Music document publishing with LaTeX

Abstract
This article presents an overview of how to create various document types about music, such as articles, e-books and web presentations. It discusses the workflow, the set-up of a specific typesetting environment with definitions, tools and additional software.

1   Introduction

The author is a long-time user of TeX and LaTeX in the science research and education field, but also privately and in hobby projects. As an author I still appreciate the fundamental aspects of computer typesetting with LaTeX: separation of content and layout, re-usability, ASCII document source files and free public domain tools.

As a parttime composer, arranger and online publisher I developed a workflow for creating various types of documents about music. Since there is only limited time for these activities, convenience, reliability and efficiency are most relevant aspects for the workflow and tooling. Publishing about music involves text, graphics, musical scores and audio; this means that there is a mix of software products involved with their own file formats and import and export options.

In this article I will illustrate the workflow for various document types and show some examples. For more products and full documents, visit the website at URL http://www.fransabsil.nl.

2   The software toolset

The publication process is based on the workflow sketched in overview in Figure 1. This requires a set of software tools:

☐ Computer typesetting software LaTeX with the TeXShop shell on Mac OS X.
☐ The MakeMusic Finale music notation software, version 2014.5.
☐ Logic Pro X digital audio workstation (DAW) and sequencer software, version 10.2.4. This includes software instruments, synthesizers and Apple sample libraries. In addition there are the Native Instruments Komplete series of products
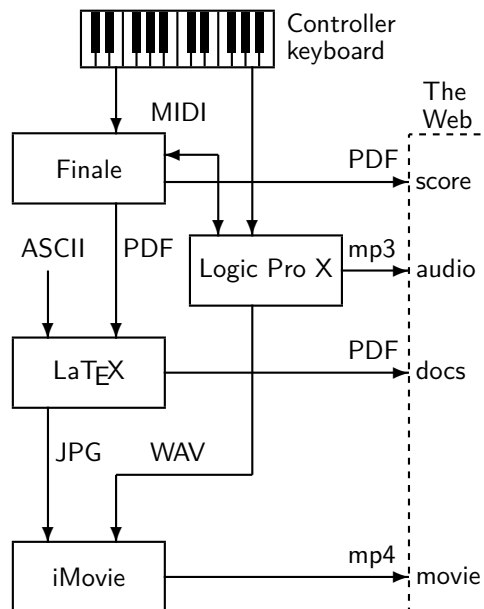

Figure 1. The workflow for producing music documents. LaTeX is used to generate both PDF files for the website Document Library and JPG images for producing YouTube video channel episodes.

(synthesizers, samplers, audio processing), some Vienna Symphonic Library samples (strings) and the Sample Modeling woodwind and brass instruments.
☐ Website content is created by programming HTML pages in an ASCII editor, with CSS page layout formatting and JavaScript applications.
☐ Video production is done with iMovie, using JPG still photographs, video fragments and the monitor window grabbing tool.
☐ Some graphics are programmed as PostScript source code, others are JPG or PDF export files.

The documents, audio and video files are published on the internet. PDF documents and mp3 files are part of a website media library. Mp3 audio is exported at 160 kbps medium quality stereo, a deliberate choice. The movie episodes are uploaded to the YouTube channel.

I am aware of various software alternatives, but this is what I have become familiar with over the years as an experienced user.

3 The recurring elements

A regular set of LaTeX packages is loaded in the document header:

- □ amssymb, special mathematical symbols in music definitions (see below);
- □ [english]babel, with the English language hyphenation patterns;
- □ epstopdf, conversion of graphics file formats;
- □ eurosym, 'We're in the € money';
- □ fancyhdr for specifying document header and footer labels;
- □ geometry for page layout;
- □ graphicx for including figures (score fragments) and various other graphics;
- □ hyperref for creating and using internal links and document metadata;
- □ ifthen for flag setting with Boolean variables (see below);
- □ palatino, font definition;
- □ xcolor for colouring it up.

In various document types we find recurring elements:

- □ The *FA logo*. This logo is a Postscript source exported as both JPG and PDF file (see below). The two musical pitches in the logo happen to be my initials.
- □ A set of *bibliography* files for use in BibTeX. There is a number of bibliographies for specific categories such as musical composition, arranging, analysis, harmony, counterpoint and instrumentation.
- □ *List environments* for examples, exercises, etc. These have a specific layout and generate appropriate numbering.
- □ A set of *definitions of music notation elements*, implemented as LaTeX commands, using \newcommand. These include chord structures and musical terminology for melody, counterpoint, instrumentation, document header and footer labels, etc.
- □ Special *diagrams* for key relationships, atonal chord structures, instrument voicings, etc.
- □ A number of *Boolean flags* for creating demo and full versions of e-books. Depending on the value of these flag variables, the compiler will skip document sections and replace them with blank pages, figure and table frames.
- □ Internal *anchors and hyperlinks* for navigating the online PDF versions of the documents. These use the hyperref package, where also metadata attributes such as title, author, subject and and a keyword list are set.

Figure 2. The FA logo. This PostScript source file draws a stylized slanted 5-line musical staff with two open notes at the pitches F and A in the treble clef.

