Beyond chord vocabularies: Exploiting pitch-relationships in a chord estimation metric

Johanna Devaney

Brooklyn College and The Graduate Center, City University of New York

johanna.devaney@brooklyn.cuny.edu

Abstract

Chord estimation metrics treat chord labels as independent of one another. This fails to represent the pitch relationships between the chords in a meaningful way, resulting in evaluations that must make compromises with complex chord vocabularies and that often require time-consuming qualitative analyses to determine details about how a chord estimation algorithm performs. This paper presents an accuracy metric for chord estimation that compares the pitch content of the estimation chords against the ground truth that captures both the correct notes that are estimated and additional notes that are inserted into the estimate. This is not a stand-alone evaluation protocol but rather a metric that can be integrated into existing evaluation approaches.

Accuracy Metric

Let C be the number of predicted notes $\hat{y}$ in the ground truth correctly identified y

$$C = |y \cap \hat{y}| \quad (1)$$

Let I be the number of insertions (extra predicted notes) in the estimated chord that are not present in the ground truth.

$$I = |\hat{y} \backslash y| \quad (2)$$

Let A be the accuracy measurement for each chord estimate, calculated from C and I scaled between 0 and 1.

$$A = \frac{C - I + |y|}{2|y|} \quad (3)$$

Pitch Class Content in C Major Diatonic Triads

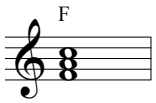
note name	C	C#	D	D#	E	F	F#	G	G#	A	A#	B
pitch class	0	1	2	3	4	5	6	7	8	9	10	11
C (I)	o	-	-	-	o	-	-	o	-	-	-	-
d (ii)	-	-	o	-	-	o	-	-	-	o	-	-
e (iii)	-	-	-	-	o	-	-	o	-	-	-	o
F (IV)	o	-	-	-	-	o	-	-	-	o	-	-
G(V)	-	-	o	-	-	-	-	o	-	-	-	o
a (vi)	o	-	-	-	o	-	-	-	-	o	-	-
b^o (vii^o)	-	-	o	-	-	o	-	-	-	-	-	o

Examples

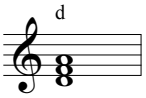
Triads estimated for a triad

one triad estimate with two common notes and one triad estimate with no common notes

Ground Truth

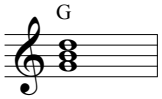


Estimate 1



$$C_d = |\{0,5,9\} \cap \{2,5,9\}|$$
$$C_d = 2$$
$$I_d = |\{2,5,9\} \backslash \{0,5,9\}|$$
$$I_d = 1$$
$$A_d = \frac{2 - 1 + |3|}{2|3|}$$
$$A_d = 0.66$$

Estimate 2

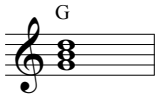


$$C_G = |\{0,5,9\} \cap \{2,7,11\}|$$
$$C_G = 0$$
$$I_g = |\{0,5,9\} \backslash \{2,7,11\}|$$
$$I_g = 3$$
$$A_g = \frac{0 - 3 + |3|}{2|3|}$$
$$A_g = 0$$

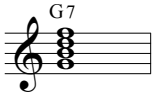
Seventh chord estimated for a triad

one seventh chord estimate with three common notes and one extra and one triad estimate with two common notes and one extra

Ground Truth

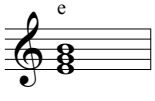


Estimate 1



$$C_G7 = |\{2,7,11\} \cap \{2,4,7,11\}|$$
$$C_G7 = 3$$
$$I_G7 = |\{2,7,11\} \backslash \{2,4,7,11\}|$$
$$I_G7 = 1$$
$$A_G7 = \frac{3 - 1 + |3|}{2|3|}$$
$$A_G7 = 0.83$$

Estimate 2



$$C_e = |\{2,7,11\} \cap \{4,7,11\}|$$
$$C_e = 2$$
$$I_e = |\{2,7,11\} \backslash \{4,7,11\}|$$
$$I_e = 1$$
$$A_e = \frac{2 - 1 + |3|}{2|3|}$$
$$A_e = 0.67$$

An implementation of the metric is available at https://github.com/jcdevaney/chordEstimationMetric