CCG Chord Grammar

Mark Steedman & Mark Wilding

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1 Original grammar

Mark Steedman's original chord grammar with semantics, as it appears in the latest version of his lecture slides on the subject, is as follows.

0a.	X(m)	:=	$I_X(m) \backslash I_X(m) : \lambda x.x$
0b.	X(m)^7	:=	$I_X(m)^7 \backslash I_X(m)^{(7)} : \lambda x.x$
1a.	X	:=	$I_X : X$
1b.	Xm	:=	$I_X m : X$
2a.	X	:=	$V_X \backslash V_X : \lambda x.x$
2b.	Xm	:=	$V_X m \backslash V_X m : \lambda x.x$
3a.	Xm^7	:=	$I_X m^7 / IV_X^7 : \lambda x.leftonto(x)$
3b.	X^7	:=	$I_X^7 / IV_X(m)^7 : \lambda x.leftonto(x)$
4.	Xm^7	:=	$\sharp IV_X(m)^7 / VII_X(m)^7 : \lambda x.leftonto(x)$
5a.	X	:=	$I_X / V_X : \lambda x.rightonto(x)$
5b.	Xm	:=	$I_X m / V_X m : \lambda x.rightonto(x)$
6.	Xm	:=	$\flat VII_X m \backslash \flat VII_X m : \lambda x.x$
7.	X∘7	:=	$\flat V_X / \flat V_X : \lambda x.x \mid \flat II_X / \flat II_X : \lambda x.x \mid \flat VII_X m^7 / \flat VII_X m^7 : \lambda x.x$

2 Grammar v0.2

The following is my first modified version of the grammar. I have made various modifications. Some are simply superficial, others are major changes to aspects the interpretations – in particular, the handling of diminished seventh chords. The changes are explained in detail below.

0a. X(m) := $I_X(m) \backslash I_X(m) : \lambda x.x$
0b. X(m)^7 := $I_X(m)^7 \backslash I_X(m)^{(7)} : \lambda x.x$
0c. X(m)^7 := $\flat V_X(m)^7 \backslash \flat V_X(m)^{(7)} : \lambda x.x$

1. X(m) := $I_X(m) : X$

2. X(m) := $V_X(m)^{(7)} \backslash V_X^{(7)} : \lambda x.x$

3a. Xm^7 := $I_X m^7 / IV_X(m)^7 : \lambda x.leftonto(x)$
3b. X^7 := $I_X^7 / IV_X(m)^7 : \lambda x.leftonto(x)$
4a. Xm^7 := $\sharp IV_X m^7 / VII_X(m)^7 : \lambda x.leftonto(x)$
4b. X^7 := $\sharp IV_X^7 / VII_X(m)^7 : \lambda x.leftonto(x)$

5. X(m) := $I_X(m) / V_X(m) : \lambda x.rightonto(x)$

6. Xm := $\flat VII_X m \backslash \flat VII_X m : \lambda x.x$

7. X$\circ$7 := (a) $I_X(m) / I_X(m) : \lambda x.x$
(b) $\flat V_X(m)^7 / VII_X(m)^7 : \lambda x.leftonto(x)$
(c) $IV_X(m)^7 / \flat VII_X(m)^7 : \lambda x.leftonto(x)$
(d) $[VI_X(m) / VI_X(m) : \lambda x.x]$
(e) $\flat III_X(m)^7 / \flat VI_X(m)^7 : \lambda x.leftonto(x)$
(f) $II_X(m)^7 / V_X(m)^7 : \lambda x.leftonto(x)$
(g) $[\flat V_X(m) / \flat V_X(m) : \lambda x.x]$
(h) $I_X(m)^7 / IV_X(m)^7 : \lambda x.leftonto(x)$
(i) $VII_X(m)^7 / III_X(m)^7 : \lambda x.leftonto(x)$
(j) $[\flat III_X(m) / \flat III_X(m) : \lambda x.x]$
(k) $VI_X(m)^7 / II_X(m)^7 : \lambda x.leftonto(x)$
(l) $\flat VI_X(m)^7 / \flat II_X(m)^7 : \lambda x.leftonto(x)$

2.1 Optional minors

A purely cosmetic change I've made is to reduce several of the pairs of categories into single categories using the optional minor convention. Some categories already used this, so it makes sense to use the more concise representation throughout. Rules 1a and 1b, 2a and 2b, and 5a and 5b have been condensed.

2.2 Tritone coordination

I have added rule 0c: the coordination of a dominant seven chord and its tritone following it. The tritone substitution is already incorporated by rules 4a and 4b, but this rule allows a dominant seven and its tritone substitution together to function as a single cadential step.