Below is the PostScript source code of the logo design.

```
%!PS-Adobe-3.0 EPSF-3.0
%%BoundingBox: 0 0 35 31
%%FA Logo, fgj absil, 2000
%% Definitions
/mt {moveto} def        /lt {lineto} def
/rlt {rlineto} def      /setlw {setlinewidth} def
/mm2pt {2.835 mul} def
%% FA Logo
/drawFAlogo {
  /logo_width 100 def /logo_height 100 def
  gsave
  [0.3 0 0.04 0.3 0 0] concat
  % dark square
  newpath
  0 0 mt
  logo_width 0 rlt
  0 logo_height rlt
  logo_width neg 0 rlt
  closepath
  0.2 setgray fill
  % 5 lines
  [10 30 50 70 90] {
    /ystaffline exch def
    newpath
    0 ystaffline mt
    logo_width  0 rlt
    1 setgray
    3 setlinewidth stroke
  } forall
  % 2 notes on F and A line
  1 0.5 scale
  newpath
  logo_width 4 div 40 20 0 360 arc
  1 setgray fill
  newpath
  logo_width 4 div 3 mul 80 20 0 360 arc
  1 setgray fill
  grestore
} def
0 0 mt
drawFAlogo
showpage
```

The logo design is shown in Figure 2. Blue colour and various greyscale versions have been exported as JPG and PDF files.

```
% Example List Environment definition (from the Arranging Book)
% Counter for Example [chapter].[examplenum]
\newcounter{examplenum}[chapter]
\renewcommand\theexamplenum{\thechapter.\arabic{examplenum}}
% Environment for Example: name = example, narg=1
\newenvironment{example}[1]{% begin environment definition
   \refstepcounter{examplenum} % add 1 to example counter
   \begin{sloppypar}
   \begin{quote}
     \colorbox{blue}{% white text in blue background bar
       \textcolor{white}{\makebox[0.155\textwidth][l]{%
         \textsf{\normalsize Example~\theexamplenum}% end textsf
          } % end of makebox
        } % end of textcolor
       } % end of blue colorbox
     % end of text/makebox/textcolor/colorbox
     \par\nopagebreak[4]
     \coltxtbf{\normalsize #1} % example title in boldface blue
     \par\nopagebreak[4]
     \rmfamily % font for example body text
} % end of begin environment definition
{% begin of end environment definition
   \textcolor{blue}
     {\hspace*{\fill}\rule[6pt]{0.2\textwidth}{1pt}
       \rule[6pt]{6pt}{6pt}}%
   \end{quote}%
   \end{sloppypar}%
} % end of example environment
```

Figure 3. The environment definition for the examples in the *Arranging by Examples* book. It creates an indented block, topped with a blue rectangular header with white text and automatic numbering. The example title is printed in blue, the body text in black and the example is closed with a blue line and rectangle at the bottom.

A number of the specific document elements will now be demonstrated. The definition of the `list` environment for the *Arranging by Examples* book (see Section 4.3) is shown in Figure 3. This is not completely foolproof as sometimes it yields nasty pagebreaks, in particular at the closing horizontal blue line.

The usage of the `example` environment is demonstrated with a brief example from the central part of the *Arranging by Examples* book. This book chapter presents techniques for writing 5-part *sectional harmony* settings in a jazz big band style; the itemized list discusses characteristics of the solution to the given problem.

Example 3.1

Sectional harmony in five parts, mixed voicing, 'drop 2'.

See the score fragment in Figure 4 with five instrumental parts (P1 to P5) and the harmony for the rhythm section (H). The lead voice P1 contains non-chordal and non-diatonic tones. The assignment is to write the parts using mixed voicing. The basic harmony is $Fm_7 - B\flat_7 - Gm_7 - C_7 - Fm_7$.

☐ The solution shows the 'drop 2' voicing as applied to a five-part saxophone section. The lead part P1 at the top is now supported by an inner voice P4.
☐ The bottom voice has the same intervallic relationship with the lead as in the four-part section.
☐ It is fairly regularly used unless the bottom voice gets into a too low register.

Figure 4. Sectional harmony in five parts. Mixed 'drop 2' voicing for given lead voice (P1) and harmony (H). This is a traditional setting for a 5-piece saxophone section in a jazz big band. (From: *Arranging by Examples: The Practical Guide to Jazz and Pop Orchestra Arranging.*)

When importing figures such as the score fragment in Figure 4, the text labels (here the part names, measure numbers and chord symbols) should have at least the size of the figure caption font. The default font size settings for expressions and staff names in the Finale music notation software are too small. There is no Finale to TeX export option; leaving out all text in the score and replacement with LaTeX fonts is possible but requires too much additional work (see the score example in Figure 7).

LaTeX commands have been defined for chord structures, melodic and other aspects. Chord structures will be entered with logical, mnemonic names for a jazz musician who is familiar with altered and extended jazz harmony. Examples of such definitions are shown in Figure 5.

