Analyzing Classical Voice Leading Using Euterpea

Overview

The formal rules of classical voice leading are the result of hundreds of years of study by composers and musicologists. Many composers undertaking study in the composition of tonal music, even today, undergo some training in species counterpoint and its successor, voice leading. The principles of “good” voice leading are still understood to produce music which is pleasing to the listener, even when outside the context of the four-part harmonies from which the principles are derived.

One of the many ways in which new composition students learn to obey the rules of voice leading is by composing four-part chorales. In these exercises, students are given a series of chords and asked to realize the harmonization of the chords in four voices: bass, tenor, alto, and soprano. While this process is quite straight-forward from a strictly vertical standpoint, it is important to keep in mind that these parts will eventually be sung, and must also fit together horizontally. The rules of voice-leading aim to produce four-parts that are independent of each other such that their individual and overall pleasantness is maximized.

The goal of this project is to write several Euterpea functions in Haskell which will analyze a four-part chorale, ultimately producing a list of voice-leading errors found within a particular exercise. The functions produced in this project will be general enough that they should benefit the Euterpea library even outside the application of voice leading.

Terminology

Before exploring the extent to which we will check for errors, clarification on some terminology is needed. *Similar motion* will refer to the movement of two voices in the same direction by different intervals. *Parallel motion* will refer to the movement of two voices in the same direction by the same intervals. *Contrary motion* will refer to the movement of two voices in opposite direction by any intervals. *Oblique motion* will refer to the movement of two voices in which one voices changes note and the other holds the name note. *Resolution* will refer to the movement from a dissonant note in a voice to a consonant note. *Step* will refer to an interval between two notes which are immediately next to each other in a scale. The opposite of a step is a *skip*. 
Common Voice Leading Rules

The project will analyze 12 commonly accepted rules of voice leading practice, listed here in no particular order:

1. Do not allow two or more voices separated by a perfect 5th or an octave to proceed in parallel motion.
2. Do not allow the soprano and the bass to leap in the same direction into octaves or fifths (these are called hidden fifths).
3. Movement of two voices from a diminished fifth to a perfect 5th and vice-versa is acceptable only between soprano, alto, and tenor voices.
4. Do not double the leading tone (the 7 of a key), the 7th of an individual chord, or a non-chord tone when building the chord vertically.
5. Within a single voice, do not create diminished or augmented melodic intervals.
6. Do not allow 2 voices to cross -- that is, when a higher voice (such as soprano) sings a note lower than a lower voice (such as alto) and vice-versa.
7. Non-chord tones and 7ths of chords must resolve by step and in the downward direction.
8. Leading tones, when in outer voices (bass or soprano), must resolve to the tonic. When in inner voices, leading tones may not resolve to the 3, as this would produce a tritone within the line, violating rule 3).
9. Leaps within a voice must be followed immediately by stepwise motion in the opposite direction of the leap. (in the alto or tenor)
10. No interval greater than an octave may exist between consecutive voices except the tenor and bass. Rules governing the spacing between tenor and soprano are rarely enforced, but would be trivial to implement after implementing the check for octave-spacing between.
11. All parts must stay within their respective vocal ranges. That is to say, soprano notes may fall within the range C4 and G5, alto notes may fall within the range G3 to C5, tenor notes may fall within the range C3 to G4, and bass notes may fall within the range E2 to C4.
12. Do not allow a voice to sing the chromatic neighbor of a note which has just been sung in another voice (cross-relation).

Program Output

The program will output a list of errors detected within the chorale. The program will also attempt to correct errors to an extent. Often when composing voice leading exercises, students discover they have written themselves into “traps” for which there is no acceptable voice leading with which they may proceed. In this case, the student will have to backtrack and rewrite several chords, not only the chord in which the error occurred. Were this program to implement the “backtracked corrections” as described here, the question of who actually has composed the exercise comes into play. Was it the student, or the algorithm? To alleviate this concern, the program will only attempt to correct one chord at a time. It may choose to correct the chord
leading to the error or leaving the error. If, as the semester progresses, further exploration into
this topic is necessary, the project may expand to include the backtracking correction feature,
though this will likely change the scope of the program to include "composition" of four-part
chorales.

**Correction-algorithm guidelines**

It would be trivial for the program to output a list of harmonizations of a chord which are
all "acceptable" in the event of an error. However, there are several rules which can be used to
dictate which re-harmonizations are preferred. In order of importance, the rules which we will
use are:

1. Avoid altering the note in the bass, unless it is the sole offending note
2. Avoid altering the note in the soprano, unless it is the sole offending note
3. Prefer “parsimonious” voice leading, in which there is as little movement in each line as
possible.
4. Prefer oblique and contrary motion to parallel and similar motion

**Deliverables**

The main deliverable will be Haskell code which detects and proposes simple
corrections for voice leading errors, given the input of a four-part chorale. The code will be highly
modular, allowing for reuse in other applications, especially within the Euterpea library. Sample
output will be provided, as well as a final report on the success of the correction-algorithm. All
materials will be delivered as a set of web pages for submission to the CPSC 490 class projects
page.

**References**

Thomson/Schirmer.
Rules involving one voice:

- All parts must stay within their respective vocal ranges. That is to say, soprano notes may fall within the range C4 and G5, alto notes may fall within the range G3 to C5, tenor notes may fall within the range C3 to G4, and bass notes may fall within the range E2 to C4.
- Non-chord tones and 7ths of chords must resolve by step and in the downward direction.
- Leading tones, when in outer voices (bass or soprano), must resolve to the tonic. When in inner voices, leading tones may not resolve to the 3, as this would produce a tritone within the line, violating rule 3).
- Leaps within a voice must be followed immediately by stepwise motion in the opposite direction of the leap.

Rules involving two voices:

- **Do not allow 2 voices to cross** — that is, when a higher voice (such as soprano) sings a note lower than a lower voice (such as alto) and vice-versa.
- Do not allow two or more voices separated by a perfect 5th or an octave to proceed in parallel motion.
- Do not allow the soprano and the bass to leap in the same direction into octaves or fifths (these are called hidden fifths).
- Movement of two voices from a diminished fifth to a perfect 5th and vice-versa is acceptable only between soprano, alto, and tenor voices.
- Do not allow a voice to sing the chromatic neighbor of a note which has just been sung in another voice (cross-relation).
- No interval greater than an octave may exist between consecutive voices except the tenor and bass. Rules governing the spacing between tenor and soprano are rarely enforced, but would be trivial to implement after implementing the check for octave-spacing between.

Rules involving all four voices:

- Do not double the leading tone (the 7 of a key), the 7th of an individual chord, or a non-chord tone when building the chord vertically.
- Within a single voice, do not create diminished or augmented melodic intervals.
Progress