INSTRUMENTAL IDIOM IN THE 16TH CENTURY: EMBELLISHMENT PATTERNS IN ARRANGEMENTS OF VOCAL MUSIC

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ABSTRACT

Much surviving 16th-century instrumental music consists of arrangements ('intabulations') of vocal music, in tablature for solo lute. Intabulating involved deciding what to omit from a score to fit the instrument, and making it fit under the hand. Notes were usually added as embellishments to the original plain score, using idiomatic patterns, typically at cadences, but often filling simple intervals in the vocal parts with faster notes.

Here we test whether such patterns are both characteristic of lute intabulations as a class (vs original lute music) and of different genres within that class. We use patterns identified in the musicological literature to search two annotated corpora of encoded lute music using the SIA(M)ESE algorithm. Diatonic patterns occur in many chromatic forms, accidentals being added depending how the arranger applied the conventions of musica ficta. Rhythms must be applied at three different scales as notation is inconsistent across the repertory. This produced over 88,000 short melodic queries to search in two corpora totalling just over 6,000 encodings of lute pieces.

We show that our method clearly discriminates between intabulations and original music for the lute ($p < .001$); it also can distinguish sacred and secular genres within the vocal models ($p < .001$).

1. INTRODUCTION

A large proportion of surviving solo instrumental music from before the 17th century is made up of arrangements, or *intabulations*, of pre-existing vocal music, much of it printed in the 16th century. [1] Most of these are for solo lute and are notated in tablature; several collections of intabulations for keyboard instruments also exist, though they are not considered in this paper. These arrangements are rarely strict reproductions of the scores of their vocal models. Even those which aim at faithful representation of the vocal parts almost invariably contain pitch and rhythmic alterations, as well as omitted and added notes.

These changes come in different forms and might arise from various motivations:

- They may reflect unnotated aspects of performance practice for the vocal model;
- They may reflect attempts to make the music better match the idioms of instrumental style;
- They may result from the practical limitations of playing multiple voices on a single instrument;
- They may arise from the individual style of the intabulator, the musical genre or current fashion.

Studying the process of intabulation, then, has the potential to reveal much about several aspects of vocal and instrumental music of the time, along with the nature of individual style, by allowing us to draw attention to explicit and conscious changes to a text and to attempt to infer the motivation for those changes.

In this paper, we describe an experiment tracing the use, in two collections of encoded lute music, of typical melodic embellishment patterns identified in the musicological literature. The collections, which are broadly representative of the 16th-century lute repertory, contain a mixture of original idiomatic music composed for the lute and intabulations of vocal music, and we wanted to determine the extent to which embellishment patterns might be viewed as diagnostic features – can we use them to distinguish intabulations from music originally composed for the lute? We also carried out a further investigation into whether the occurrence of the patterns can be associated with the style of the music being arranged – were they applied differently to sacred and secular vocal music by the arrangers? These may be considered as simple proxies for more complex questions about the distinct identity of lute intabulation as a genre and are intended as a first step towards richer and larger-scale musicological studies which, for example, might compare intabulations with encoded scores of the original vocal music, or induce patterns of embellishment automatically.

2. BACKGROUND

About half of the surviving repertory of sixteenth-century lute music consists of intabulations. The Early Music Online (EMO) resource hosted by the British Library and RHUL comprises digital images of 300 books of printed music from before 1700.[1] About 10% are books of lute music, written in tablature. A number of these have been

[1] http://www.earlymusiconline.org

incorporated in the Electronic Corpus of Lute Music (ECOLM).[2] In the Transforming Musicology project[3] one of the three main work-packages is a programme of research on workflows and methods for musicological investigation of these resources. The tablature encodings used in this paper, together with detailed metadata, will soon be released as Linked Open Data.[4]

There is a considerable degree of repertorial overlap between the vocal and instrumental music in EMO; much of the vocal music also appears in intabulations for lute or keyboard, sometimes in multiple arrangements. This overlap provides the basis for ongoing musicological investigations within Transforming Musicology.