Here are the calls to these commands:

```
$C\addsix$,
$B\halfdim$
$D\plusfive$,
$G\minnine$,
$A\ninesusfour$
```

```
\Seq{3}{2}{5},
\diatparch,
\chrdescmv,
\conmotop,
\dpped{b\flat},
\meter{6}{8}
```

and the printed results are C^6 (major triad with added 6th), $B_{\emptyset 7}$ (the half-diminished chord, with lowered 5th and minor 7th), $D_7^{\sharp 5}$ (altered dominant 7th chord with raised 5th), $G_7^{\flat 9}$ (extended dominant 7th chord with lowered 9th), $A_7^{9/\mathrm{sus4}}$ (the dominant 9th chord with suspended 4th), $\mathrm{Seq}(3{\times}2\mathrm{m};R_5)$ (a chord sequence with three groups of two measures repeating at descending 5ths), $\vec{H}\|_d$ (diatonic parallel chords), $P_m^i(\searrow)$ (a chromatically descending middle voice), $\Sigma(\mathrm{cm}{<})$ (opening contrary motion between top and bottom voice), $\overline{P}_D(b\flat)$, (dominant pedal point on pitch $b\flat$), $\left[\begin{smallmatrix}6\\8\end{smallmatrix}\right]$ (time signature, meter). Some definition calls require input in mathematical mode, others in text mode.

```
\newcommand\addsix{^{6}}
\newcommand\halfdim{_{\emptyset 7}}
\newcommand\plusfive{_{7}^{\sharp5}}
\newcommand\minnine{_{7}^{\flat9}}
\newcommand\ninesusfour{_{7}^{9/\mathrm{sus}4}}
\newcommand\Seq[3]{Seq($#1\!\times\!#2\mathrm{m};\!R_{#3}$)}
\newcommand\diatparch{$\vec{H}{\parallel}_{d}\,$}
\newcommand\chrdescmv{$P^{i}_{m}(\searrow)$\/}
\newcommand\conmotop{$\Sigma$(cm$<$)\/}
\newcommand\dpped[1]{$\overline{P}_{D}(#1)$}
\newcommand{\meter}[2]{$\left[ {#1 \atop #2} \right]$}
```

Figure 5. Definitions of chord structures and melodic aspects as LaTeX commands.

The *pitch disc* is a diagram for representing the 12 pitch classes from the chromatic scale as dots at the edge of a clock face. Below is the `picture` environment source code that generates this graphic element.

```
\setlength{\unitlength}{1.2mm}
% Pitch Disc template
\begin{picture}(28,25)
%\put(0,0)
  {\framebox(28,25)[tl]{}}
\thicklines
% Clock face with numbers
\put(15,15){\circle{20}}
\put(15,22){\line(0,-1){2}}
\put(14.4,18){\scriptsize 0}
\put(22,15){\line(-1,0){2}}
\put(18.3,14.4){\scriptsize 3}
\put(15,8){\line(0,1){2}}
\put(14.4,11){\scriptsize 6}
\put(8,15){\line(1,0){2}}
\put(10.6,14.4){\scriptsize 9}
% mark pitches (closed circles)
\put(15,23){\circle*{1.5}}
\put(19,21.93){\circle*{1.5}}
%\put(21.93,19){\circle*{1.5}}
%\put(23,15){\circle*{1.5}}
\put(21.93,11){\circle*{1.5}}
%\put(19,8.07){\circle*{1.5}}
\put(15,7){\circle*{1.5}}
%\put(11,8.07){\circle*{1.5}}
%\put(8.07,11){\circle*{1.5}}
%\put(7,15){\circle*{1.5}}
%\put(8.07,19){\circle*{1.5}}
%\put(11,21.93){\circle*{1.5}}
% text label
\put(1,1){4-Z15$=\{0,1,4,6\}$}
\end{picture}
```

Note that all 12 pitches are present in the template and can be displayed when required (remove comments). The result is shown in Figure 6. The circular (modulo 12) character of the pitches through octave transposition is
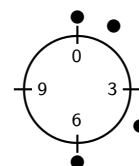
$$4\text{-}Z15 = \{0, 1, 4, 6\}$$

Figure 6. The pitch disc. The dots represent the 12 pitch classes $\{0, 1, 2, \ldots, 11\}$ from the chromatic scale in the form of a clock face. Shown is the Pitch-Class Set 4-Z15, the all-interval tetrachord.

clear. This diagram is most useful when studying pitch-class set properties and transformations in atonal music. They are used frequently in the YouTube video episodes (see Section 4.4).

4　Document types

In the process various document types are created: score excerpts, articles, e-books and YouTube movies. These products are added to the Website Document Library, where they receive a HTML annotation and link, and a set of keywords for the search engine (a JavaScript tool for internal search on the website).

All documents are characterized by a very restricted use of colour. Most articles are in black and white. The e-books are limited to two colours only: the main text is black and occasionally there are blue elements, such as the internal hyperlinks for the online version, and lines, arrows and labels in figures and score excerpts. This makes printing easy and cheap. Only occasionally there are colour photographs and diagrams; multicolour never is an essential element.

