET73695218	6-14[013458]
70	37TE4681259	6-14[013458]
71	4ET79635218	6-14[013458]
72	3521864ET79	6-14[013458]
73	5TE83694127	6-8[023457]
74	38ET5672149	6-8[023457]
75	5TE89634127	6-32[024579]
76	3412765TE89	6-32[024579]
77	54E2369T187	6-14[013458]
78	32E456781T9	6-14[013458]
79	54E2963T187	6-8[023457]
80	3T187654E29	6-8[023457]
81	45T1369E278	6-14[013458]
82	31T546872E9	6-14[013458]
83	45T1963E278	6-14[013458]
84	3E278645T19	6-14[013458]
85	592E4681T37	6-8[023457]
86	4E295673T18	6-8[023457]
87	4E235679T18	6-14[013458]
88	532E4681T97	6-14[013458]

since 1 + 2 + 3 ... + 10 + 11 = 66, every RT6-row can be realized in p-space with a span of 5½ octaves.[16]

When an RT6-row spans 5½ octaves in p-space, it exhibits what Robert Morris calls *minimal spacing*, in which "the intervals between successive pitches of the pitch set are equal to the INT of the pc-space segment."[17] For example, the INT of the row in Example 1 is ⟨274316E985T⟩. Since Carter has realized the INT in p-space with the opis ⟨+2, +7, +4, +3, +1, +6, +E, +9, +8, +5, +T⟩, we know that Example 1 exhibits minimal spacing. Likewise, if the INT is realized with the opis ⟨-2, -7, -4, -3, -1, -6, -E, -9, -8, -5, -T⟩, the resultant pitches will exhibit minimal spacing. Because Carter treats each INT and its retrograde as equivalent, there are two additional pitch realizations for the INT in Example 1: ⟨+T, +5, +8, +9, +E, +6, +1, +3, +4, +7, +2⟩ and ⟨-T, -5, -8, -9, -E, -6, -1, -3, -4, -7, -2⟩. Carter treats the remaining INTs in Example 3 identically. As the notion of minimal spacing is crucial to Carter's handling of RT6-rows in *Changes*, we shall regard the minimal spacing of 5½ octaves as a reference point against which to gauge the pitch realizations of RT6-rows in *Changes*.

Form and Pitch Material in *Changes*

The form of *Changes* divides into six sections on the basis of rests, double bars, tempo changes, dynamics changes, texture changes, phrasing slurs, and/or performance directions. The sections are: Introduction (mm. 1–13; ♩ = ca. 100 b.p.m.), Episodes (mm. 14–88; same tempo), Scherzando (mm. 89–110; same tempo; *subito leggero e scherzando; leggero sempre; scherzando*), Climax (mm. 110–114; ♩ = ca. 125 b.p.m.), a second set of

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[16] Bauer-Mengelberg and Ferentz 1965, 93–94. A familiar example of an RT6-row that does *not* span 5½ octaves in p-space is found in Berg's *Lyric Suite*, where, in mm. 2–4, the first violin plays ⟨F4, E4, C5, A4, G5, D5, A♭5, D♭5, E♭5, G♭4, B♭4, B3⟩. The interval from the lowest pitch to the highest pitch (B3–A♭5) is twenty semitones, but each upi from 1 to 11 occurs once, in the succession ⟨183T567294E⟩. In pc-space, the row ⟨5409728136TE⟩ realizes the INT ⟨E89T7652341⟩, no. 24 on Carter's list.

[17] Morris 1987, 344. Minimal spacing is somewhat akin to "close position" voicings in tonal harmony, in which the upper voices of a chord are as close to one another as possible.

Episodes (mm. 115–130; ♩ = ca. 100 b.p.m.), and Coda (mm. 131–150; ♩ = 67 b.p.m.; *lento tranquillo, molto espressivo*). The C1 scs along with the all-trichord hexachord 6-Z17[012478] and its Z-partner 6-Z43[012568] provide the pitch material for *Changes*. The RT6-rows relate to the C1 scs to the extent that each row combines T6-related pcsets from a single C1 sc.[18] But the RT6-rows also have a life of their own, as the following analyses demonstrate.

RT6-Rows in *Changes*

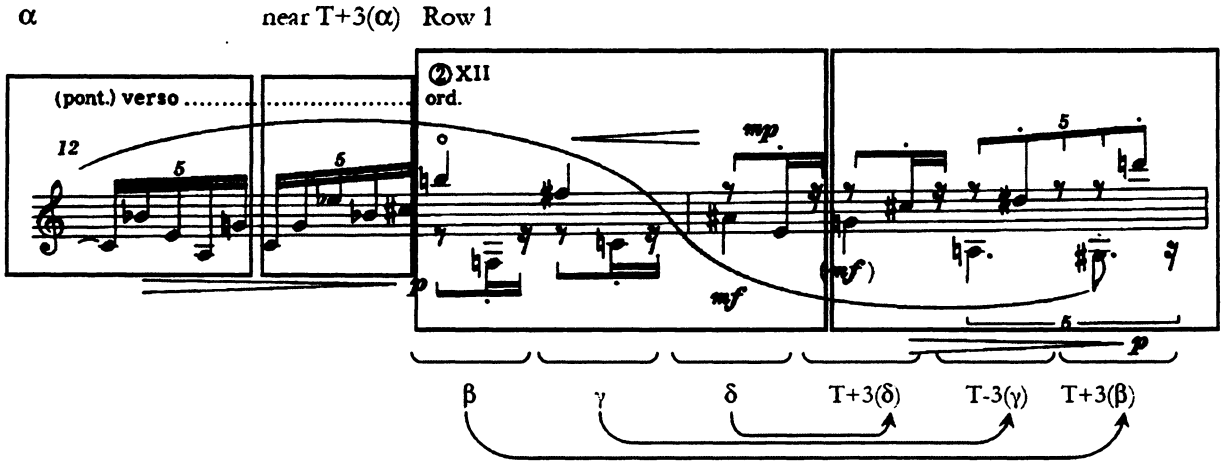
To realize RT6-rows in p-space in *Changes*, Carter employs two techniques:

- **Technique 1: The pitch transposition of one or more pitches of H1 or H2 by one or more octaves to accommodate the range of the guitar.**
  If all of H1 or H2 is transposed by one or more octaves, H1 and H2 will both exhibit minimal spacing, but the entire row will not, since the opi separating H1 and H2 will not be +6.
- **Techniques 2a and 2b: The use of harmonics (2a) or open strings (2b) to facilitate transitions across the fretboard.**
  These techniques allow a pitch to sound after the fretting hand has been lifted in a manner akin to the use of the damper pedal on the piano (2a), or without the use of the fretting hand at all (2b).