There is some specialist literature on the methods of intabulation adopted by various lutenist-composers of the 16th century [9][10][11], but systematic (computational) study has not hitherto been possible owing to a general lack of suitable annotated corpora of encodings. Here we describe an experiment to test the notion that, while some of the melodic patterns found in the corpus may be part of the common stylistic currency of a period, others may be diagnostic of an idiom of arrangement, or of a musical genre (in the musicological, rather than MIR, sense). That is, we ask whether some patterns are found across all lute music of a certain time or place, while others are encountered more in intabulations than in more exclusively idiomatic music composed for the instrument such as dances, preludes or fantasias.

Since we know that there were generally stylistic differences between vocal music composed for religious contexts and those for secular use, we further ask whether the use of embellishment patterns suggest that intabulators treated sacred music differently than secular in their arrangements. In this period, and with this repertory, a distinction based on language is generally safe – that is, Latin masses and motets are classified as sacred, whilst vernacular chansons and madrigals in French and Italian (or occasionally English or German), are considered secular even if the events they describe are biblical.[5]

The chromatic inflection of pitches in 16th-century staff-based music notation is not fully explicit. When such music is intabulated, however, the precise chromatic pitch of each note is given in the tablature. The resulting chromatic changes to the plain diatonic vocal model could be assigned to two contrasting motivations on the part of an intabulator: either as a record of a contemporary interpretation of standard *musica ficta* practice, or as the result of idiosyncracies of instrumental music which may in turn have had an effect on the emergence of the modern tonal system. Considered as the former, they have been used to attempt to reconstruct elements of vocal performance practice [2].

As an example of the practice, in Figure 1 we show the opening of a popular madrigal, first published in 1541. The original vocal version is shown (a) in short score, together with (b) one of its many intabulations, from a late 16th-century source. The interpolated notes in the bass (bar 1) and alto (bar 3) parts represent typical embellishment patterns of the type we discuss in this paper. Note also that the lute version supplies *musica ficta* accidentals not present in the vocal original; these are likely to differ from those supplied in other intabulations.

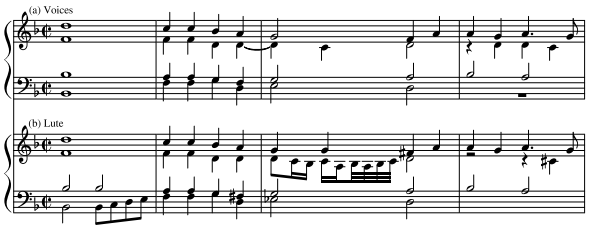

Figure 1. The opening of Berchem's 'O s'io potessi donna': (a) the original for voices, and (b) as intabulated by Emanuel Adriansen (*Pratum Musicum*, 1584)

For this paper, we study melodic embellishment patterns as possible stylistic markers of instrumental idiom. A few scholars have published 'vocabularies' of such patterns, inspired by the significant number of treatises from between 1535 and 1620 which give copious examples by way of instruction for players of string and wind instruments. [7][8]

In this preliminary study, we focus on a seminal example by a leading musicologist of the last century. In [3], Brown considers the embellishment patterns applied by three different early 16th-century intabulators to a single popular (secular) madrigal, Giachet Berchem's 'O si'o potessi donna', and provides a table of the patterns he identifies (78 distinct patterns). This table is effectively a set of embellishment templates that might be used by intabulators to expand simple intervals in the vocal parts of the model. An extract from Brown's table, showing some of the embellishment patterns used by Dominico Bianchini i n his intabulation in [4] is shown as Figure 2. The patterns are given without clefs or accidentals, as the precise pitches and intervals used can be expected to vary depending on context (including diatonic transposition and *musica ficta*).

In [5] Robison studied a single source of lute intabulations from 1558, listing a set of 95 such patterns found in the 76 arrangements therein. Neither he nor Brown attempted to generalize this work or to assess empirically the extent to which the patterns identified are themselves indicative of something more general, although in [7] Brown had discussed the tradition of instrumental and vocal embellishment through the numerous treatises published in the 16th and early 17th centuries.

[2] http://www.ecolm.org
[3] http://www.transforming-musicology.org
[4] Much of the metadata is already published at http://slickmem.data.t-mus.org/ .
[5] An example of the latter case is the enormously popular chanson by Orlande de Lassus, 'Susanne un jour', which concerns the story of Susanna and the Elders from the Book of Daniel.

