Chapter 18

Fingers, Footsteps and Frets

Throughout this book, our examples have tended to rely on just a handful of Humdrum representations — **kern in particular. Of course the Humdrum syntax provides opportunities for an unlimited number of representations. In this chapter, we will consider some less common representations. Most of the chapter will deal with the **fret representation — a pre-defined Humdrum representation for fretted instrument tablatures. However, we will begin with a grab-bag of unorthodox representations.

Heart Beats and Other Esoterica

The Humdrum syntax provides a framework within which different symbol systems can be defined. Each symbol system or representation scheme is denoted by a unique exclusive interpretation. There is no restriction on the number of schemes that can be used or created by the user. Each time you create a new exclusive interpretation, all of the alphanumeric characters can be redefined. A representation scheme springs into existence simply by encoding some data.

In research activities, it is common to create representation schemes for a specific task. A user might define a spine that represents the heart-rate (in beats per minute) of a music listener:

```
**cardio
76
76
74
73
73
*-
```

A scheme might be created to represent different types of contrapuntal motion:

```
**motion
similar
contrary
parallel
oblique
*-
```

Chords might be classified — using words:

```
**chords
minor
.
augmented
major
*_
```

Or using abbreviations:

```
**chords
m
.
A
M
*_
```

Fingerings might be represented. Each hand may have a separate spine:

```
**finger    **finger
*left       *right
.           1
1 5         2
.           3
.           5
1 5         2 5
*_          *_
```

Or the hands might be combined in a single spine:

```
**finger
R1
L1 L5 R2
R3
5
L1 L5 R2 R5
*_
```

Time-scales might be large:

```
**Periods
Medieval
Renaissance
Baroque
Classical
Romantic
*_
```

Or miniscule:

```
**milliseconds
0.03
0.8
23.2
31.6
*-
```

A user might define a highly refined special-purpose representation. For example, the following scheme is fashioned after the Benesh dance notation:

```
!! Kellom Tomlinson's Gavot of 1720.
!! Transcribed from Feuillet's notation.
**kern         **Benesh
*MM120         *MM120
*M2/2          *M2
*e:            *
!! First Couplet
!                  ! Half Coupee
4.gg             |  |u|  |  |
.              %|+|  |  |  |
.               |=|v|  |  |
.              (|  |  |  |  |
.              (|-|  |  |  |{
8ff#            |_|  |  |  |2
=1             -----------
2ee            m|  |  |  |  |}
!                  ! Bound
.              _|^|  |  |  |{
.              (|+|  |  |  |
4.b            -|  |  |  |  |
.              (|+|  |  |  |}
.              _|  |  |  |  |{
8a             _|+|+|  |  |
=2             -----------
!                  ! Bouree
4g              |  |  |  |  |
.               |=|  |  |  |
4e              |=|  |  |  |}
.              _|=|  |  |  |
4g              |o|  |  |  |
!                  ! Bouree
4a             _|+|+|  |  |
=3             -----------
*-             *-
```

Depending on the task, user-defined schemes can be either carefully designed, or "throw-away" concoctions created for momentary purposes. The *Humdrum Reference Manual* provides detailed

advice on how to go about designing special-purpose Humdrum representations.

For the remainder of this chapter we will examine a pre-defined representation scheme for fretted instrument tablatures. Although not all users will be interested in the **fret representation, it provides an instructive contrast to the score- and MIDIbased representations that we have relied on for most of the examples in this book.

The **fret Representation

The **fret representation is a pre-defined Humdrum scheme that provides a comprehensive system for representing performance aspects for fretted instruments. The **fret scheme is suitable for representing tablature information for most fretted instruments, such as various guitars, lute, mandore, theorbo, chitarrone, mandoline, banjo, dulcimer, and even viols. The **fret interpretation is not limited to equal-temperament tuning, and so can be used to represent non-Western fretted instruments, such as the *oud* and the *sitar*.

The **fret representation is performance-oriented rather than notationally-oriented. Thus **fret is not suitable for distinguishing different visual renderings — such as differences between traditional French or German lute tablatures. Some other Humdrum representation should be used if the user's goal is to distinguish different forms of visual signifiers.