Example 4a displays the first RT6-row to appear in *Changes*. The formal placement of Row 1 is conspicuous: it occurs at the end of a phrasing slur at the close of the Introduction. The articulations and durations suggest a polyphonic hearing of Row 1 in two voices. The first voice, consisting of descending unmarked pitches traced by the phrasing slur, projects H1 = ⟨B, F♮, A♮, G, A, G♮⟩. The second voice, consisting of shorter ascending *staccato* pitches, projects H2 = ⟨F, C, E, C♯, D♮, D⟩. H1 and H2 form T6-

[18] This could be what Schiff means when he says that *Changes* is "exclusively based on hexachordal harmony" (1998, 137). However, his analysis of *Changes* mentions neither RT6-rows nor aggregate formations of any type.

Example 4a. Changes, *mm. 12–13.*



H1 = ⟨B, F♯, A♯, G, A, G♯⟩
H2 = ⟨F, C, E, C♯, D♯, D⟩
H1 + R(H2) = ⟨B, F♯, A♯, G, A, G♯, D, D♯, C♯, E, C, F⟩ = Row 1

related 6-1s.[19] By placing H1 first and retrograding H2, Row 1 emerges: ⟨B, F♯, A♯, G, A, G♯, D, D♯, C♯, E, C, F⟩. The INT of Row 1 is ⟨7492E61T385⟩ (no. 11).

The pitch realization of Row 1 employs Techniques 1 and 2a. Technique 1 is evident in the upi 30 that separates the first pitch of R(H2) (D5) from the last pitch of H1 (G♯2). Technique 2a is evident in the Roman numeral "XII" and the circled Arabic numeral 2 above B4, which indicate that B4 is to be played as a harmonic on the twelfth fret of the second string. Carter likely does this to ease the transition to F2. Without the harmonic, the distance from B4 to F2 is a minimum of six frets, a large stretch that few, if any, guitarists can accomplish. Instead, most guitarists would cut B4 short to reach F2 on time, blurring the distinction between H1 and H2. The harmonic allows B4 to sustain while the fretting hand leaps down to F2.

The order of Row 1's pitches on the musical surface pairs the first pitch (B4) with the twelfth pitch (F2), followed by the second pitch (F♯4) with the eleventh pitch (C3), and so on. The pattern concludes when the sixth pitch (G♯2) pairs with the seventh pitch (D5), joining each pitch with its ic6 partner. The order of the pitches also reflects the influence of two p-space transpositions, T+3 and T-3. The passage opens with two pentachords labeled in the score α and "near T+3 α," indicating that all but one of the pitches in α is transposed three semitones higher in p-space (the remaining pitch, C3, is transposed fifteen semitones higher, to E♭4). Row 1 then presents two pairs of dyads (δ and β) and their T+3 transpositions, plus another dyad (γ) and its T-3 transposition.[20]

Carter has composed Row 1 such that different segmentations reveal members of other C1 scs. The upstem/downstem hexachords ⟨B, F♯, E, C♯, D♯, D⟩ and ⟨F, C, A♯, G, A, G♯⟩ form T6-related 6-8s, and the discrete hexachords formed by all twelve pitches ordered from low to high, ⟨F, G♯, A, C, E, G, A♯, C♯, D♯, F♯, B, D⟩, form T6-related 6-14s. Neither of these rows, however, is an RT6-row. This remarkable range of reference will be evident in Rows 2, 3, and 5 as well.

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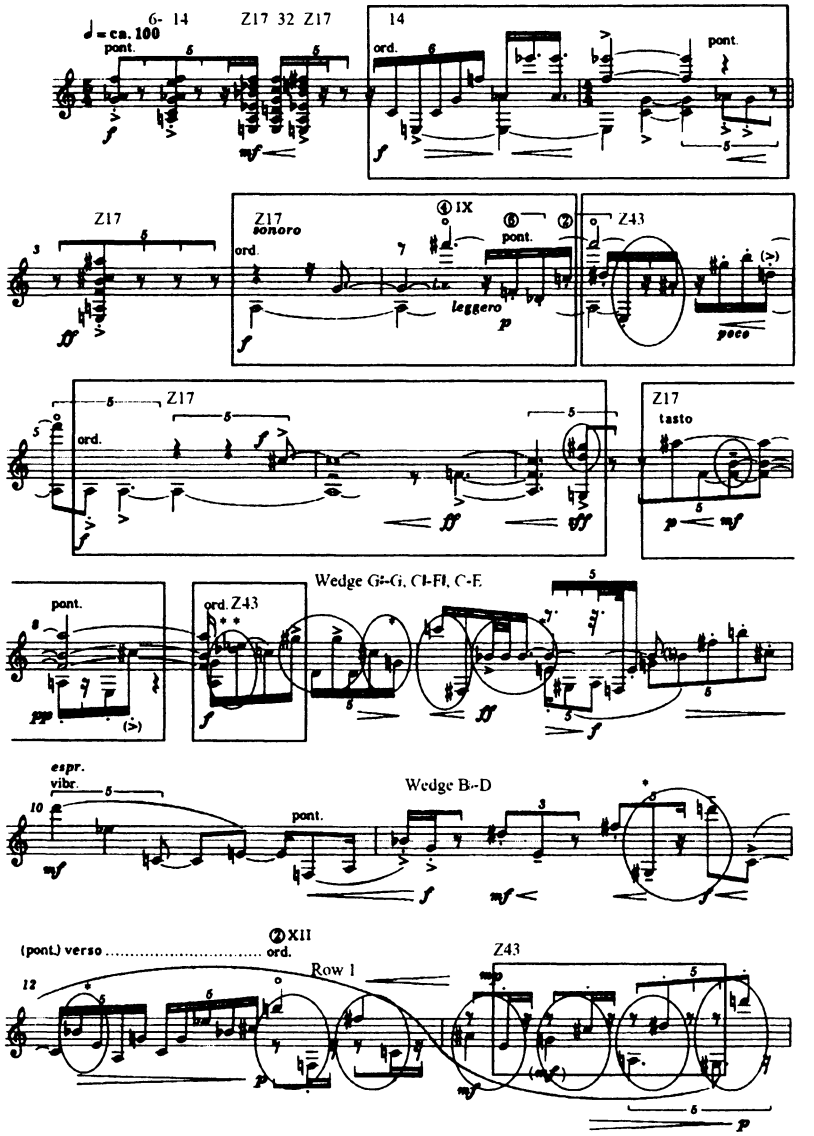
[19] "T6-related 6-1s" is shorthand for "T6-related pcsets that form members of sc 6-1[012345]."

