

Melody-to-Harmony Correction Based on Simplified Counterpoint

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ABSTRACT

Creating an aesthetically pleasing melody is no simple task; indeed, the process has been studied and scrutinized for centuries. Even today, it is not easy for someone with little musical background to create a melody that sounds harmonious with a given chord progression, even if that melody is in the correct key signature. J. S. Bach is considered one of the greatest melody writers of all time, so in researching melodies, it is natural to look to the rules by which he wrote melodies: Counterpoint. The goal of this research is to derive the basic rules by which Counterpoint was founded, and to apply them to contemporary melody creation. Specifically, the focus is to correct a melody so that it consonates with a given harmony (e.g. a chord progression) after the notes are already in the correct key signature. The research presented here is the foundation of algorithms that have been incorporated in a new genre of commercially available music software and has found to be effective in bringing melodic composition more accessible to the musically un-trained mainstream.

1. APPROACH

In order to correct a melody, a two-pronged approach was found to be most useful. The first challenge is to identify what notes are already consonant with the chord over which they are played. Since those notes already sound harmonious, they do not need to be corrected or changed. Secondly, the notes that create dissonance with the chord over which they are played must be categorized into two sets: those that are an acceptable use of a dissonant note, according to simplified Counterpoint, and those that need to be corrected. The harmony under the melody is considered to be a set of consecutive triads within the diatonic key: a chord progression.

1.1 Note Consonance

In a diatonic framework, there are three types of basic triads that occur: Major, Minor, and Diminished. To simplify the problem, this research excluded the less-common Diminished triads. There is a finite set of intervals (from the root of the triad to the diatonic note) that occur over these types of triads (Major and Minor), given the possible diatonic positions of each.

With the sets of all possible intervals for each type of triad defined, it is possible to know all the potential dissonances for any diatonic melody played over any diatonic chord progression (excluding Diminished triads).

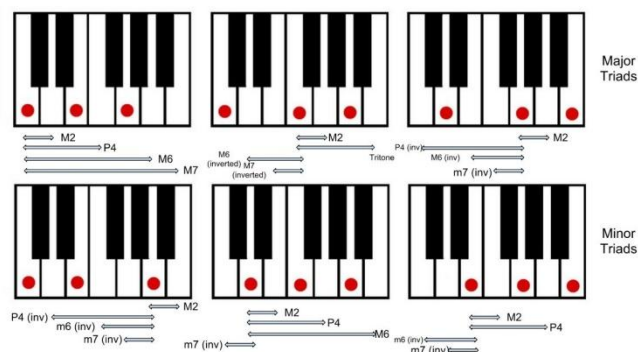


Figure 1 Chords shown are (left to right, top to bottom): CM, FM, GM, Am, Dm, Em. Arrows from the root of the chord to each non-chord tone denote the possible intervals.

In order to define this, we consider the most dissonant interval, as defined by three separate studies¹: the Minor 2nd. To categorize the intervals that are dissonant with a triad, any non-chord tone that creates a Minor 2nd with any of the given chord tones is considered to be dissonant. The interval sets, with the dissonant intervals emboldened and consonant intervals listed in plain text, are as follows:

Major Triad interval set: {Major 2nd, **Perfect 4th**, Major 6th, Major 7th, Tritone, and Minor 7th}

Minor Triad interval set: {Major 2nd, **Perfect 4th**, Major 6th, Minor 7th, and Minor 6th}

1.2 Distilling Counterpoint

The most useful rules which can be applied to contemporary melodies are found in the Second Species of Counterpoint. The Second Species introduces the use of non-chord tones—that is, any note that is not contained in the chord over which it is played. Moreover, the Second Species defines how these non-chord tones can be used in contrapuntal melodies. It categorizes non-chord tones into two main types, Passing Tones and Neighboring Tones:

"Passing tones are approached by step and resolved by step in the same direction. Neighboring tones are approached by step and resolved by step in the opposite direction. Less frequently one can employ appoggiaturas and escape tones"²

¹ [1] Malmberg (1918), [2] Hutchinson & Knopoff, (1979), and [3] Kameoka & Kuriyagawa, (1969), as cited by [4] Krumhansl (1990)
² [5] University of Arkansas, 2011

There is an underlying implication that these notes relate to chord tones; for example, any sequence of three diatonic steps will include a chord tone, and any neighbor tone that is not next to a chord tone is not a contrapuntal neighbor tone. All of these types can be encapsulated in a new category of notes: the Step Tone is defined as any note that moves one diatonic step into or away from a chord tone.

1.3 Melody Correction

Within the diatonic framework, given any chord, any note is at most one step away from a chord tone in the given chord. That means that any note needs to be moved, at most, two semitones in either direction in order to sound harmonious with the chord progression for any given diatonic melody played over any diatonic progression. Given the previous definition of dissonant intervals, as well as the new type of contrapuntal function, the Step Tone, we have the tools to identify dissonance in a given melody. Only those notes that both create a dissonant interval with the chord at hand, and also do not satisfy the definition of a Step Tone will be corrected.

The results demonstrate that the approach of utilizing simplified counterpoint rules along with a simple definition of dissonance is an effective technique to correct and increase the consonance of melodies. It is an integral part of the technology incorporated in a new genre of music software that will bring composition and arrangement into the realm of the non-musician.

2. DEMONSTRATION OF RESULTS

In the accompanying demonstration, the effectiveness of the simplified Counterpoint approach in automatically improving the consonance and shape of a melody will be established. The user will take a melody from a chromatic, out of key tune, to a key-corrected set of midi pitches, and finally to a guided melody corrected and shaped to the underlying harmony. The user will be able to hear her original vocals, pitch-corrected to the Counterpoint-based melody with the industry-standard Autotune plug-in, by Antares. Optionally, the user will be able to change the newly created vocal melody into an instrument via the rendering of the underlying midi with a range of VST plug-in options.

Furthermore, we will show how this exact algorithm allows for a set of pre-recorded vocal licks to be harmonized in any key or chord progression.

The software will be presented both with its 3D studio environment consumer-facing GUI, as well as its bare-bones development interface, to demonstrate the feature set of the underlying audio engine in more detail. The demonstration will merely require a projector with a VGA hookup

and screen, and a speaker system with a 1/8" jack. Music Mastermind's software will take the user from a simple sung melody, to a polished, produced song with extensive use of VST instruments, vocal and instrument effects, all mixed according to a proprietary mastering algorithm.

3. REFERENCES

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