ASPECTS OF MELODY GENERATION FOR THE LOST CHANT OF THE MOZARABIC RITE

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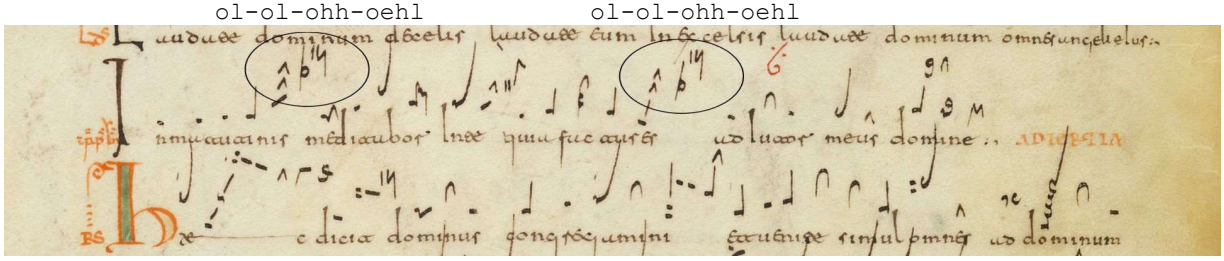
ol-ol-ohh-oehl ol-ol-ohh-oehl



oh-ohhh-oell-ol-ol-ohl---o--oel-oehl---oh--ol--o---oh--o--ohh--ol--ohhll-oh-ol

Figure 1. Two lines from the early tenth-century León antiphoner (E-L 8, 111v6-7). At the bottom: the opening of the responsory *Haec dicit Dominus congregamini.* Below the manuscript image a representation of the neumatic notation on these first four words in contour letters. In the top line two occurrences of an *intra-opus* pattern with representation.

1. INTRODUCTION

In medieval Europe several textually and musically related monophonic liturgical chant traditions existed. Most famous is the Franco-Roman chant of the Roman rite, better known as Gregorian chant. Most other rites and traditions were abolished at some point in favor of the Roman rite and its chant (Hiley, 1993).

The Mozarabic rite existed from the end of the sixth till the end of the eleventh centuries on the Iberian peninsula. Its music (over 5000 chants) is preserved in pitch-unreadable neumatic notation. Figure 1 gives an example. The tradition was abolished in the time when pitch readable notation came in use. Therefore the intervals of most melodies are unknown. Only a handful of chants was ever found in pitch readable notation (Randel, 2001).

We have presented two computational methods of melody generation for the lost chant of the Mozarabic rite (Maessen & Conklin, 2018). To improve this generation we examined melodic aspects to be included, experimentally and in the literature (Gregoriana Amsterdam; Hiley, 1993; Troelsgård, 2014). Some aspects appear hard to quantify, for example, the meaning of the chant texts in relation to the liturgical calendar in which all chants have their specific places. Also problematic is the recent articulation of *musemes* that underline specific text passages (Lousberg, 2018). We found ten quantifiable aspects of the lost melodies that can (and should) be implemented in the generation. More aspects may emerge by using a third method, based on deep learning and neural networks.

2. QUANTIFIABLE ASPECTS

1. All generated melodies should agree with the *neumatic notation* in which the chants are preserved. The meaning of this notation (Rojo & Prado, 1929) should be represented in machine readable form. A basic way to do so is with contour letters. Each neume can be represented as a sequence of letters from the set L ={`o, h, l, e`}, the `o` representing the first note of a neume, the `h` a note higher than the previous one, the `l` a note lower, and the `e` a note of equal pitch. Figure 1 gives an illustration including Volpiano conventions to separate notes for different neumes with a dash `-`, for neumes on different syllables with two dashes `--`, and neumes on different words with three dashes `---` (Swanson, Bain, Helsen et al. 2016). However, since most neumes have several variants in their graphical forms, the representation in four letters needs improvement. Figure 1 shows e.g. three variants of the *pes* (`oh`) and three for the *clivis* (`ol`). Also, neumatic positions above the chant text may represent indications for melodic motion. The second neume (`ohhh`) in Figure 1 e.g. starts lower than the first (`oh`) and the third (`oell`) starts higher than the second. Including variants and positions in the representation could improve melody generation.