4.1　Score excerpts

There are excerpts of full musical scores in the two categories Compositions and Arrangements of the Website. These contain approximately one third of the total set of

score pages. These are exported as either Encapsulated PostScript or PDF figures from the Finale music notation software and then imported into a template LaTeX document, that generates the appropriate headers and footers with title, copyright and logo elements.

Recent Finale versions also have a reliable PDF export option for sections of score pages, such as a single staff or staff system. This is most convenient as it generates relatively small file sizes and the import in LaTeX documents allows the use of the `pdflatex` compiler. Thus compilation is much quicker than for the old approach with PostScript source files or `pstricks` figures.

4.2 Articles

In the Website Document Library there are articles about music composition and arranging techniques, DAW software aspects and audio signal processing. Some articles may consist of a single page diagram only; see the musical instrument range chart on the website.

Many documents contain score fragments. A simple example is shown in Figure 7. The notation in a (reduced) score with multiple staves is the typical source material for a musical analysis. The start is to annotate the printed score with pencil markings, here replaced with blue graphical elements in the LaTeX `picture` environment. First there is the harmonic analysis (see the chord symbols below the bottom staff), then other elements such as chordal functions (numbers), melody direction (arrows), and non-harmonic pitches (+-sign) are labeled.

The annotated score will be used for the description of the piece and the detailed analysis tables (see Section 4.3).

As the figure demonstrates, the graphic elements in the simple `picture` environment, such as lines, vectors, circles and Bezier curves and text in boxes are sufficiently powerful for score annotation. Correct placement requires multiple compiler runs. And once again the font size may be an issue when text is combined with musical notation.

The reduced score example in Figure 8 is the slow introduction (60 BPM) to my arrangement of this jazz standard for a studio orchestra workshop. It is part of an article about composing with two layers of chord structures in perfect fifths. The score fragment is played by tremolo strings at mezzopiano (mp) dynamic level, with timpani and celesta fills on the fermata chords in m. 4 and 8 (not shown here). The first violin lead carries the melody of the song. Below the score excerpt is the *tension curve* based on the Hindemith scheme, illustrating the dissonance level of these chord structures. A well-composed musical phrase will have maximum tension at approximately the Golden Section length, or, better, duration.

This example demonstrates a few additional problems with musical scores. Unless the page layout is carefully 'tuned' in Finale, i.e., typically no more than four to five measures per staff system, the total width becomes the limiting factor for the figure scaling. For a fragment from a full orchestral score with more than say 15 staves in a system, the page height sets the magnification limits. In Finale these scores are designed with a layout for a portrait orientation A4 page size or, more likely, for A3 paper size, taking into account that the conductor has to be able to read the music during rehearsal from a distance of 50 to 70 centimeters. Inclusion of such scores in a LaTeX document with appropriate page margins leads to display space conflicts.

4.3 E-books

Currently there are three e-books on the website:

1. *Musical Analysis: Visiting the Great Composers.* This book contains a detailed analysis of hundreds of movements from the tonal period masterworks, written between say 1700 and 1950. Composers are covered in separate chapters. For each piece there is a description, diagrams with an overall formal analysis (proportion of essential sections) and key relations (proximity to the basic key, the tonic, and remoteness during devlopment sections), and a set of tables with a measure-by-measure analysis of the harmony, melody (theme, motif, variation), compositional techniques (counterpoint, parallel, direction of motion, climax) and instrumentation. The current 5th edition contains 736 pages.
2. *Arranging by Examples: The Practical Guide to Jazz and Pop Orchestra Arranging.* This book is in three parts: Preparations, Techniques and Assembling the Piece. Based on a number of score examples there is detailed discussion of arranging techniques and aspects, especially in the middle part. The current 3rd edition is 243 pages long.
3. *A Guide to Schillinger's Theory of Harmony.* In its 2nd edition this 167 page book helps understanding the element of rhythm as it was presented by Russian theorist, composer and artist Joseph Schillinger in his *Schillinger System of Musical Composition.* This unique approach involved a lot of (integer number and set theory) mathematics and therefore has been considered a somewhat weird outlier in the field of music theory.[1]