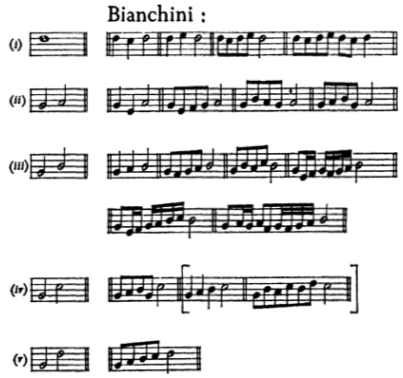

Figure 2. An extract from Brown's table of embellishment patterns found in lute intabulations of Berchem's 'O s'io potessi donna' (from [3])

3. METHOD

For this experiment, we use two test corpora:[6]

- a snapshot of the works currently in ECOLM, containing some 1,351 lute pieces. Works in ECOLM are transcribed as they appear in the original sources (including printing or scribal errors) and have been added and selected based on a series of academic research projects funded by the UK Arts and Humanities Research Council since 1999;
- a private collection, created by Sarge Gerbode, of 4,723 performing editions of lute pieces. These have been edited by the compiler, who is not an academic musicologist. The test corpus used is a subset of a larger collection, including only pieces from the 16th or very early 17th century. The corpus is known to contain some duplicates, for example to support performance on different instruments, but these represent a very small proportion of the works.

	Intabulations	Other	Total
ECOLM	147	1,204	1,351
Gerbode	1,048	3,675	4,723
Total	1,195	4,879	6,074

Table 1. Summary of our two test corpora

Metadata for the corpora includes genre and subgenre labels. The distribution of pieces is shown in Table 1. Dates, places and attributions are also available for some of the pieces, but there is likely to be some approximation involved. For the purpose of this experiment, pieces in these collections are represented as a sequence of `<onset, pitch>` tuples and interrogated using a Javascript implementation of SIA(M)ESE. [6] All versions of the subject of Brown's study [3], Berchem's madrigal, 'O s'io potessi donna', were deliberately excluded from both corpora to avoid bias.

[6] Both corpora, in the format we used for our experiment, and related metadata will be made available in due course to researchers via the Transforming Musicology web-site (see note 3).

Lute tablature has no voicing, pitch spelling or individual note-duration built explicitly into the notation. Instead, it indicates the fret/string positions of the left-hand fingers and the duration between successive chords or single notes struck with the right hand. We have encoded Brown's set of 78 (monophonic) embellishment templates using diatonic note-names. To search for passages matching one of the templates in the onset/pitch matrix, we need to realize all the possible chromatic inflections of all notes in each template. These are represented using chromatic pitch.

Each pattern was taken to start on (diatonic) C and all its notes realized in such a way that they could be spelled using 16th-century staff notation. This allowed pitches to be spelled as any of [C, C#, D, Eb, E, F, F#, G, G#, Ab, A, Bb, B]. All possible spellings of the pattern's note sequence starting on C and corresponding queries were generated, and then the process was repeated starting on D, and so on.

Figure 3a shows one of the simplest patterns from the Brown set, a plain passing-note motion. This is listed by Brown as one of those used to fill a rise of a third in a vocal line of the model (cf Figure 2, (iii)). In practice, the third might (in modern terms) be major or minor and filled by a combination of tones and semitones dependent on the local tonal context. Figure 3b-d are all what, in modern terms, would be called diatonic, in either major or minor modes. Figure 3e-g are less 'tonal' in that sense, and they are unlikely to occur in this context in 16th-century music. This does not mean that the note patterns within them will not occur in our corpora. Figure 3e, for example, is a simple chromatic scale and, while it is unlikely to happen in the context of 'filling a third', since the diminished third it connects probably never happens, in other contexts, it may be fairly common.

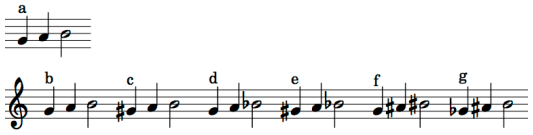

Figure 3. An embellishment pattern from Brown's list (the first at (iii) in Fig. 2) and some of its realisations.