2. Some recurring patterns within single chants seem to represent the same melodic content, for example, the encircled neumes in Figure 1. For these *intra-opus patterns* melody generation should result in patterns with equal sequences of pitches (Conklin, 2010). Recurring patterns of five notes, such as `oh--ol--o`, should not always generate the same sequence of pitches. On the other hand there is a wide consensus that recurring patterns of twenty or more notes do represent the same sequence of pitches (Maloy & Hornby, 2012). Of importance also, is the precision of the representation. Representations using all pattern information should result more easily in equal pitch sequences than representations using only the letters of L.

3. Melodies generated for single chants should be constrained to a specific *range* or *ambitus.* Random melody

generation could not only exceed the limits of the human voice, but also the expected range of certain chant genres. Simple antiphons should be limited in their range, while more complex chants could have a wider range. In Gregorian chant the range of a chant depends at least on chant genre, mode, and the parts within genres. Ranges could be set manually, or trained on related traditions.

4. In some cases it will be desirable to define *specific pitches* of the generated melody beforehand, like the first and the last pitch. For some chants specific pitches may be known, as is the case with some responsory verses.

5. Melody generation should respect *cadences.* The melodic pacing of Mozarabic chant is determined by the grammatical phrases of the text and specific recurring patterns in the neumatic notation (Maloy & Hornby, 2012). These cadences should be included in the representation. Volpiano conventions make the numerals `6`, `3`, `4` and `5` respectively represent the end of a phrase, of a sentence, of a major part, and of the end of the piece. Longer melismas, also, can include cadences.

6. Several chants seem to have patterns in common. For these *inter-opus patterns* melody generation should result in equal sequences of pitches, or even better, intervals. We have similar problems here as with *intra-opus* patterns. *Inter-opus* patterns of 30 or more notes definitely should result in equal pitch sequences, but some specific patterns of only five notes should also do so. The 30-note pattern on the three opening words of the responsory in Figure 1 exists in six different chants (four responsories, a sacrificium and an alleluiaticus; E-L 8: 66r12, 94v03, 98r15, 111v07, 240r16 & 266r09) and therefore is an *inter-opus* pattern. In 458 responsories, the five-note pattern on *Dominus,* however, exists 39 times with the same neume variants on the same word, *Domin(us),* and only 14 times on other words. Unspecified, `oh--ol--o` exists 122 times. Therefore the specific pattern is a serious candidate for equal pitch sequences. *Inter-opus* patterns require the generation of a set of related melodies. Most chant traditions consist of such related melodies.

7. Several lost chants are related to chants on the same text in other traditions (Levy, 1998). For each chant, melody generation should be based on the *most related tradition* and within that tradition on the most related genre. We developed a method to find the most related tradition (Maessen & Van Kranenburg, 2018).

8. Most chants of the Franco-Roman tradition are associated with one of the eight church *modes.* Don Randel suggested the improbability of a well-defined concept of mode (or tonality) for the responsories of the Mozarabic Office (Randel, 2001). We are looking for ways to define melodic characteristics of subsets of large sets of chants, specific for those only preserved in neumatic notation.

9. Melody generation should handle *rhythm.* Equal pitch sequences with different rhythm appear to have different occurrence rates in chant. Also, there is a distinct mensuralistic interpretation for the tenth-century notation of Gregorian chant (Van Biezen, 2013). A similar interpretation can (partially) be given for Mozarabic notations.

10. Finally we consider *word accents* a quantitative aspect that should be implemented in melody generation. Word accents of medieval Latin are known and determine the melodic motion of chant (Randel, 2001).

3. CONCLUSION AND FUTURE WORK

In order to improve any method of melody generation for the lost chant of the Mozarabic rite there are at least ten quantifiable aspects, features or constraints, that should be implemented. Until now, the first five aspects have been partially implemented in our methods. We are working on the full implementation of these and the other aspects. Aspect 7 is already the subject of a publication. Currently we are focusing on aspect 8. Since September 2018 we are also experimenting with aspect 9 in performances.

4. REFERENCES

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