0c. X(m)^7 := $\flat V_X(m)^7 \backslash \flat V_X(m)^{(7)} : \lambda x.x$

Autumn Leaves, as it is transcribed in Elliott (2007), contains an example of a place where this category can be used. The B section (third line) consists

of a short cadence to I and then a cadence which gets as far as $\flat VI$ by the end of the section.

$$IVm^7\ \flat VII^7\ \flat III^{(7)}\ \flat VI^{(7)}$$

The C section begins with a cadence from II. The whole C section seems to be most plausibly interpreted as a single cadence back to I. This requires interpreting most of the line using the 4-rules, that is as tritone substitutions.

$$II^7\ V^7\ Im^7\ \flat II \circ 7\ \flat VIIm^7\ \flat III^7\ \flat VI^7\ V^7\ Im$$

This gives us an interpretation of the line as a cadence essentially from $\flat VI$ to I. This, of course, joins up neatly with what seemed to be a cadence onto an unlikely close on $\flat VI$ at the end of the B section, provided we can interpret the $\flat VI$–II transition across the section boundary not as a step in the tonal space, but as a continuation of the same (left-stepping) chord in the middle of a cadence.

The 0c rule allows an interpretation in which the $\flat VI^{(7)}$ gets the category $\flat VI^7/\flat II^7$ and the II^7 the category $\flat VI^7\backslash\flat VI^7$, which combine by crossing composition into a simple $\flat VI^7/\flat II^7$.

Naturally, this category can only apply to seventh chords, since the tritone substitution only occurs in a dominant seventh interpretation of a seventh chord in the first place.

See section 3 for a full analysis of Autumn Leaves using the new grammar.

2.3 Authentic minor resolution

I have added an optional minor to the resolution of category 3a. This is supported by many examples of authentic cadences including transitions from a minor chord to another minor chord. A common example is

$$VIm^7\ IIm^7\ V^7\ I$$

which requires category 3a with the optional minor to be assigned to the VIm^7.

2.4 Major tritone substitution

The original grammar contained category 4 for tritone substitutions of minor chords. A minor chord could be interpreted as a substitution for the (major or minor) chord on its tritone, resolving to the (major or minor) chord a semitone below (i.e. a left step).

It should also be possible for major chord to be used as a tritone substitution. Take, for example, the ending of Beautiful Love:

$$Im\ VI\varphi 7\ \flat VI^7\ V^7\ Im$$

This should cleary be interpreted as a cadence onto I, using $\flat VI^7$ (note major) as the tritone substitution for II^7. This corresponds to John Elliott's interpretation (Elliott (2007)), as a variant on a POT.

I have therefore added a major version of rule 4, now rules 4a and 4b. Both may resolve to a major or minor chord.

2.5 New diminished seventh interpretations

7. X○7 := (a) $I_X(m)/I_X(m) : \lambda x.x$
(b) $\flat V_X(m)^7/VII_X(m)^7 : \lambda x.leftonto(x)$
(c) $IV_X(m)^7/\flat VII_X(m)^7 : \lambda x.leftonto(x)$
(d) $[VI_X(m)/VI_X(m) : \lambda x.x]$
(e) $\flat III_X(m)^7/\flat VI_X(m)^7 : \lambda x.leftonto(x)$
(f) $II_X(m)^7/V_X(m)^7 : \lambda x.leftonto(x)$
(g) $[\flat V_X(m)/\flat V_X(m) : \lambda x.x]$
(h) $I_X(m)^7/IV_X(m)^7 : \lambda x.leftonto(x)$
(i) $VII_X(m)^7/III_X(m)^7 : \lambda x.leftonto(x)$
(j) $[\flat III_X(m)/\flat III_X(m) : \lambda x.x]$
(k) $VI_X(m)^7/II_X(m)^7 : \lambda x.leftonto(x)$
(l) $\flat VI_X(m)^7/\flat II_X(m)^7 : \lambda x.leftonto(x)$

I have completely redrafted categories 7 – the interpretations of diminished seventh chords. It should be noted that the different categories not only allow for different resolutions of this highly ambiguous chord, but also ascribe it different semantics.

I will first deal with the issue of the extent of the lexical ambiguity required and then discuss to reasoning behind and evidence for the categories proposed.

2.5.1 Full resolution ambiguity

I have listed here categories to describe the complete ambiguity of resolution of the diminished seventh chord. The chord may resolved to a major or minor chord on any root and each possible resolution root corresponds to one of the categories.