For the 78 unique patterns in [3], this produced a total of 29,476 queries, which we have classified, based on the scale degrees chosen, according to whether or not they make tonal sense within the modern major/minor mode system, the idea being that we might be able to eliminate *a priori* those transformations with vanishingly small probability of occurrence. Of the realizations, we found 58 that could be interpreted in either a major or minor context, 88 just in major and 4,936 in minor (permitting the sixth and seventh degrees to be flattened or natural). This may be a fairly naïve approach from a music-theoretic standpoint, but it is reasonably complete and inclusive. The instrumental music of the period was changing rapidly in terms of scales, tonality and chro-

matic inflection, and we have not attempted to generate rules from the musical data itself. On the other hand, the only cost of generating too many patterns is computational time – if our searches include unlikely patterns, their effect on the final analysis will be negligible, since they will produce very few or no results. In the event we carried out all our searches using the full set of 29,476 patterns. If the major or minor forms had proved as diagnostically useful as the full set of patterns, then searches in future experiments could be limited to these, dramatically reducing the time required for searching, however this was not the case.

Turning to the time dimension, the relationship between metrical level and rhythmic notation is especially varied during this period, particularly so for lute music, the notation of which favors short durations. For this reason, each pattern is tested using not only the rhythms given by Brown, but also with the durations doubled and halved, trebling the final number of search patterns to 88,428.

As we have indicated, some of the shorter patterns described are trivial, and can be expected to occur universally, not only as elaboration patterns in other genres, but also as melodic elements in their own right. (The example given in Figure 3 is such a case; the other, more elaborate patterns in Figure 2 (iii) are less likely to appear ubiquitously.)

As an alternative method of *a priori* selection, those of Brown's list of patterns judged by an expert musicologist to be most characteristic of intabulations were labelled in advance. Although this was not used for pruning the search as originally intended, it gives an informal set of 'ground truth' judgements which offer us the opportunity to carry out a further test of our method.[7] In general, the patterns preselected by our expert were longer than those rejected, so we also did a similar evaluation based on pattern length.

Analyses were carried out on a complete set of results obtained from the exhaustive search of our two test-sets using all 88,428 transformations of the patterns as queries; the resulting 'hits' were stored in an SQL database together with metadata from the annotated corpus as the search was done. Since SIA(M)ESE is a partial-matching algorithm (as opposed to approximate-matching) we had the possibility of recording incomplete matches, which we limited to a threshold of 80% of the notes in the query; a simple SQL operation enables us to filter out the partial matches if necessary.

4. RESULTS

58.3% of all queries from our list of patterns found matches in intabulations, while only 48.3% of all queries on other lute pieces produced matches. This association of patterns with the intabulation repertoire was confirmed by a χ^2-test, comparing observed and expected frequencies of hits and non-hits between intabulations and other lute pieces ($\chi^2 = 6041$, $df = 1$, $p < .001$).

63.7% of the queries on intabulations from the sacred repertoire found patterns, while only 57.1% of queries on non-sacred intabulations contained patterns. A subsequent χ^2-test using data only from intabulations confirmed the strong association of pattern occurrences with the sacred repertoire ($\chi^2 = 508$, $df = 1$, $p < .001$).

However, simple χ^2-tests do not offer the possibility of investigating for the influence of other variables that might affect the likelihood of a pattern occurring in a given piece beyond the fact that it is an intabulation or not. Therefore we analysed the results with binomial mixed effects models where the variables of primary interest (`isIntabulation` and `isSacred`) can be entered alongside other variables we wish to control for. The dependent variable was a binary indicator recording whether or not a particular query returned a 'hit' (i.e. the query pattern was found in the queried piece). The main independent variable in the first model was `isIntabulation`. But we also controlled for the influence of three additional variables in the model (all described above): `isLong` (long patterns were defined to have between 7 and 13 notes, short patterns ranged from 3 to 6 notes), `IsMajor`, and `HasExpertLabel`. We used the identifier of the 78 patterns as a random effects variable.

Modelling was done using the glmer function in the R package lme4 [13] and started from a fully saturated model specifying all main effects as well as all 2-way, 3-way and the 4-way interaction effect. We then used a step-wise backward model selection procedure based on improvements in the Bayesian Information Criterion (BIC) to arrive at a more parsimonious final model which only contained highly significant effect terms (all p-values < .001). The parameter estimates, their standard errors, z-values of the Wald-statistic, associated significance level and the odds ratios derived from the parameter estimates of the final model are given in Table 2.

