

Palestrina Pal: A Grammar Checker for Music Compositions in the Style of Palestrina

1. Research Team

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2. Statement of Project Goals

The goal is to design algorithms and a user interface for an automatic grammar checker for compositions in the style of Palestrina. This form of counterpoint forms the pedagogical foundation for composition classes today and consists of numerous well-defined rules. Checking for violation of these rules in a composition is a tedious task that can be automated so that composers can focus on higher level aesthetic issues.

3. Project Role in Support of IMSC Strategic Plan

This research supports IMSC's research in user centered sciences and information management through interfaces for computer-assisted music composition (CAC). The software application uses knowledge-based and automatic evaluation of music to improve musical communication and the learning of compositional skills.

4. Discussion of Methodology Used

The software is coded in Java using object-oriented programming (OOP) methodology. We have chosen the GUIDO representation for musical scores [3][4]. Any polyphonic composition can be encoded using the GUIDO format. For example, the following is a GUIDO representation of measure 47 in Palestrina's *Sicut Cervus* shown in Figure 1:

```
[ a1*1/2 g1*1/4 f1*1/4 g1*1/1 ]  
[ f1*1/2 e1*1/2 e1*1/1 ]  
[ c1*1/2 c0*1/4 d0*1/4 e0*1/4 f0*1/4 g0*1/4 e0*1/4 ]  
[ c0*1/1 c0*1/1 d0*1/2 ]
```

Sicut Cervus Palestrina

The image shows a musical score for 'Sicut Cervus' by Palestrina, featuring four voices: Soprano, Alto, Tenor, and Bass. The time signature is 4/2. The score includes annotations for dissonance treatments: 'Neighbouring Note against Alto and Bass' (circled note in Soprano), 'Passing Tone against Alto and Bass' (circled note in Tenor), and 'Passing Tone against Bass' (circled note in Tenor).

Figure 1: Palestrina's *Sicut Cervus*

Using the GUIDO notation to handle musical score data, algorithms are designed to address each of the rules pertaining to voice-leading, suspensions and parallel intervals in Palestrina compositions. The implementation of the rule-checking mimics how composers might actually proofread their work, scanning it for rule violations.

The composition rules (see [1]) implemented in the Palestrina Pal software includes:

Harmonic rules:

Perfect parallelism – avoid parallel fifths, octaves and unisons.

Direct/Contrary parallelism – avoid fifths and octaves approached by leaps in the same direction or by contrary motion.

(Dissonance treatments)

Suspension – this idiom involves a consonant preparation, dissonance (a half note) on the same pitch on a strong beat, and resolution down by step to a consonance.

Neighbor Note – a quarter or eighth note dissonance on the weak part of a beat approached and resolved in opposite directions.

Passing Tone – a half note or quarter note dissonance on the weak beat approached and resolved by step and in the same direction.

Anticipation (consonant or dissonant) – a quarter note on the weak part of any beat that anticipates the pitch of the coming consonant vertical interval.

Melodic rules:

Range – soprano, alto, tenor and bass voices must operate within well-specified ranges.

Melodic leaps – use only m2, M2, m3, M3, P4, P5, m6(ascending only), and P8(rare).

Uncompensated leaps – melodic leaps are to be compensated (approached and left in opposite direction as leap).

Rhythmic rules:

Note values – Basic note values are limited to double whole notes to eighth notes.

Dotted note values – Any values other than the quarter and eighth notes may be dotted.

Dotted note Positions – Dotted whole notes may begin only on beats 1 or 3, and dotted half notes must start on the beginning of a beat.

A score representation with manual musical analysis identifying the correct dissonance treatments by Palestrina are shown in Figure 1. When such an example is given to the Palestrina Pal as input, one would expect no errors to be found. Figure 2 shows the GUI for the Palestrina Pal showing the evaluation results when the *Sicut Cervus* was given as input. As expected, the evaluation results concur with the manual analysis, and no errors are found.