[20] If pitch order is taken into account, the transpositions are RT+3 and RT-3.

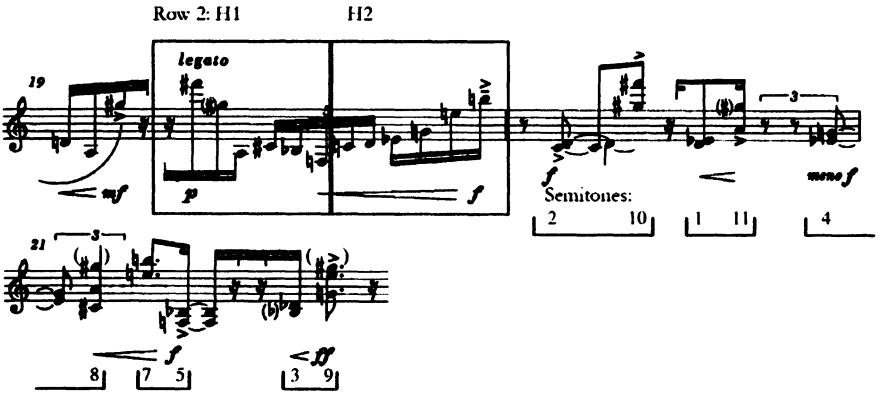
Example 4b. Changes, *mm. 1–13.*

Circles indicate ic6s

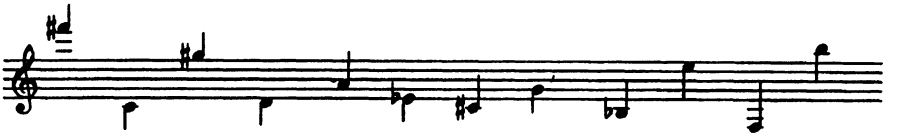
* indicates ic6s whose pitches appear in Row 1



Example 5a. Changes, *mm. 19–21.*



H1 = ⟨F♯, G♯, A, C♯, B♭, F⟩
H2 = ⟨C, D, E♭, G, E, B⟩
H1 + R(H2) = ⟨F♯, G♯, A, C♯, B♭, F, B, E, G, E♭, D, C⟩ = Row 2



Wedge inward F♯-E♭
Wedge outward C♯-B
Upstem pitches: H1 of Row 2 (with A3 not A2)
Downstem pitches: H2 of Row 2

Example 4b shows how Row 1 completes two musical processes that span the Introduction.[21] One process involves the gradual emergence of ic6s, circled on the example.[22] The second process involves melodic contours that wedge inward or outward. The wedges differ from the well-known wedges found in Bartók's music in two respects: they are not symmetrical in p-space (and thus there is no central pitch axis) and the wedging is not semitonal.[23] After a lone ic6 in m. 4, two ic6s appear in m. 7. Five ic6s then follow, set to overlapping wedges: the inward wedge ⟨G♯4, D3, C♯4, G3⟩, the outward wedge ⟨C♯4, G3, C5, F♯2⟩, and the inward wedge ⟨C5, F♯2, B♭3, E3⟩. A seven-pitch outward wedge follows in m. 11, from B♭3 to the ic6 ⟨G♯2, D5⟩. After a fleeting ic6 at the outset of m. 12, Row 1 wedges inward from B4 to E3, then outward from G3 to D5 as all six ic6s unite. The Introduction concludes with the last pitch of Row 1, as a shift from single notes to dyads announces the Episodes.

Example 5a illustrates Techniques 1 and 2b in the second RT6-row to appear in *Changes*.[24] Boxes isolate the row ⟨F♯, G♯, A, C♯, B♭, F, C, D, E♭, G, E, B⟩. H1 and H2 form T6-related 6-14s. By placing H1 first and retrograding H2, Row 2 emerges (no. 58). In registral ascent, the discrete hexachords ⟨F, A, B♭, C, C♯, D⟩ and ⟨E♭, G, E, G♯, B, F♯⟩ form a second pair of T6-related 6-14s, but their union does not form an RT6-row. Technique 2b is evident in H1's pitch A2 which, to create a descending contour, "should be" A3.[25] A2 likely stands in for A3 since A2 is an open string, which facilitates the leap from G♯4 to C♯3. This perhaps explains why H1 "hits a bump" at ⟨A2, C♯3, B♭2⟩.

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[21] The examples label members of C1 scs, 6-Z17, and 6-Z43. More extensive analyses of the passages in Exx. 4–11 appear in Capuzzo 2000 and 2004.

[22] I exclude ic6s within strummed hexachords.

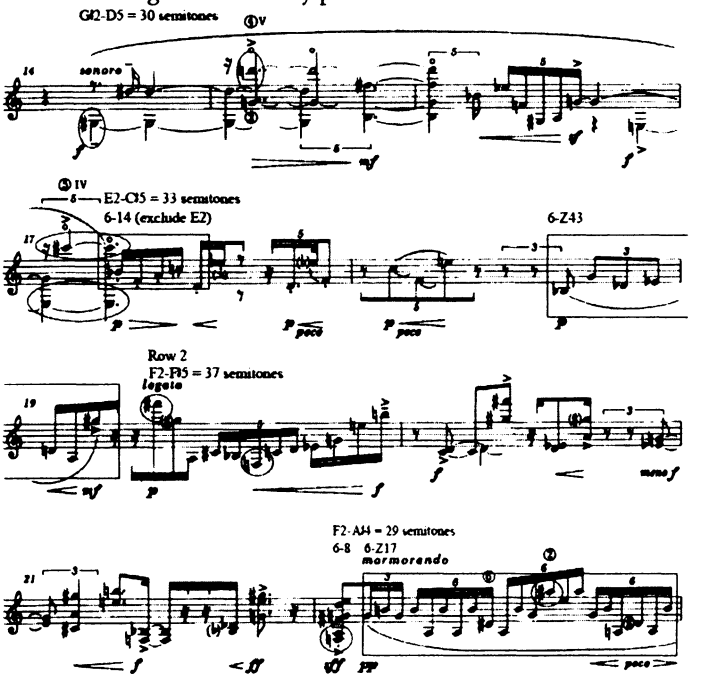
[23] Carter describes his aversion to symmetrical pitch constructs in Bernard 1990, 203. On Carter's use of wedges, see Capuzzo 2000, 64–65; 229–231 and Sallmen 1998, 81.