The model confirms the result from the first χ^2-test. The significant main effect for `IsIntabulation` indicates that patterns are more likely to be found in intabulations compared to the other pieces (odds ratio = 2.14). Thus, the collection of patterns can therefore be regarded as strongly characteristic of the intabulation repertoire. Further insights from the other three variables in the model suggest that overall: shorter patterns occur more frequently; major variants are less likely; and patterns preselected by the expert musicologist are less frequent. Insight from the significant 2-way interaction effects suggests that versions of patterns that are longer or are major are more likely in intabulations and also that longer versions with expert labels are more likely in intabulations.

[7] The full set of patterns we used, with those preselected as 'likely' highlighted, is available in music notation from: http://intabulations.data.t-mus.org/ .

Factors	Coeff.	SE	z	OR
(Intercept)	2.15	0.08	27.32***	8.58
isIntabulation	0.76	0.02	48.79***	2.14
isLong	-3.23	0.11	-28.88***	0.04
Major	-1.45	0.01	-178.40***	0.23
HasExpertLabel	-0.77	0.11	-6.76***	0.46
isIntabulation x isLong	0.13	0.02	5.20***	1.14
isIntabulation x Major	0.10	0.02	6.13***	1.11
isLong x Major	-0.11	0.01	-8.15***	0.90
isIntabulation x HasExpertLabel	-0.33	0.04	-7.42***	0.72
isLong x HasExpertLabel	-0.12	0.12	-0.96	0.89
isIntabulation x isLong x HasExpertLabel	0.30	0.05	6.00**	1.35

Table 2. Intabulations vs. non-intabulations: coefficient estimates, standard errors, z-values of Wald statistic with associated significance levels, and odds ratios for the independent variables in the binomial mixed effects model of all database queries. Coefficients represent the difference between the binary feature being present in the query compared with the feature being absent (the reference level). Significance levels are coded as follows:
* < .05, ** < .01, *** < .001.

To answer the question whether the patterns are more common in secular music, a second binomial mixed effects model was fitted to the data from the intabulations only. This model included the same variables as fixed effects. However, the main variable of interest was `isSacred`, a binary variable indicating whether the queried piece was from a sacred or secular repertoire. The same modelling selection strategy was employed, starting from a fully saturated model including all higher-order interaction effects and then applying a step-wise backward selection procedure based on the improvement in BIC. The parameter estimates, their standard errors, z-values of the Wald-statistic, associated significance level and the odds ratios derived from the parameter estimates of the final model are given in Table 3.

In this model `isSacred` on its own was not a significant predictor ($p = .259$; OR = 1.05). However, two 2nd order effects involving `isSacred` were highly significant (p-values < .001): queries that were either major variants or were longer queries on pieces from the sacred repertoire had a higher chance of returning a hit. Thus, the second order effects suggest that once pattern variants possess certain characteristics, they are more likely to be found in the sacred repertoire.

In summary, the results of the statistical analysis show that a) the embellishment patterns we used are more common in intabulations and b) the variants of these patterns with certain features (relatively long or major) are more common in the sacred repertoire. In sum, the results indicate the usefulness and relevance of embellishment patterns as descriptors of the idiom of intabulations but also highlight the importance of structural features (length, mode) of the patterns which should be taken into consideration in future studies to select specific subsets of patterns for musicological queries.

Factors	Coeff.	SE	z	OR
(Intercept)	2.85	0.13	22.51***	17.29
IsSacred	0.05	0.05	1.13	1.05
isLong	-3.93	0.20	-20.06***	0.02
Major	-1.42	0.02	-60.87***	0.24
isSacred x isLong	0.60	0.05	11.03***	1.82
isSacred x Major	0.59	0.06	10.46***	1.80
isLong x Major	-0.08	0.03	-2.29*	0.92
isSacred x isLong x Major	-0.55	0.07	-7.38***	0.58

Table 3. Sacred vs. secular: coefficient estimates, standard errors, z-values of Wald statistic with associated significance levels and odds ratios for the independent variables in the binomial mixed effects model of database queries including intabulations only. Coefficients represent the difference between the binary feature being present in the query compared with the feature being absent (the reference level). Significance levels are coded as follows:
* < .05, ** < .01, *** < .001.