The screenshot displays the Palestrina Pal software interface. The title bar reads "Palestrina Pal by Cheng Zhi Anna Huang, Faculty mentor: Professor Elaine Chew". The interface is divided into several sections:

- Left Panel (Checkings):** A list of checkboxes for various musical rules, all of which are checked. The categories are:
 - Click to ENABLE checkings:
 - Palestrinian style (enables all)
 - Harmonic checkings:
 - Perfect parallelism - //
 - Direct/Contrary parallelism - dc//
 - Near parallelism - n//
 - Suspension - Sus
 - Neighbor Note - NT
 - Passing Tone - PT
 - Anticipation - Ant
 - Cambiata Figure - Cam
 - Melodic checkings:
 - Range check - OR
 - Illegal melodic leaps - IL
 - Uncompensated leaps - UL
 - Rhythmic checkings:
 - Illegal Note Values - I duration
 - Illegal dotted note values - L
 - Illegal Dotted note Position - LP
- Main Area:** Displays musical notation for four voices (soprano, alto, tenor, bass) across four beats. The notation includes note values and pitch classes. For example, Voice 1 starts with a dotted half note (a1*1/2) on beat 1, followed by quarter notes (g1*1/4, f1*1/4, g1*1/4) on beats 2, 3, and 4. The error message area below the notation is empty, indicating no errors were found.
- Bottom Panel:** Includes a piano keyboard graphic, a velocity slider (set to 64), pressure, reverb, and bend sliders, and a "Run checking" button.

Figure 2: The Palestrina Pal evaluation result for *Sicut Cervus*.

5. Short Description of Achievements in Previous Years

N/A.

5a. Detail of Accomplishments During the Past Year

A working prototype of the Palestrina Pal application has been completed. This software was demonstrated at the Integrated Media Systems Center's Scientific Advisory Board/ Board of Councilors meeting on November 20, 2003.□

Data input: Users can input their music compositions by importing GUIDO text files or from the keyboard interface shown in the lower part of Figure 3. The keyboard interface allows users to choose the desired note values and accidentals before clicking on the keyboard and to adjust common MIDI parameters such as velocity.