From these e-books we will discuss a number of additional document elements. Most books consist of many chapters, tables and figures. This requires adaptation of the indentation and width of numbers in the table of contents. The settings are shown in Figure 9 (see *The*
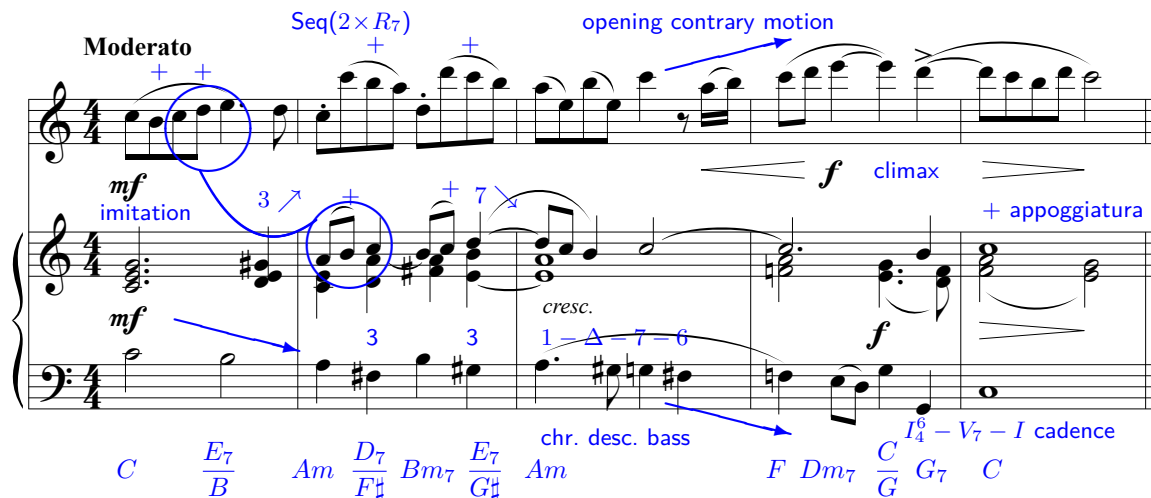
Figure 7. Simple score fragment with a melody in the upper staff and a harmony accompaniment. This is overlayed with annotation marks (text, symbols, arrows, Bezier curves) labeling all sorts of musical aspects of this phrase. Here the annotations are reproduced as blue elements in the LaTeX `picture` environment.
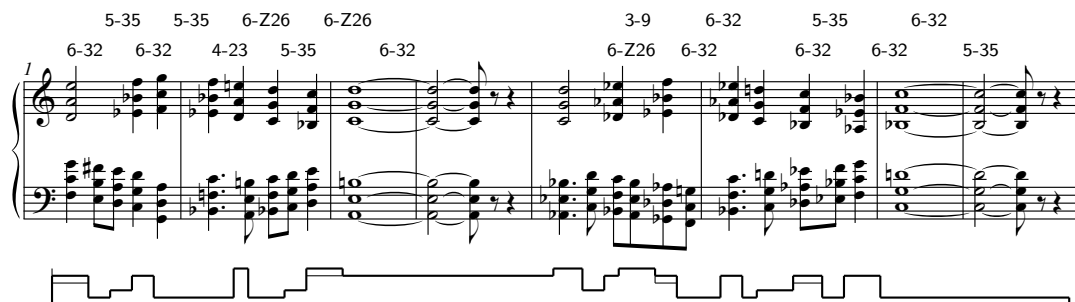
Figure 8. Tension curve. Gene de Paul, *I'll Remember April*, arrangement for studio orchestra by the author, Introduction. Pitch-class set labels are indicated above the staff. The tension level contour line is shown below the staff (reduced vertical scale). The thin line represents the Hindemith dissonance ranking correction. (From: *Harmonic Structures: Analysis and Application of Two Layers of Three-part Chord Structures in Perfect Fifths.*)

LaTeX Companion book, p. 52).

The books all use the recommended approach of having the chapter content in separate files. During the compilation there is frequent use of the `includeonly` command for single chapter error checking and the `draft` option in order to do a quick layout inspection and repair overfull boxes. For some documents the `hyperref` attribute `bookmarks=false` is set during the error correction process in order to prevent the compiler stopping (a well-known bug reported on the internet).

The *Musical Analysis* book contains *formal analysis* diagrams. An example with two movements from the Mozart *Symphony No. 41 in C Major KV 551, 'Jupiter'* is shown in Figure 10. The movement header has metadata from the original score such as the tempo and style (Allegro vivace), main key, meter and length. Simple dia-

grams in the `picture` environment with some (dashed) rectangular frames and text labels illustrate the relative proportions, such as the 'classical' exposition - development - recapitulation sections of a sonata form movement. The second movement is in ternary ABA' form, here with a coda.[2]

In the same book we also find *key relation diagrams*, such as the one from the Mahler *Symphony No. 6, 'Tragic'* in Figure 11. This is another diagram in the `picture` environment, with a regular grid of musical key labels, line and vector segments and Bezier curves with dotted ends. The third movement, Andante moderato, starts in the main key $E\flat$ (rectangular frame around the tonic key root) and then starts to move through the keys. The diagram shows the tonic-dominant 'circle of fifths' relationship along the horizontal axis (e.g., $\ldots - C -$

```
\makeatletter
\renewcommand\l@section{\@dottedtocline{1}{1.5em}{2.5em}}
\renewcommand\l@subsection{\@dottedtocline{2}{4.0em}{2.9em}}
\renewcommand\l@figure{\@dottedtocline{1}{1.5em}{2.9em}}
\renewcommand\l@table{\l@figure}
\makeatother
```

Figure 9. Table of contents layout for books with many (i.e., more than 10) chapters, (sub)sections and figures. Number indentation and width at various document levels has been modified from the default values.

Mvt. 1 Allegro vivace: sonata form (C, $\left[\begin{smallmatrix}4\\4\end{smallmatrix}\right]$, 313 m.)

Exposition (121 m.)		Development (68 m.)	