A large part of this ambiguity should probably not be handled by the grammar, hence the brackets around many of the categories. Any diminished seventh chord may be transcribed as having one of four possible roots (each of its constituent notes). Considering all four of these to be the same chord, there are only three distinct diminished seventh chords. Arguably, the ambiguity of the root should be handled by the chord transcriber, in the case of notated chord input, or the tagger component, in the case of note (MIDI) input. If we can assume that a root is chosen that resolves to its following chord by a small step, we need only include in the lexicon those categories that resolve to the root's prime, semitone above or below, or tone above or below[1]. This calls for the inclusion of a, b, c, k and l.

We cannot limit the categories to only these five, however. We must also include those that accomodate resolution by left-step semantics (see below) to the tritones of the resolutions already represented by the four left-step categories of the five proposed above (b, c, k and l). The reason for this is that a diminished seventh chord may (and often does) appear as a left step in a chain of left steps of a cadence. If the chords on either side of it (in particular, that following it) are interpreted as tritone substitutions, one of the tritone inversions of b, c, k and l is called for, since the root of the diminished seventh chord will have been chosen to make a small step to the following root. An example of this can be

[1] In this last case, the resolution is midway between possible roots, so either root would have been a reasonable choice on the part of the transriber/tagger and would probably depend on preceding chords

seen in the interpretation of Autumn Leaves presented below. The $\flat II \circ 7$ in the C section appears as one of a series of left steps, all of which are tritone substituted.

Consequently, we must include in the lexicon at least a, b, c, e, f, h, i, k and l. It will probably be acceptable to ommit the remaining three.

2.5.2 Semantics

The categories proposed for diminished sevenths are of three types, each with a different justification. These are exemplified by the three categories a, h and l; the remaining categories are merely an identical interpretation applied to inversions of the diminished seventh chord.

7. X∘7 := (a) $I_X(m)/I_X(m) : \lambda x.x$
(h) $I_X(m)^7/IV_X(m)^7 : \lambda x.leftonto(x)$
(l) $\flat VI_X(m)^7/\flat II_X(m)^7 : \lambda x.leftonto(x)$

The analysis of diminished seventh chords put forward by most texts on music theory is that which construes it as an inverted minor ninth chord (or more precisely a minor ninth chord with its prime ommitted). A minor ninth chord formed on the dominant root is a dominant seventh with a minor ninth added. For various explanations of this analysis, see for example Pratt (1984), Clarke (188?) and Schenker (1906).

If a diminished seventh chord is interpreted in this way, it follows that it must function in the same way as the dominant seventh rooted a major third below its root (the addition of the minor ninth does not alter the function of the chord). This gives rise to category h in the above grammar, which interprets an X∘7 as if it were a $\flat VI_X(m)^7$ with its prime missing.

There is evidence for diminished seventh chords having this function among the jazz standards in Elliott (2007). Take, for example, the cadence that begins the A section of The Joint is Jumpin':

$$I \ \flat II \circ 7 \ IIm^7 \ V^7 \ I$$

Here the $\flat II \circ 7$ can be interpreted as a VI^7 (with an added minor ninth and a missing prime), beginning the three-level cadence back to I.

The diminished seventh is used in this way in many examples. In most cases it appears at the beginning of a cadences, so could potentially be interpreted as a transient chord leading to the first dominant seventh of the cadence, but I believe the left step analysis more plausible due to the frequent use of the diminished seventh in this way in cadences and the consistent support of classical theory for this understanding[2]. This is certainly not the only interpretation of diminished sevenths, as Schenker (1906) makes emphatically clear.

Category l appears to be similar to h. This interpretation simply says that a diminished seventh can behave as if it were a dominant seventh on the same root. Clarke (188?) suggests this interpretation for diminished chords and I believe that the interpretation may be extended to diminished sevenths. Furthermore, there is ample evidence for this use in our jazz standards. Take the A section

[2]I will also deal with an interpretation of diminished sevenths as transient chords, but in a way also suggested by classical analyses; the interpretation of this semitone-rising resolution as a transient chord would not be so supported.

of A Ghost of a Chance (line 2) as an example. The second half includes an extended cadence onto I:

$$IIIm^7 \ \flat III \circ 7 \ IIm^7 \ V^7 \ I$$

Here the $\flat III \circ 7$ functions as if it were a VI^7. Note that $\flat III \circ 7$ could just as well have been notated $VI \circ 7$, giving us an example of the simple subdominant resolution of the diminished seventh. In this case, as in many others, the chord appears in the middle of a cadence, suggesting very strongly that this is the correct interpretation.