[24] In the examples, parentheses exclude a note/s from the sc or row at hand.

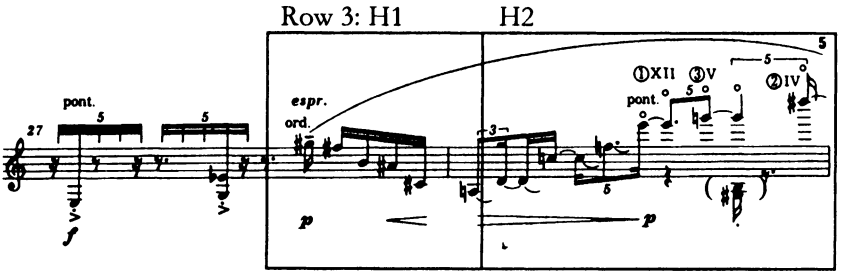
[25] Taking A3 instead of A2 yields T6-related 6-8 discrete hexachords: ⟨F, B♭, C, C♯, D, E♭, G, A, E, G♯, B, F♯⟩.

Example 5b. Changes, *mm. 14–22.*

Circles indicate registral boundary pitches



Example 6. Changes, *mm. 27–28.*



H1 = ⟨G♯, F♯, B, A♯, C♯, A⟩
H2 = ⟨D, C, F, E, G, D♯⟩
H1 + R(H2) = ⟨G♯, F♯, B, A♯, C♯, A, D♯, G, E, F, C, D⟩ = Row 3

Both Row 2 and the chords that follow it present ten of the eleven upis, making the all-interval property of Row 2 explicit. On Example 5a, the number of semitones in each chord appears below the staff. Adjacent chords present complementary upis, which are bracketed: 2 then 10, 1 then 11, 4 then 8, 7 then 5, and 3 then 9. Two factors imply the missing upi 6: the T6 relation between H1 and H2, and the pc content of adjacent chords. This emerges by pairing C from the {C, D} dyad with F♯ from {G♯, F♯}, followed by D from {C, D} with G♯ from {G♯, F♯}. At this point, note repetitions creep in, obscuring the prototype somewhat, but the pattern is still discernible: E♭ pairs with A (notice that the "correct" A3 has replaced A2); G with C♯; E with B♭; and B with F. The bottom of Example 5a shows how the dyads suggest the non-all-interval row ⟨F♯5, C3, G♯4, D3, A3, E♭3, C♯3, G3, B♭2, E4, F2, B4⟩, which features wedging contours (in from F♯ to E♭ and out from C♯ to B) and ic6s as did Row 1.

Row 2 shares two additional features with Row 1. First, both (single note) rows precede dyadic passages. Second, Rows 1 and 2 each expand the range of their respective passages. Example 5b reveals how Row 2 accomplishes the registral expansion; circles indicate registral boundary pitches. In m. 14 (right after Row 1), the p-space range is thirty semitones (G♯2–D5). The first expansion occurs with E2–C♯5 (m. 17, thirty-three semitones). Finally, the p-space range peaks at thirty-seven semitones with the lowest and highest pitches of Row 2 (F2–F♯5). After Row 2, the p-space range contracts to twenty-nine semitones (F2–A♯4, m. 22).

Example 6 highlights the use of Technique 1 in Row 3. A phrasing slur binds the descending H1 = ⟨G♯, F♯, B, A♯, C♯, A⟩ to the ascending H2 = ⟨D, C, F, E, G, D♯⟩,[26] which form T6-related 6-8s. By placing H1 first and retrograding H2, Row 3 emerges: ⟨G♯, F♯, B, A♯, C♯, A, D♯, G, E, F, C, D⟩. In registral ascent, the discrete hexachords ⟨A, C♯, D, A♯, B, C⟩ and ⟨F, F♯, G♯, E, G, D♯⟩ form T6-related 6-1s but do not create an RT6-row.[27]

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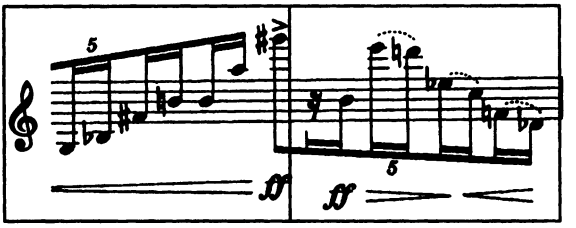
[26] The slur terminates at D♯6. These hexachords appeared in Row 5 (Example 2); I shall return to this point.

[27] The {G♯2, B2} dyad below the high ringing harmonics launches a type of texture that David Starobin (the work's dedicatee) calls "little duets," a texture

Example 7. Changes, *m. 105.*

Row 4: H1 H2



H1 = ⟨G, B♭, F♯, B, A, G♯⟩
H2 reordered = ⟨D, E♭, F, C, E, D♭⟩
H1 + H2 reordered = ⟨G, B♭, F♯, B, A, G♯, D, E♭, F, C, E, D♭⟩ = Row 4

Example 7 presents Row 4. The passage opens with H1 = ⟨G, B♭, F♯, B, A, G♯⟩, a 6-1. The INT of H1 is ⟨385TE⟩, which begins the INT ⟨385TE612479⟩ (no. 15). T6 of H1 follows, but it does not realize the INT ⟨12749⟩ with H2 = ⟨D, E♭, F, C, E, D♭⟩ as we might expect. Instead, H2 appears as ⟨E, D, E♭, C, F, D♭⟩, perhaps to permit the descending slurs from E to D, E♭ to C, and F to D♭; such slurs are not possible with the proper ordering. But despite the reordering, the ascending/descending contours of H1 and H2 relate Row 4 to the other rows, and the pc content of H2 remains intact.[28] Technique 1 is evident in the fact that H2 begins one octave lower than in minimal spacing. Technique 2b is apparent in H1's repeated open string B3s, which give the performer time to shift up to ⟨A4, G♯5⟩.