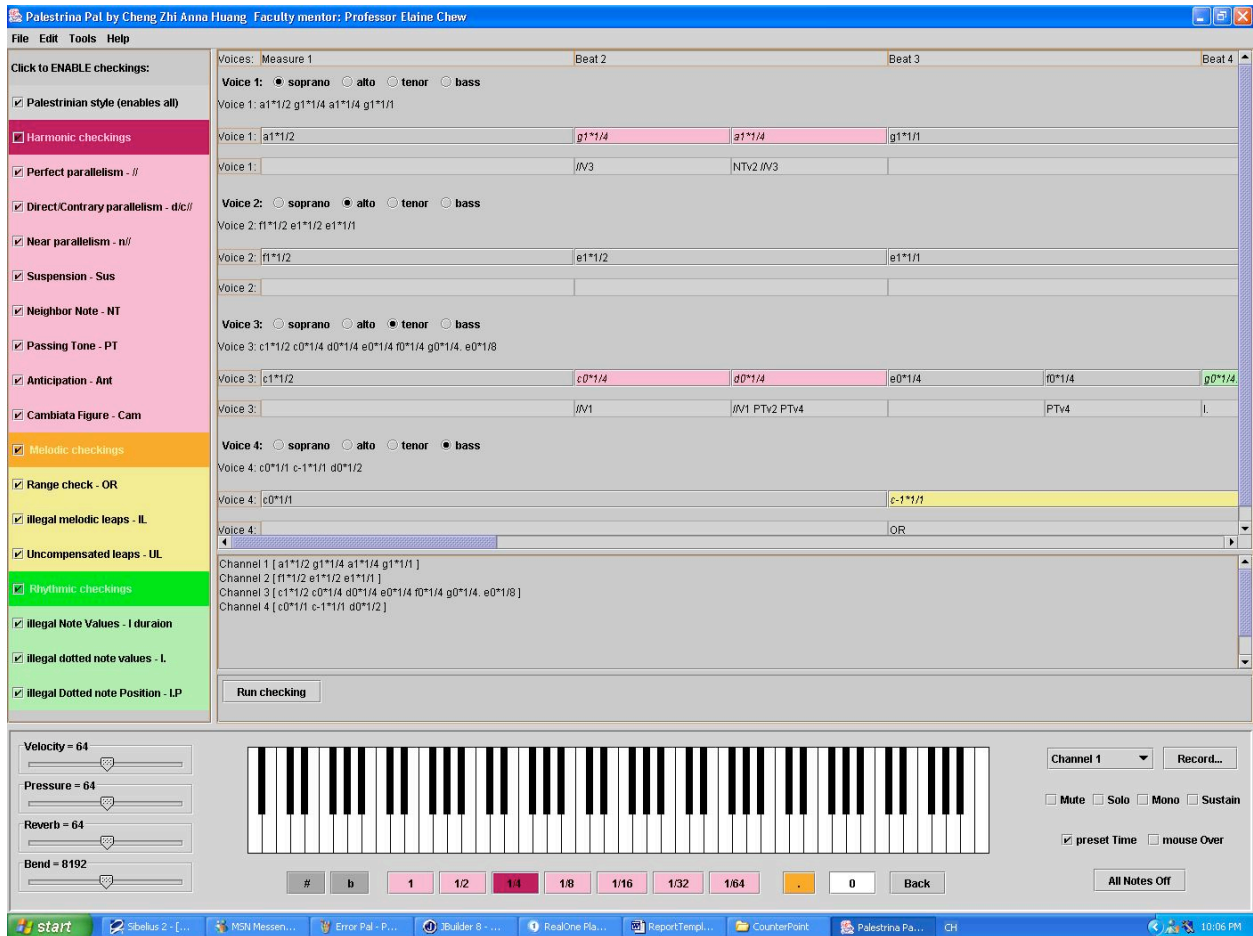


Figure 3: The GUI with all the stops.

Customization: Users can click on the check boxes on the left-hand panel to select the types of rule violations to be checked. The rules are grouped into three types: harmonic, melodic and rhythmic. Special buttons at the header of each group enables all rules in each group to be

selected. In the example in Figure 3, all rule checks are enabled. In addition, users can decide the range (soprano, alto, tenor or bass) for each of their voices.

Error Display: All errors are highlighted and color-coded in the graphical user interface. Pink highlights indicate harmonic rule violations, including parallelisms and dissonance treatments. Yellow highlights indicate melodic rule violations such as melodic leaps and range. Green highlights indicate rhythmic rule violations such as illegal note values and placements.

Error Correction: Users can correct the notes by typing in the text fields that represent the note until they are satisfied.

The corresponding score and analysis for the evaluation of the Modified *Sicut Cervus* shown in Figure 3 are shown in Figure 4.

The image shows a musical score for four voices: Soprano, Alto, Tenor, and Bass, in 4/2 time. The title is "Modified Sicut Cervus". The score is annotated with several errors:

- Neighbouring Tone against Alto:** A blue callout box points to a pair of notes in the Soprano and Alto staves.
- Parallel Fifths:** A pink callout box points to a pair of notes in the Soprano and Tenor staves.
- Quarter Notes can not be Dotted:** A green callout box points to a dotted quarter note in the Tenor staff.
- Out of Range:** A yellow callout box with an eye icon points to a note in the Bass staff.
- Passing Tone against Alto and Bass:** A blue callout box points to a pair of notes in the Tenor and Bass staves.

Figure 4: Manual analysis of score shown in Figure 3.

A description of Palestrina Pal and related experiments is being prepared for submission to the 2004 International Computer Music Conference:

Huang, Cheng-Zhi Anna and Chew, Elaine. "Palestrina Pal: An Object-Oriented Grammar Checker for Music Compositions in the Style of Palestrina" In preparation for the International Computer Music Conference, Miami, FL, November 2004.

6. Other Relevant Work Being Conducted and How this Project is Different

As far as we know, this is the first such system developed for the automated evaluation of Palestrina style compositions. Other computational work on Palestrina style compositions by Farbood and Schoener [2] focus only on the synthesis of Palestrina style compositions using Markov models. What we have developed is a composition tool to assist composers in the creation of better Palestrina style compositions with potential for practical use in the music classroom.

7. Plan for the Next Year

Plans for the next year include: improving the user interface by introducing a piano roll representation for the music, incorporating secondary level rules, adding suggestions for corrections, and conducting some user studies.□

Although preliminary attempts to introduce music faculty to the system has met with some resistance, it is our goal to bring the software to practical use as an educational tool in the composition curriculum.

8. Expected Milestones and Deliverables

All points mentioned in part 7.

9. Member Company Benefits

The deliverables include a software product ready for use in the classroom that can change the way Palestrina composition is taught and vastly improve the educational experience of budding composers.

10. References

- [1] Benjamin, T. (1979). *The Craft of Modal Counterpoint*. Canada: Schirmer Books.
- [2] Farbood, M. & Schoner, B. Analysis and Synthesis of Palestrina-Style Counterpoint Using Markov Chains. *Proceedings of International Computer Music Conference*. Havana, Cuba. 2001.
- [3] Hoos, H.H., Hamel, K.A., Renz, K. and Kilian, J. (1998). The GUIDO Music Notation Format – A Novel Approach for Adequately Representing Score-level Music. *Proceedings of the International Computer Music Conference*, p.451-454.
- [4] The GUIDO Music Notation Format Page: www.informatik.tu-darmstadt.de/AFS/GUIDO