5. CONCLUSIONS

This experiment shows that there is a clear stylistic difference between lute intabulations of vocal music and music composed directly for the lute in our corpus of 6,000 pieces, and that this can be revealed by comparing the frequency of occurrence of embellishment patterns identified in the musicological literature. To our knowledge, this is the first time a corpus of early instrumental music has been analysed in this way, and this result suggests that these patterns have promise for further use in stylistic analysis.

There are some biases in the corpora that affect this finding. Possibly the most important consideration from the statistical point of view is that not only do the corpora contain different arrangements of the same vocal piece, but they also may have multiple instances of the same intabulation from different sources. These versions should be note-identical in principle, but will often differ either in a few details (due to printing or transmission errors) or more substantially. The extent of these concordances is hard to estimate from the metadata we have, nor is it clear how they should be treated once identified, but it is certain that they will affect the assumption of independence of samples. We consider that identifying these and assessing their significance is an important musicological task, which will also help to make our methodology more sound.

Most of the intabulations present are from a narrower date range than the corpus as a whole. For the ECOLM collection especially, this bias is not particularly grave, due to the data gathering policy used so far, but evaluating its extent is not straightforward. Dating works is not easy and, although most printed collections have a known year of publication during this period, this may be later than the date of composition of the works in the book.

Another bias that is hard to evaluate is due to the relative length of pieces. The intabulations in both collections are longer, on average, than other genres and contain more notes. This could increase the likelihood of any given pattern occurring in any given piece; however, the relationship is unlikely to be straightforwardly linear and, since French chansons of the time (the favourite vocal models for intabulation) are characterized by a significant degree of repetition, even the increased note count cannot be taken to indicate a larger amount of distinct musical material. Further analysis is needed to determine the extent to which the same embellishment patterns were reused upon repetitions in the model.

6. FURTHER WORK

In the present study, we used melodic indicators drawn by a musicologist from three exemplary arrangements of a single vocal work published at around the same time. The madrigal in question in fact survives in over a dozen 16th-century intabulations (in both printed and manuscript sources for lute and keyboard), so an obvious next step would be to broaden our list of embellishment patterns to include at least some of these. The list could be further augmented by including patterns given in treatises for other instruments.

In general, our assertions here would be strengthened by a more fine-grained analysis. In particular, if a date and place of composition can be established for a sufficiently large number of works, then we should be able to evaluate the extent of any biases in our corpora. Similarly, where the intabulator is known and also composed original lute music, the two can be compared.

Intabulations are also distinguished by other parameters, most obviously texture. Even when one or more original voice-parts are omitted in an intabulation, one might expect the latter to maintain the texture of the remaining voices fairly consistently throughout the piece, whereas in freely-composed lute music there is in general no such obligation on the part of the composer. Though some fantasias and recercars (the main contrapuntal genres of 'pure' lute music) maintain a strict three, four or even five-voice texture, this is much less likely in dance music, for example.

In future studies, it will be helpful to make use of voice-leading where it can be derived from the tablature. In the case of much 16th-century keyboard music, especially that notated in so-called 'German organ tablature' the notes are separated into voices and given durations; with lute tablature the voices and durations (sometimes ambiguous, even for experienced players) have to be deduced, so in future work on lute music we shall apply recently-developed techniques such as that described in [12].

From a musicological standpoint, this experiment represents a first step towards a more detailed, corpus-level understanding of how intabulation worked as an artistic activity. Separating out the different influences and intentions of a composer or arranger is difficult, but it is our belief that some steps towards that separation can be made using approaches like this one.

The methods presented here can easily be replicated with a larger set of examples and on an enlarged corpus. Given encodings of the vocal models for the intabulations in the collections and a means of aligning the two, we hope to perform more nuanced studies, looking at arrangement as a process as well as simply studying the end product. In particular, we intend to investigate the notion of 'playability' as an aspect of this process and of the choice of repertory for intabulation, in the belief that the prescriptive nature of tablature itself captures much useful evidence which has not yet been exploited by scholars.

7. ACKNOWLEDGEMENTS

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