Example 8 reproduces Row 5 (first seen in Example 2) to place it in a larger context. Row 5 is an altered recurrence of Row 3 that uses Techniques 1 and 2b and marks the registral peak of mm. 126–130. Occurring at the end of the second set of Episodes and

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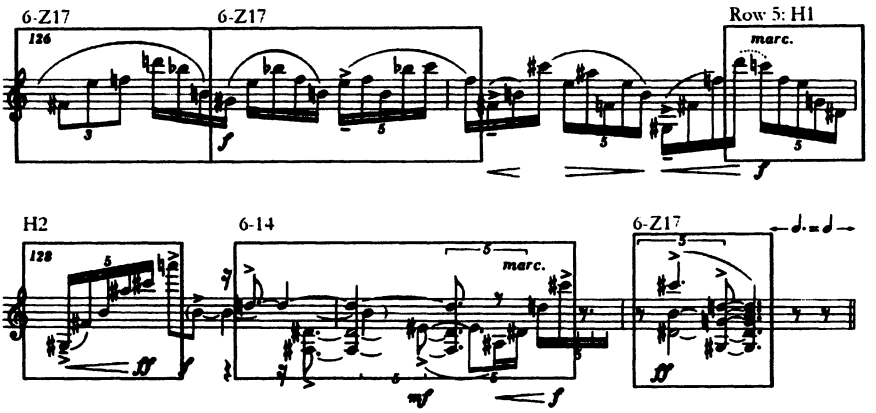
foreshadowed by the opposing registers, durations, and articulations of Row 1. Starobin is quoted in Kozinn 1984, 3–4.

[28] Alternately, Carter could have written ⟨C♯5, E4, C4, F3, E♭3, D3⟩, which forms a 6-1 member, realizes a descending contour, completes the RT6-row, and remains within register. However, a descending slur from C4 to F3 is not possible; the stretch is too wide.

Example 8. Changes, *mm. 126-130*



marked *marcato*, Row 5 exchanges the two hexachords from Row 3, so that H1 of Row 3 becomes H2 of Row 5, and H2 of Row 3 becomes H1 of Row 5. A second alteration present in Row 5 involves the use of contour. Whereas ⟨G♯, F♯, B, A♯, C♯, A⟩ descends in Row 3, it ascends in Row 5, and vice versa for ⟨D, C, F, E, G, D♯⟩. In registral ascent, Row 5's discrete hexachords ⟨G♯, D♯, F♯, G, B, E⟩ and ⟨F, B♭, C, C♯, D, A⟩ form T6-related 6-14s but do not create an all-interval row. T6 relates the 6-Z17s that precede Row 5 (m. 126) as well as H1 and H2 of Row 5. After Row 5, a 6-14 and a 6-Z17 that share three pitches close the section.

Isegs in *Changes*

The preceding excerpts from *Changes* feature presentations of the aggregate that realize RT6-rows. Other excerpts exhibit a related technique involving *incomplete* statements of the INTs in Example 3. I will refer to such statements as *INT segments* (hereafter *isegs*). Some instances of isegs yield the aggregate, while others do not.[29]

[29] In Exx. 9–13, I determine isegs by taking pitches in registral ascent. Mead 1995, 87 identifies in *Night Fantasies* what I call isegs: "the composition contains sections

To realize isegs in p-space in *Changes*, Carter employs three techniques in addition to those used for RT6-rows:

- **Iseg Technique 1: The use of isegs from different INTs to form the aggregate.**
- **Iseg Technique 2: The use of one pitch-set to realize different isegs.**
- **Iseg Technique 3: The use of the E2 open string to begin different isegs.**

Example 9 illustrates Iseg Technique 1 in the opening bars of the Coda. H1 = ⟨G♯, D♯, B, C, A♯, C♯⟩ projects a 6-8, and H2 = ⟨F, A, F♯, G, D, E⟩ projects T6 of H1. The INT of H1 reads ⟨781T3⟩, forming an iseg from ⟨781T3692E45⟩ (no. 79). The INT of H2 reads ⟨49172⟩, which forms an iseg from ⟨491726T5E38⟩ (no. 29).[30] Both H1 and H2 exhibit minimal spacing and fall within phrasing slurs. Either iseg could be completed to form an RT6-row, but this does not occur in the music. The ic labels below the staves draw a connection with the dyads that follow Row 2 (cf. Example 5a): ics 1, 2, 3, 4, and 5 are present, while the missing ic6 is manifest in the T6 relation between H1 and H2. But unlike Example 5a, the pcs of the adjacent dyads do not relate by T6, and ten of the eleven upis are not present.

Example 10a analyzes the first instances of Iseg Technique 2. The piece opens with ε = {G3, A♭3, F4}, realizing the INT ⟨19⟩. The notation "⊂ ε" indicates literal inclusion of ε, here by two 6-14s. While the first 6-14 does not form an iseg, the second presents the iseg ⟨8719T⟩ from INT no. 47. Another C1 sc appears as well, a 6-32 whose INT ⟨55555⟩ clearly is not an iseg. Of the remaining chords—both 6-Z17s—the first presents the iseg ⟨56734⟩ from INT no. 60. Example 10b shows three subsequent appearances of ε, one of which situates it in a new iseg. The first two appearances realize the INT ⟨195⟩. The third appearance forms a 6-1 and realizes the iseg ⟨8591T⟩ from INT no. 68.

To illustrate Iseg Technique 3, Example 11a reproduces one of Carter's sketches for *Changes*.[31] The sketch contains six hexachords.