Category a does not give us left step semantics. In this case the diminished chord is seen as just a *transient chord* (in the terminology of Clarke (188?)), or a *passing harmony* (in that of Schenker (1906)). Clarke (188?) notes that transient chords "assume the appearance of inversions of the minor ninth [diminished seventh], from which, however, they are distinguished by their resolution". He also mentions, of course, that they may appear in any inversion. Since such chords are merely passing harmonies and no more than colouration, we associate with them no movement in the tonal space.

Riemann (1896) gives us one further interpretation of diminished sevenths, which I have not included in the grammar, since it seems a little far-fetched. He seems to suggest (by means of his frightfully complicated notation and convoluted explanations) that they may behave as (very) modified subdominants, which would give rise to right step semantics in the tonal space. For now, I overlook this possibility.

3 Autumn Leaves analysis

The following shows the association of categories to the chords of Autumn Leaves. The full derivation is not shown for the sake of space, but is fairly trivial.

3.1 A section

The first two bracketed chords appear at the end of every line that leads into the A section. They are required to assign a complete cadential interpretation to the line and are essentially a part of the line. The final G7 is really part of the next line.

(Gm	G7)	Cm7	F7	B♭(7)	E♭(7)	Aφ7	D7	Gm	(G7)...
Im	I^7	IVm^7	$\flat VII^7$	$\flat II^{(7)}$	$\flat VI^{(7)}$	II^7	V^7	Im	I^7...
I	$\flat V^7/VII^7$	VII^7/III^7	III^7/VI^7	VI^7/II^7	II^7/V^7	$II^7\backslash II^7$	V^7/I^7	Im	I^7/IV^7

This whole section is a single extended authentic cadence, in which the first half is tritone substituted, accounting for the tritone leap from the E♭ to the Aφ7. Note that this uses category 0b to interpret the unsubstituted Aφ7 as a continuation of the tritone substituted E♭7. This is the exact opposite of the transition from the B to C section, which must use the new 0c category.

Since this is in a minor key, it also requires a minor version of the cadence-raising rule, allowing a minor chord category to be raised into a cadence ending.

The final category this section receives (ignoring the bracketed chords) is:

$$Im\backslash Im \ : \ \lambda x.x + leftonto(leftonto(leftonto(leftonto(leftonto(leftonto(x))))))$$

So, assuming this is the first time round, first line, with the bracketed chords supplied as a lead-in at the beginning, it becomes[3]:

$$Im \ : \ I + leftonto(leftonto(leftonto(leftonto(leftonto(leftonto(leftonto(x)))))))$$

3.2 B and C sections

The B section begins with another short authentic cadence. The second half of the B section must be interpreted with the C section – otherwise we have an implausible cadence onto $\flat VI$. It is even possible to interpret the whole of the B and C sections as a single (very)

[3]The G7 in the lead-in is also part of the cadence, hence the extra *leftonto* in the semantics

extended authentic cadence just by assuming the Gm at the end of the first is really a Gm7, since the second cadence takes us all the way round to circle of fifths. For now I will assume they are two cadences.

(Gm)	Aφ7	D7	Gm
Im	II^7	V^7	Im
Im	II^7/V^7	V^7/I^7	Im

As a single cadence, this receives the category $I\ :\ I + leftonto(leftonto(I))$.

The second half of the B section and the C section are then as follows:

Cm7	F7	B♭(7)	E♭(7)	Aφ7	D7	...
IVm^7	$\flat VII^7$	$\flat III^7$	$\flat VI^7$	II^7	V^7	...
$IVm^7\flat VII^7$	$\flat VII^7/\flat III^7$	$\flat III^7/\flat VI^7$	$\flat VI^7/\flat II^7$	$\flat VI^7\backslash\flat VI^7$	$\flat II^7/\flat V^7$	...

...	Gm7	F♯$\circ$7	Fm7	B♭7	E♭7+9	D7+9	Gm
...	Im^7	$\flat II \circ 7$	$\flat VIIm^7$	$\flat III^7$	$\flat VI^7$	V^7	Im
...	$\flat V^7/VII^7$	$VII^7/IIIm^7$	$IIIm^7/VI^7$	VI^7/II^7	II^7/V^7	V^7/I^7	Im

Put simply, the whole sequence is an authentic cadence going all the way round the circle of fifths, with a large section in the middle substituted with tritones.

Note especially in this the example of the use of the new category 0c. Just as in the A section 0b was used to interpret a tritone leap in the middle of a cadence as a switch from a passage entirely substituted with tritones back to an unsubstituted passage, here the same leap is interpreted as a switch in the other direction. For a fuller explanation see section 2.2.

References

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