The basic pitches produced by fretted instruments depend on three factors: (1) the relative tuning of the strings with respect to each other, (2) the absolute overall tuning of the instrument, and (3) the position of the frets. Three tandem interpretations allow the user to specify each of these aspects.

The absolute tuning of an instrument is indicated by encoding the pitch of the lowest string using the *AT: tandem interpretation. For the common six-string guitar, the lowest pitch is normally tuned to E2, and so would be encoded with the following tandem interpretation:

    *AT:E2

The *AT: interpretation makes use of **pitch-type pitch designations and may also include cents deviation. For example, an instrument tuned 45 cents sharp might be represented as *AT:E2+45. Encoding the absolute tuning is optional with **fret; when absent, a default tuning of E2 will be assumed by various processing tools.

A second tandem interpretation (*RT:) specifies the relative tuning as well as the number and arrangement of strings. Some instruments pair strings together in close physical proximity so that two strings are treated by the performer as a single virtual "string." Such paired strings are referred to as *courses*. For example, the 12-string guitar is constructed using 6 courses, and is played much like a 6-string guitar — except that two strings sound together, rather than a single string.

The *RT: tandem interpretation encodes the relative tuning of each string by specifying the number of semitones above the lowest string — where each course is delineated by a colon (:). In Example 18.1 three sample tunings are shown. Example (a) defines the most common relative tuning for the six-string guitar. Successive strings are tuned 0, 5, 10, 15, 19, and 24 semitones above the

Example 18.1. Sample Tunings for Fretted Instruments.

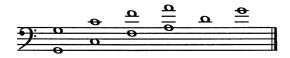(a) Common 6-string guitar.


```
AT:E2
*RT:0:5:10:15:19:24
```

(b) Common 12-string guitar.


```
AT:E2
*RT:0,12:5,17:10,22:15,27:19,19:24,24
```

(c) Vieil accord lute.


```
AT:G2
*RT:0,12:5,17:10,22:14,14:19,19:24,24
```

lowest string.

Example (b) defines the most common relative tuning for the 12-string guitar. The six courses are delineated by colons and the tuning of strings withint courses are delineated by commas. In this case, the lower four courses consists of two strings tuned an octave apart, whereas the upper two courses consist of paired unison strings.

Example (c) shows the most common tuning of the 6-course *lute* a tuning referred to as the so-called *vieil accord*: G2, C3, F3, A3, D4, and G4. During the first half of the 16th century, it was common to tune the lower three courses in octaves.

For non-Western and other instruments, it is possible to encode non-integer semitone values for various strings, such as a string tuned 9.91 semitones above the lowest string.

In addition to the absolute and relative tunings, **fret also allows the user to specify the tuning of successive frets using the FT: tandem interpretation. In Western instruments, frets are normally placed in semitone increments. For a 12-fret instrument, this semitone arrangement may be explicitly represented using the following tandem interpretation:

```
*FT:1,2,3,4,5,6,7,8,9,10,11,12
```

Each successive numerical value indicates the number of semitones above the open string for successive fret positions. The interpretation begins with the tuning of the first fret rather than the tuning of the open string. The above interpretation is similar to the *default fret tuning* — which is an increase of precisely one semitone for each successive fret. The default fret tuning is not limited to 12 frets as in the above example. An instrument constructed with nine 1/4-tone fret positions

can be encoded as follows:

```
*FT:.5,1,1.5,2,2.5,3,3.5,4,4.5
```

The only restriction imposed by `*FT:` is that all strings must have identical fret distances. That is, if the first fret is positioned 1 semitone above the open string, then this relative pitch arrangement must be true of all strings.