Recapitulation (124 m.)	
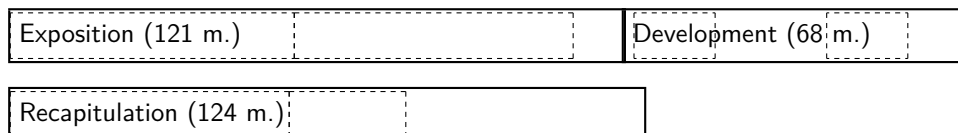
Mvt. 2 Andante cantabile: ABA form (F, $\left[\begin{smallmatrix}3\\4\end{smallmatrix}\right]$, 101 m.)

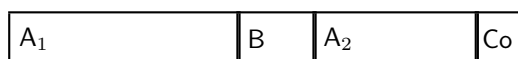| A_1	B	A_2	Co

Figure 10. Mozart, Symphony No. 41 in C Major KV 551 *'Jupiter'*, Movement 1 and 2, formal analysis diagram with movement metadata and relative proportions of movement sections. (From: *Musical Analysis: Visiting the Great Composers.*)

$G - D - \ldots$) and the (sub)mediant parallel relationships along the vertical axis (e.g., $\ldots - Cm - C - Am - A - \ldots$). The number of steps from the main key position is a measure for the key remoteness. The 'octave modulo' property yields multiple key occurrences (see the remote keys E and B). Placement of the line, arrow and curved segments requires a bit of trial-and-error for avoidance of crossing the labels and maintain legibility. Numbers in this diagram support easy reading of the path and are used in the text description. Comparing the envelope of the curve in the Mahler movement with earlier pieces from the tonal music repertoire immediately shows the more complex key patterns in the late Romantic period.

The detailed analysis results are presented as tables. The result for the simple score fragment in Figure 7 is shown in Table 1. The first column refers to the measure numbers, the second column lists the melodic material (themes such as $M_{1.1}$, variations on a theme M', inverted motif I(M), etc.). The 3rd column shows the current key; this contrived example has a brief modulation from the major key C to the relative parallel key Am and back to the tonic key. The 4th column has the harmonic analysis in jazz chord notation (root - type - extensions - inversions), while the last column presents comments, often as 'coded' symbols.

Vertical orientation of the tables with measure numbers on a new table row runs contrary to musical notation, but is the only option to manage the content (experiments with a horizontal layout with a single measure in a table column proved too cumbersome to handle; the

variable number of chords in a measure yields overfull horizontal boxes).

This example contains a chord sequence (m. 2), chromatically descending bass (m. 3), opening contrary motion (melody top part going up, bass descending), and closing climax with a second-inversion group full cadence in m. 4-5.

From the table it can be seen that horizontal spacing is essential in limiting the table width and being able to cover multiple measures in a single table row. Chord and pitch notation are in mathematical mode, which leads to wide spacing in chord progressions (see the 4th column). Most symbols in the 5th column have been defined with negative spacing in order to reduce the width.

The *Arranging by Examples* book contains *voicing diagrams*, such as the one for woodwinds shown in Figure 12. The diagram in the picture environment consists of open circles for each player, line and vector segments. It shows the vertical ordering of the instruments. The various options yield a different blending of sounds (timbre) and orchestral balance.

In the book *A Guide to Schillinger's Theory of Harmony* there is frequent use of alternative rhythm notation, either as integer numbers, as ticking metronomes or clocks, and as notes on a staff. Three PostScript icons help the reader to distinguish between pitch or various rhythm notations. These icons are shown in Figure 14.

The different systems of notation in the book about rhythm are illustrated in Figure 13.
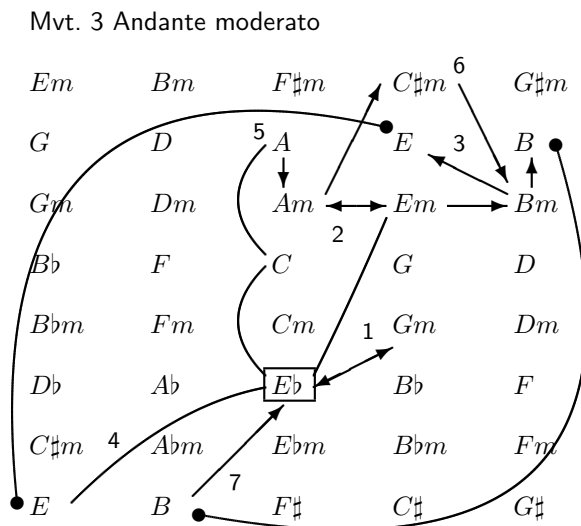
Mvt. 3 Andante moderato

Figure 11. Mahler, Symphony No. 6 *'Tragic'*, Mvt. 3 Andante moderato, key relationship diagram showing the main key $E\flat$ and the modulation path in this movement. (From: *Musical Analysis: Visiting the Great Composers.*)

Table 1. Analysis table for the simple score example in Fig. 7.

m	M	R	H	Comment
1	M	C	$C - E_7/G\sharp-$	main theme, mod
2	⋮	Am	$Am - D_7/F\sharp - Bm - E_7/G\sharp-$	Seq($2\times R_7$)
3	⋮		$Am - A_{\Delta 7}/G\sharp - Am/G - Am^6/F\sharp-$	$P_B^i(\searrow)$, Σ(cm<)
4	⋮	C	$F - Dm_7 - (C_4^6 = C/G) - G_7-$	climax, S_4^6 cadence
5	⊥		$F/C - C$	appoggiaturas