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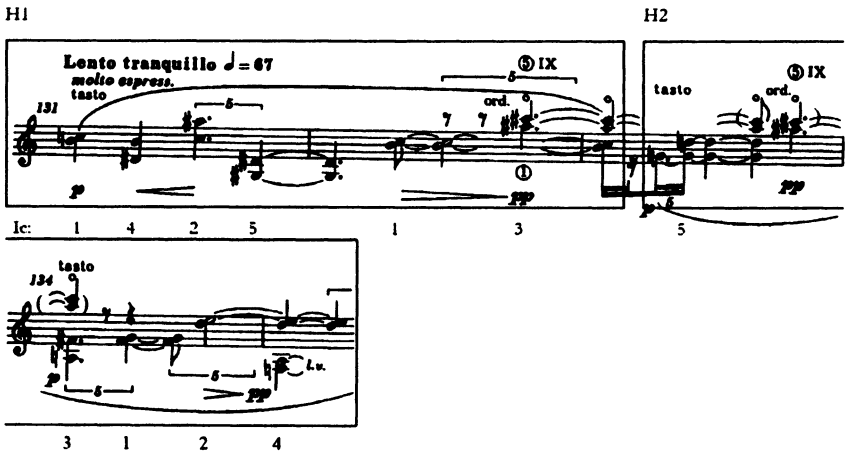
employing complete twelve-tone rows, and sections using *merely the ordered hexachords of the rows*" (emphasis added).

[30] H2 appeared in Example 5b, measure 22.

[31] The sketch, held by the Paul Sacher Foundation, is numbered 230-0849.

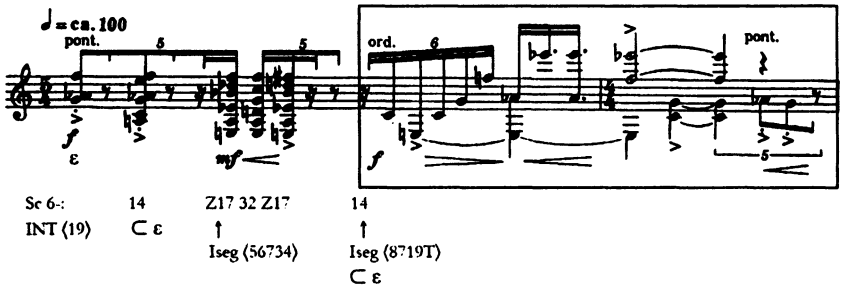
Example 9. Changes, *mm. 131–135.*



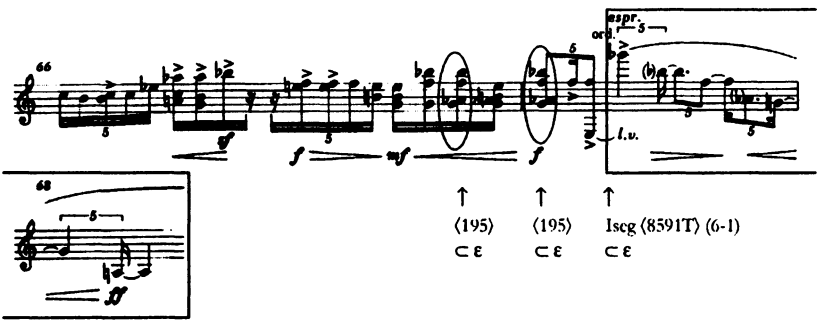
H1 = ⟨G♯, D♯, B, C, A♯, C♯⟩
INT(H1) = Iseg ⟨781T3⟩

H2 = ⟨F, A, F♯, G, D, E⟩
INT(H2) = Iseg ⟨49172⟩

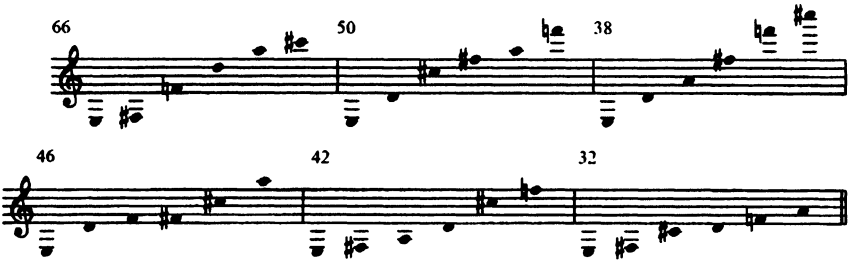
Example 10a. Changes, *mm. 1–2.*



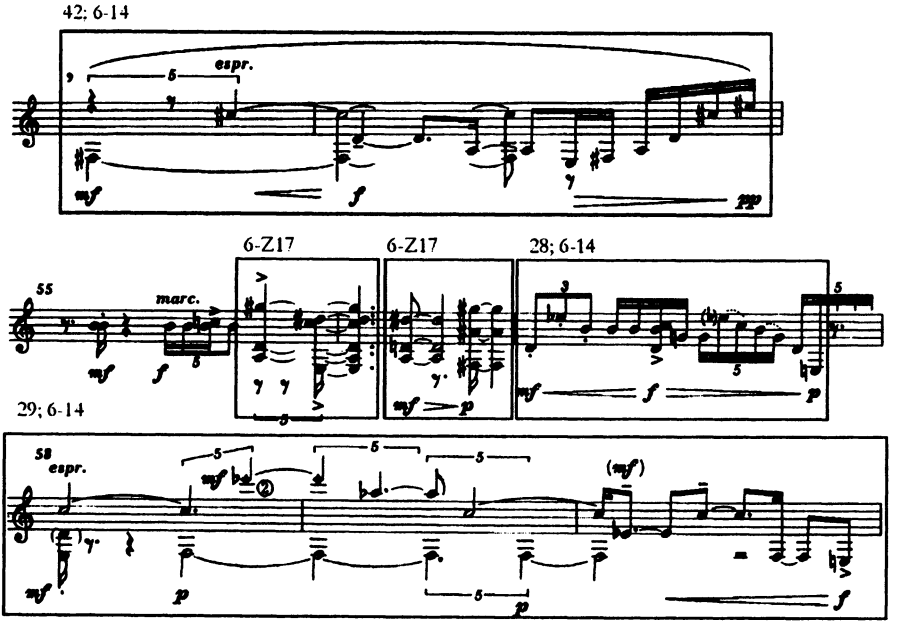
Example 10b. Changes, *mm. 66–68.*



Example 11a. Carter, sketch for Changes.



Example 11b. Changes, *mm. 53–60.*



Each hexachord realizes an iseg; the *Harmony Book* number for each INT appears above the staff, as it does on Carter's sketch. Each hexachord forms a 6-14 and begins with ⟨E2, F♯2⟩ or ⟨E2, D3⟩. Example 11b indicates how the sketch appears in mm. 53–60 of *Changes*. Only chord number forty-two from the sketch occurs in the piece, but isegs from INTs twenty-eight and twenty-nine also appear. All three chords form 6-14s, contain E2, F♯2, and/or D3, and feature the ascending or descending contours associated with the RT6-rows. The 6-Z17s that separate chords forty-two and twenty-eight also feature E2, F♯2, and/or D3 but do not form isegs. Many more isegs occur in *Changes*; an Appendix to this article lists them.

