Perspectives in Voice Leading: Extending the General Chord Type and Directional Interval Class Representations

Introduction

Representing harmony is important both for analytic tasks (such as harmonic encoding, retrieval, classification) and for creative tasks (such as melodic harmonization). Encodings such as guitar style chord labels or roman numeral analysis notation that are meaningful for representing tonal music, are inadequate for non-tonal musics; conversely, pc-set theoretic encodings that are employed for atonal and other non-tonal musics are inadequate for tonal music. Two novel harmonic representations (the GCT and DIC representations) have already been devised so that they can be applied in a plethora of musical idioms. However, they are too abstract; they do not incorporate aspects of voice leading and cannot be applied directly in harmonic generation tasks. This paper explores a novel data-driven extension of these representations that embodies voice leading properties of chord transitions.

Related Work and Motivation

The General Chord Type (GCT) (Cambouropoulos et al, 2014; 2015) representation is an idiom-independent representation of chord types that is appropriate for encoding tone simultaneities in any harmonic context (such as tonal, modal, jazz, octatonic, atonal). It allows the re-arrangement of the notes of a harmonic simultaneity such that abstract idiom-specific types of chords may be derived; this encoding is inspired by the standard roman numeral chord type labelling but is more general and flexible. Given a consonance-dissonance classification of intervals (that reflects culturally-dependent notions of consonance/dissonance), and a scale/key, the GCT algorithm computes, for a given multi-tone simultaneity, the 'optimal' ordering of pitches such that a maximal subset of consonant intervals appears at the 'base' of the ordering in the most compact form. The lowest tone in the base is the 'root' of the chord. If a tonal centre (key) is given, the position within the given scale is automatically calculated.

A different representation, namely the *Directed Interval Class (DIC) vector* (Cambouropoulos et al., 2013; 2015) represents the harmonic transition between two chords, i.e. the interval content of a given chord sequence. The proposed 12-

dimensional vector encodes the number of occurrences of all directional interval classes (from 0 to 6 including +/- for direction) between all the pairs of notes of two successive chords. Apart from octave equivalence and interval inversion equivalence, this representation preserves directionality of intervals (up or down). Interesting properties of this representation are the fact that it is easy to compute, it is independent of root and local key, it incorporates a portion of the voice leading qualities, preserves chord transition asymmetry, it is transposition invariant, and applicable to tonal / post-tonal / atonal music.

Both representations, however, are rather abstract for encoding aspects of harmonic content in a general and compact manner. They do not incorporate crucial information regarding voice-leading, such as which notes may be doubled or missed out, chord inversions, spacing, movement of specific notes (e.g. resolution of dissonant intervals or leading note), relative movement between melody and bass line, and so on. Such information is necessary when attempting to employ such representations in more refined analytic tasks or in a harmonic generation context where actual chords must be fleshed out and connected one with another.

Voice leading has been approached and studied from various perspectives. Some studies attempt to create mathematical models that describe voice leading in a geometric fashion (Tymoczko, 2005, 2006; Callender et al., 2007) or by employing graphs (Toussaint, 2012). Extended research has been conducted from a music theoretical perspective by Straus (2003, 2005, 2014) broadening voice leading to the atonal realm, and, additionally, taking into account textural characteristics, like timbre, dynamics, register or articulation. Huron (2016) links the voice leading rules of the Baroque canon with fundamental auditory perception principles. Finally, as a component of melodic harmonisation algorithms, voice leading rules have been described and formalised for Bach chorale-like harmony (e.g. Hanlon & Ledlie, 2002), common practice harmony (e.g., Yi & Goldsmith, 2007) or jazz harmony (e.g., Eigenfeldt & Pasquier, 2010), whereas a recent study proposes a probabilistic voice leading system (only for the melody and bass line) that is idiom-independent (Makris et al. 2015).

The purpose of this study is to dissect a chord progression in a more detailed manner and encode all necessary information involved. A chord progression occurs in three stages: (a) the voicing of the first chord (e.g. inversions, doubled or omitted notes, etc), (b) the movement of the respective voices (e.g. movement of bass and inner voices, resolution of dissonances and leading notes) and (c) the voicing of the second chord. Analysing statistically these three factors in corpora of various musical styles, we opt to automatically encode voice leading in the harmonic representation itself so as to be able to render actual transitions between chords. Such voice-leading information is accumulated using data-driven methodologies, extracting voice-leading specificities from selected harmonic corpora from different harmonic idioms.

Methodology and Results

The GCT encoding will be enriched with DIC properties and additional appropriate voice-leading characteristics extracted from the above corpus-based study. The GCT representation is extended so as to encode: inversion (note in bass), common note doublings and omissions, statistically important note movements (e.g. leading note, resolution of seventh), statistically common bass note and inner voice movements. By encoding such voice leading information, we aim to bridge the abstract nature of these two novel representations with aspects of the actual musical surface.

The proposed encoding and methodology will be employed and tested on a melodic harmonisation task in the context of the CHAMELEON melodic harmonising assistant (http://ccm.web.auth.gr/chameleonmain.html; Kaliakatsos-Papakostas et al., 2016) applied on various melodies and harmonic idioms. The idioms include corpora that extend from fauxbourdon and organum pieces, Bach chorales and classical music of the 18th and 19th century to jazz, songs by The Beatles, atonal music and folk songs from Epirus. Harmonisations produced by the proposed methodology in well-understood idioms such as Bach chorale or fauxbourdon or classic jazz harmonies can be scrutinized by music theorists so as to evaluate the effectiveness of the system and the potential of the proposed encoding. We believe that the proposed voice leading sensitive encoding scheme may be a useful tool for systematising various musical idioms and for developing more sophisticated musical harmonisation algorithms.

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