Double woodwinds, 3 groups (Flute, Oboe, Clarinet)

(a): Juxtaposition   (b): Overlapping   (c): Mixed   (d): Interlocking   (e): Mixed
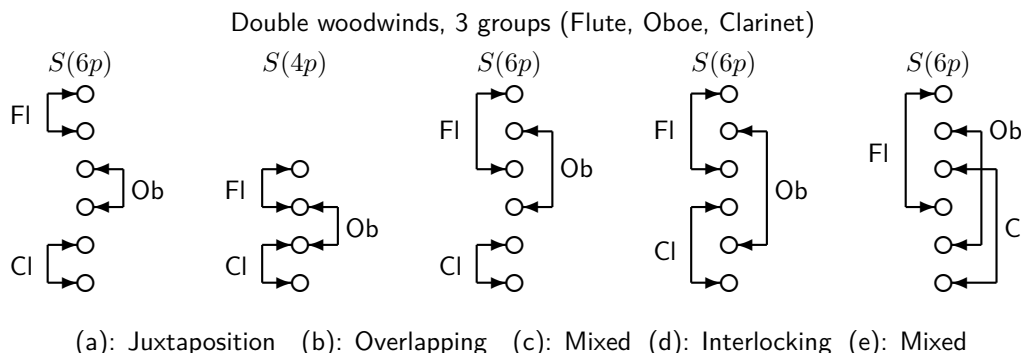
Figure 12. Woodwind voicing. Non-exhaustive set of diagrams for double woodwinds, demonstrating juxtaposition (overlaying), overlapping, interlocking (dovetailing), enclosing and mixed voicing. The diagram demonstrates lead (upper part) to lowest voicing options for 4- and 6-part chord structures, $S(4p), S(6p)$. (From: *Arranging by Examples: The Practical Guide to Jazz and Pop Orchestra Arranging.*)
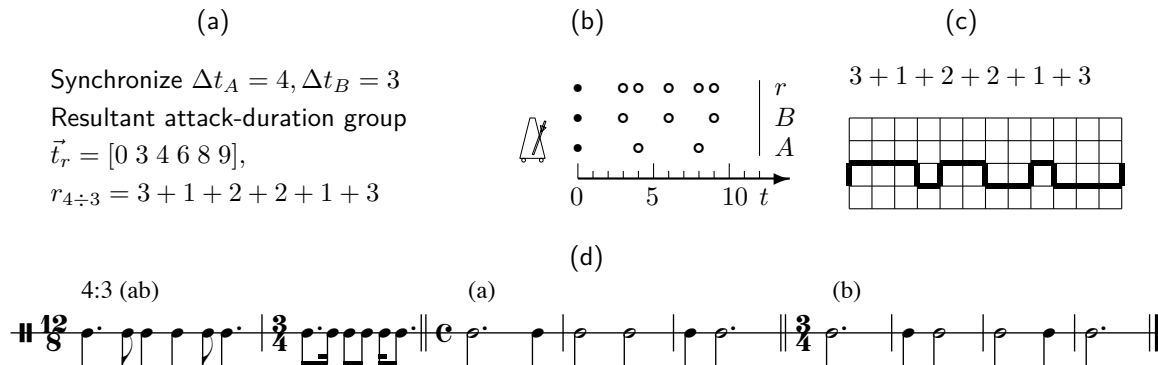
(a)

Synchronize $\Delta t_A = 4, \Delta t_B = 3$
Resultant attack-duration group
$\vec{t}_r = [0\ 3\ 4\ 6\ 8\ 9]$,
$r_{4 \div 3} = 3 + 1 + 2 + 2 + 1 + 3$

(b)

(c)

$3 + 1 + 2 + 2 + 1 + 3$

(d)

Figure 13. Non-uniform binary synchronization. The resultant $r_{a \div b}$ of two generators A and B that tick at different time intervals (interference pattern after starting simultaneously). $\Delta t_A = 4, \Delta t_B = 3$. The rhythm is $3t + t + 2t + 2t + t + 3t$ at time unit t. (a): Mathematical notation (integer numbers), (b): Timeline notation (ticking metronomes), (c): original Schillinger notation (graph paper), (d): musical rhythm notation on a single line staff for various time signatures (meter groupings). (From: *A Guide to Schillinger's Theory of Harmony.*)

Figure 14. PostScript icons for rhythm notation. Shown are the metronome, clock and keyboard.

4.4   YouTube movies

Attracting an audience as a composer and arranger requires having an online presence. Traditionally this meant an internet website. However, these days this implies creating content on social media and video channels such as YouTube and audio files on SoundCloud or equivalent online media services.

A playlist was created on the YouTube channel, with a number of episodes about musical composition and arranging techniques. These episodes have a duration between five and ten minutes. They have a common structure: the goal and stepwise approach is announced in the introduction, then there will be the fundamentals of the technique, a section with the processing of the basic music elements and a demonstration in a couple of complete examples with reduced score and audio track.