Two Additional Works

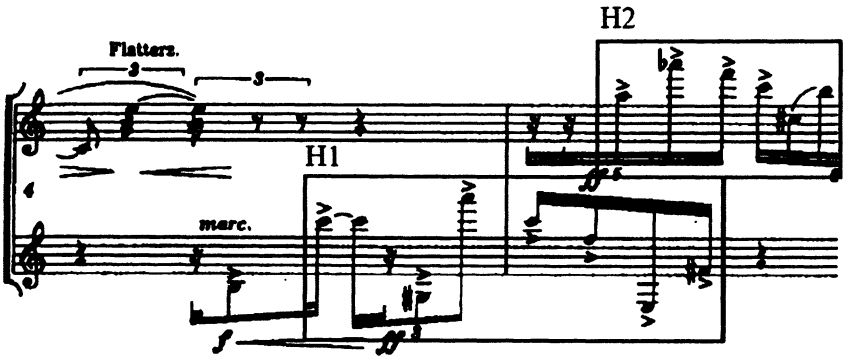
While I have focused on Carter's pitch realizations of RT6-rows and isegs in *Changes*, one may extend these observations to the pitch realizations of other types of all-interval rows in Carter's works for instruments with ranges smaller than 5½ octaves. The following examples demonstrate the use of RT6 Technique 1 in two such works, in which H1 and H2 each exhibits minimal spacing but the opi separating the highest pitch of H1 from the lowest pitch of H2 is not +6.

Example 12 reproduces mm. 4–5 of *esprit rude/esprit doux*. The INT of the all-interval row in the excerpt is ⟨4TE79682153⟩. This is a *QI-invariant* all-interval row, in which complementary upis appear in the first and seventh positions, (upis 4 and 8), as well as the second and eighth (T and 2), third and ninth (E and 1), fourth and tenth (7 and 5), and fifth and eleventh (9 and 3).[32] The minimal spacing of 5½ octaves (for any type of all-interval row) exceeds the range of the flute (C4–F7, forty-one semitones), the clarinet (D3–C7, forty-six semitones), and the distance from the lowest pitch of the clarinet to the highest pitch of the flute (D3–F7, fifty-one semitones).[33] Carter works around this limitation by assigning the first five upis to the clarinet and the last five to the flute; both

[32] See Carter 2002, 54–57; 69–76, Heinemann 2001, Koivisto 2004, 159 ff., Morris and Starr 1974, 365 ff., and Schiff 1998, 140–143.

[33] These ranges, set forth in Blatter 1980, exclude harmonics and vary slightly among performers.

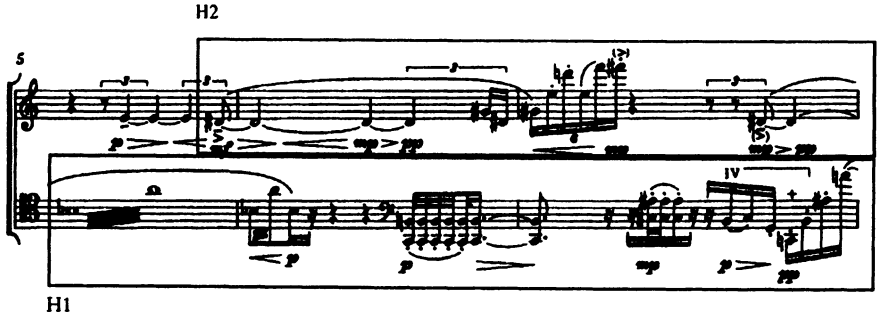
Example 12. Carter, esprit rude/esprit doux, *mm. 4–5: 3½ octave range.*



Lower staff: B♭ clarinet (not at concert pitch): H1 = ⟨D3, F♯3, E4, E♭5, B♭5, G6⟩
INT(H1) = ⟨4TE79⟩

Upper staff: flute: H2 = ⟨C♯5, A5, B5, C6, F6, A♭6⟩
INT(H2) = ⟨82153⟩

Example 13. Carter, Enchanted Preludes, *mm. 5–6: 4½ octave range.*



Lower staff: 'cello: H1 = ⟨C2, G2, B2, C♯3, A♯3, A4⟩
INT(H1) = ⟨7429E⟩

Upper staff: flute: H2 = ⟨D♯4, G♯4, E5, D6, F6, F♯6⟩
INT(H2) = ⟨58T31⟩

instruments use ic6. The boxed pitches on the lower staff indicate the clarinet's pitch realization of its iseg, H1 = ⟨D3, F♯3, E4, E♭5, B♭5, G6⟩, whose INT is ⟨4TE79⟩. The boxed pitches on the upper staff indicate the flute's pitch realization of its iseg, H2 = ⟨C♯5, A5, B5, C6, F6, A♭6⟩, whose INT is ⟨82153⟩. In *esprit rude/esprit doux*, the p-space range of the row spans 3½ octaves; H2 appears two octaves lower than in minimal spacing, and opi -18 separates the highest pitch of H1 (G6) from the lowest pitch of H2 (C♯5).

Example 13, from *Enchanted Preludes*, reveals a related solution to the limitation imposed by instruments that cannot accommodate the minimal spacing of 5½ octaves. The INT of the QI-row that opens the work is ⟨7429E658T31⟩. The minimal spacing of 5½ octaves exceeds the range of the flute (C4–F7; forty-one semitones), the 'cello (C2–F7, sixty–five semitones), and the distance from the lowest pitch of the 'cello to the highest pitch of the flute (equivalent to the range of the 'cello). As in *esprit rude/esprit doux*, Carter works around this limitation by assigning the first five upis to one instrument and the last five to the other. Unlike *esprit rude/esprit doux*, however, neither instrument uses ic6, and the pitch realization of the row spans 4½ octaves. H2 appears one octave lower than in minimal spacing, and opi -6 separates the highest pitch of H1 (A4) from the lowest pitch of H2 (D♯4). The lower staff of Example 13 shows the 'cello's pitch realization of its iseg, H1 = ⟨C2, G2, B2, C♯3, A♯3, A4⟩, whose INT is ⟨7429E⟩. The upper staff shows the flute's pitch realization of its iseg, H2 = ⟨D♯4, G♯4, E5, D6, F6, F♯6⟩, whose INT is ⟨58T31⟩.

Final Considerations

This paper has presented two techniques for the pitch realization of RT6-rows in Carter's *Changes*. These techniques include the pitch transposition of one or more pitches of H1 or H2 by one or more octaves to accommodate the range of the guitar, and the use of harmonics or open strings to facilitate transitions across the fretboard. I have also illustrated the roles of isegs in *Changes*, including the use of isegs from different INTs to form the aggregate, the use of one pitch-set to realize different isegs, and the use of the E2 open string to begin different isegs.

We are now in a position to answer a fundamental question: why are the RT6-rows and isegs present in *Changes*? Example 14

Example 14. Features of rows and isegs in Changes.

	Starts or end a section	Prompts a change in texture	Forms registral lowpoint and/or highpoint	Presents 10 of 11 opis within one octave	Occurs within a phrasing slur	Performance markings	Asc./ desc. contours	Same number of semitones in H1 or H2	Tn relates H1/ H2
Row 1	†	†	†	†	†	†			Rows 1/4
Row 2		†	†	† (A3)		†	†	†	
Row 3		†	†	†	†	†	†	†	Rows 3/5
Row 4			†				†		
Row 5	†	†	†	†		†	†	†	
Ex. 9 Isegs	†	†	†		†	†			
Ex. 10 Isegs	†		†		† (10b)	†	†		
Ex. 11 Isegs		†	† (mm. 58–60)		†	†	†		

shows that four rows and isegs start or end a section. Second, six rows and isegs prompt a change in texture. Third, every row and iseg forms the registral low- or highpoint of its passage. Fourth, four rows present ten of the eleven upis within the span of one octave. We may also observe some commonalities among the five rows. Example 14 shows that five rows and isegs occur within phrasing slurs. Second, all but one of the rows and isegs have performance markings that the surrounding music does not. Third, six rows and isegs feature ascending/descending contours. Fourth, the pitch realizations of H1 and H2 in three rows share the same number of semitones; this is one way that Carter categorizes the RT6-rows.[34] Specifically, Rows 2, 3, and 5 have hexachords whose pitches (in minimal spacing) span thirty-seven and twenty-three semitones respectively. Fifth, the discrete hexachords of Rows 1 and 4 relate by T0, and the discrete hexachords of Rows 3 and 5 relate by T6.

Carter describes himself as a composer who is "very enmeshed in the human aspect of musical performance...When I write for an instrument, I try to find out what its characteristics are."[35] Further study of the constraints that a given instrument imposes on Carter's favored pitch resources is an important topic for future investigation.[36]

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[34] Carter 2002, 58. The other way he categorizes the RT6-rows is by the sc formed by H1 or H2.

[35] The first sentence is from Carter 1997, 222; the second is from Kozinn 1984, 3.

[36] Garrison 1994 and Heinemann 1998 take steps in this direction.

Appendix: Additional Isegs in *Changes*

This appendix lists every iseg in *Changes* other than those discussed in the article. The first column lists the measure number that the iseg appears in. If the iseg appears in two or more consecutive measures, only the first measure number is given. The second column lists the pcs that realize the iseg, in registral order from low to high (accidentals apply only to the note they immediately precede). The third column lists the sc formed by the six pcs. The fourth column lists the iseg. The fifth column lists the INT that the iseg is drawn from. The sixth column lists the number of the INT on Carter's list (cf. Example 3).

Measure	Pcs	Sc	Iseg	From INT	Carter #
22	⟨F, A, F♯, G, D, E⟩	6-8[023457]	49172	491726T5E38	29
34	⟨G, A, D, F, F♯, B♭⟩	6-14[013458]	25314	2531468E97T	38
48	⟨C, D, G, A♯, B, D♯⟩	6-14[013458]	25314	2531468E97T	38
70	⟨D, C♯, F, B♭, C, E♭⟩	6-8[023457]	E4523	3254E6187T9	19
70	⟨C♭, D♭, B♭, E♭, D, F♯⟩	6-14[013458]	295E4	295E468173T	44
73	⟨F♯, A, D, A♯, B, C♯⟩	6-14[013458]	35812	358126TE479	53
89	⟨F, D♯, E, G, C, A♭⟩	6-14[013458]	T1358	479E26T1358	65
90	⟨F♯, C♯, B, D, B♭, A⟩	6-14[013458]	7T38E	1492567T38E	22
91	⟨A♭, F♯, G, B♭, F, A⟩	6-1[012345]	T1374	4731T62E958	63
92	⟨E, D♭, A♭, C, B, A⟩	6-14[013458]	974ET	218536974ET	54
94	⟨G, G♯, B, D♯, A♯, C⟩	6-14[013458]	13472	134726T589E	2
95	⟨D, C♯, F, B♭, C, E♭⟩	6-8[023457]	E4523	3254E6187T9	19
96	⟨B♭, G, D, C, B, D♯⟩	6-14[013458]	97TE4	97TE4681253	72
98	⟨A, B, E, G, A♭, C⟩	6-14[013458]	25314	2531468E97T	38
99	⟨B, D, G, D♯, E, F♯⟩	6-14[013458]	35812	358126TE479	53
100	⟨D♯, C♯, D, F, C, E⟩	6-1[012345]	T1374	4731T62E958	63
101	⟨A, B, E, G, A♭, C⟩	6-14[013458]	25314	2531468E97T	38
102	⟨A, B, F♯, A♯, C♯, D⟩	6-14[013458]	27431	274316E985T	1
107	⟨G♯, A♯, D♯, F♯, G, B⟩	6-14[013458]	25314	2513468E97T	38
107	⟨E♭, C, E, B, C♯, D⟩	6-1[012345]	94721	94721385TE6	15
108	⟨E, G♯, D♯, F♯, G, F⟩	6-1[012345]	4731T	4731T62E958	63
108	⟨G♯, F♯, G, B♭, F, A⟩	6-1[012345]	T1374	4731T62E958	63
109	⟨G, B, D, E♭, B♭, C⟩	6-14[013458]	43172	431726T5E98	31
128	⟨F♯, A♯, D♯, E♯, D, C♯⟩	6-14[013458]	4529E	4529E613T78	7

References

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