The LaTeX typesetting tools were also involved in the making of these video productions. This requires the full workflow path from Figure 1, starting with a MIDI file and finally creating a movie for online publication. The graphics are still images created with the `beamer` package for presentations. A somewhat modified version of the `Madrid` theme is used, that has the short title and page numbers in the footer. This theme does not need navigation hyperlinks in the header, since each slide will be incorporated as a still image in a movie. The beamer class attribute option `[aspectratio=169]` adapts the slide size to HD format, but makes reading of

the resulting wide lines of text cumbersome, so I stuck with the 3:4 screen ratio.

Using Apple Preview each page from the PDF presentation is exported as a high resolution 600 dpi JPG image at best conversion quality, yielding a file size between 1 and 2 Mb. See the example of a single slide image in Figure 15. It is part of an episode based on the *Schillinger System of Musical Composition* that demonstrates three techniques for key modulation using a given melody.

The audio content is exported from the Logic Pro X DAW; stereo WAV files are bounced at 44.1 kHz. In iMovie audio fragments are synchronized as a background track with the video stills. Movies are uploaded to the web, annotated and receive a link from the website and social media.

Currently there are 14 video episodes on YouTube with highly condensed content. Mastering the techniques will require frequent pausing and rewinding the episode, taking notes and (hours of) practicing. Game and media composers trying to widen their skill toolbox highly appreciate this playlist.

5   Conclusion

The workflow as described in the previous sections has been established over the years. It has been adapted as new document types were required and software components were updated. Within LaTeX there is no use of advanced features or fancy packages; the standard environment with a set of new commands for specific symbols and a few layout modifications is more than sufficient to create the books, articles and web content.
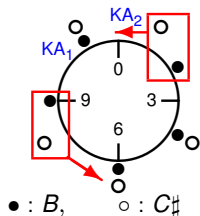
Most changes have to do with the creation or inclusion of graphics and figures. The old approach with Encapsulated PostScript figures and the `pstricks` package

Melodic modulation: chromatic alterations

For the chromatic alterations technique:

- Find the subset of non-overlapping pitch-units in both scales.
- Identify the stepwise chromatic alterations, going from source to destination scale. Write the pairs $p_{i,R_1} \to \{\sharp, \flat, \natural\} \to p_{j,R_2}$.
- Base the modulating transition on long durations.
- Use all pairs of chromatic alterations, and finish with the next diatonic step in the new scale, i.e., $p_i \to \{\sharp, \flat, \natural\} \to p_j \to p_{j\pm1}$.

Ex. 2: Modulation $B \Rightarrow C\sharp$

$R_1 : B \Rightarrow R_2 : C\sharp$

KA$_2$
KA$_1$

● : B,   ○ : $C\sharp$
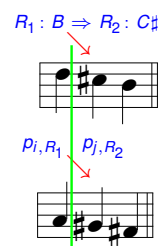
Pitch-scales and chromatic alterations:
$B : b - d - e - f\sharp - a$
$C\sharp : c\sharp - e - f\sharp - g\sharp - b$
Non-overlapping: $\{d, a\}_{R_1}$ and $\{c\sharp, g\sharp\}_{R_2}$
Chromatic alterations:
$d \to c\sharp \to (b)$ and $a \to g\sharp \to (f\sharp)$

p_{i,R_1} p_{j,R_2}

Frans Absil
Melodic Modulation   1/1

Figure 15. Slide for the YouTube video episode *Melodic Modulation*, as created with the beamer presentation package and converted into JPG for use in iMovie. The slide has header and footer information, and contains an itemized list, the pitch class disc image and an annotated score fragment. (From: *Melodic Modulation* movie.)

required the two-step `dvitops` compilation. This has been replaced by creating simple figures in the `picture` environment and importing PDF figures created with other software. For more complex graphics the free Inskcape software is a great alternative: it generates SVG figures and exports to PDF. Integration with LaTeX is fairly straightforward; all recent content has been created by using PDF figures and the `pdflatex` compiler. Problems with score page scaling have been addressed; sometimes a reference to the full PDF score on the website is the best solution.

The workflow is satisfactory and manageable; updating editions is easy by adding new chapters and sections. Long tables for detailed musical analysis are slightly problematic; column width and table height need correcting during the compilation. When modifying existing symbols the requirement is to reduce the symbol width. The compromise between typesetting 'beauty' and creating content within a limited timeframe requires a most pragmatic approach. This article illustrates the current 'design point' for creating various types of doc-

uments about classical, jazz and popular music. The author obviously remains open to suggestions for workflow improvement; the bottom line is *'Let's face the music and dance!'*

Notes

1. The famous Berklee School of Music in Boston, MA in the US originally started as an institute working with remote learning courses based the Schillinger System. It has evolved into an internationally renowned place for training jazz and pop musicians and, nowadays, audio mixing engineers and media music composers.
2. The fourth and closing fast movement from the *'Jupiter'* symphony is a genius masterpiece, known for using intricate multiple subject counterpoint.

Frans Absil