The `**fret` representation distinguishes three types of data tokens: tablature-tokens, rests, and barlines. *Tablature-tokens* encode information regarding the fret/finger positions, the manner by which individual strings are plucked (or bowed), pitch-bending, vibrato, damping, harmonics, and other effects. The actions of individual fingers can also be represented. Each tablature-token consists of a several subtokens in the form of Humdrum multiple-stops. Subtokens are delimited by spaces and represent individual courses/strings. A six-string (or six-course) instrument will require six subtokens in each tablature-token. For example, the following tablature token encodes the plucking of the first and sixth string:

```
|  -  -  -  -  |
```

Subtokens consist of up to five component elements: (1) the string/course status, (2) fret position, (3) bowing/strumming, (4) finger action, and (5) percussive effects. In addition, the tablature-token can encode bowing and strumming information.

In the `**fret` representation, the status of a string/course can occupy one of sixteen states. An *inactive* string is signified by the minus sign (−). An ordinary *plucked* string is represented by the vertical line (`|`). Plucking near the bridge (*plucked ponticello*) is represented by the slash character (`/`). Plucking near the tone-hole (*plucked sul tasto*) is represented by the backslash character (`\`). The repeated *plucked-tremolo* (commonly used on the mandoline) is represented using the octothorpe or hash character (`#`). *Pizzicato* is represented by the small letter 'z'. Normal bowing of a string is represented by the plus sign (+); *ponticello* bowing is represented by the open parenthesis '(' whereas *sul tasto* bowing is represented by the closed parenthesis ')'. *Spiccato* (bouncing the bow) is represented by the open curly brace '{'. *Col legno* (using the wood of the bow) is represented by the closed curly brace '}'. *Tremolo bowing* is represented by the ampersand (&). *Natural harmonics* and *artificial harmonics* are represented by the lower-case 'o' and upper-case 'O' respectively. String *ringing* is denoted by the colon (:), and the *damping* of a string is denoted by the small letter 'x'.

By way of illustration, the following tablature-token represents a six-string or six-course instrument, where the first through sixth strings are respectively (1 and 2) plucked, (3) damped, (4) bowed, (5) plucked sul tasto, (6) inactive.

```
|  |  x  +  \  -
```

Note that the layout of the strings in a tablature-token always corresponds to the tuning specified in the relative-tuning interpretation. In most representations, the lower-pitched strings will be toward the left side of the tablature token.

Fret-position information is indicated through the use of numbers, with the first fret signified by the number '1'. Fret-position numbers are encoded immediately to the right of their respective

string/course. For example, the following tablature-token encodes a six-string/course instrument in which the second and third strings are both stopped at the second fret.

```
|  |2 |2 |  |  |
```

Example 18.2 shows a sample passage for guitar with a corresponding **fret representation displayed beneath. The **fret representation does not encode duration information. It is common to join the **fret spine with a **recip spine representing the nominal duration data. In example 18.2 a **kern spine is also shown indicating the pitches in the **fret representation.

Example 18.2. J.S. Bach, *Anna Magdalena Bach Notebook* Menuet II. Guitar arr.


```
**recip    **kern  **fret
*          *       *AT:G2
*          *       *RT:0,12:5,17:10,22:14,14:19,19:24,24
*M3/4      *       *M3/4
=1         =1      =1
4          E e g   − |4 − − − |0
8          c       − : : |3 : :
8          d       − : : : |0 x
8          D d e   − |2 : : |2 :
8          f       − : : : |3 :
=2         =2      =2
4          E e g   − |4 : : : |0
4          c       − : : |3 : :
4          c       − : : |3 : x
=3         =3      =3
4          F f a   − |5 : : : |2W
8          f       − : : : |3 :
8          g       − : : : : |0
8          a       − : : : : |2
8          b       − : : : : |4
=4         =4      =4
2          E e cc  − |4 : : : |5v
*−         *−      *−
```

The **fret representation also provides several short-hand abbreviations for common ornaments and effects. Trills are indicated by the letters 't' (one semitone) and 'T' (two semitones). Mordents are indicated by the letters 'm' (one semitone) and 'D' (two semitones). Inverted mordents are indicated by the letters 'w' (one semitone) and 'W' (two semitones). Turns are indicated by the letters 'S' and '$' (for the inverted "Wagnerian" turn). Two types of vibrato are distin-

guished: 'v' for transverse vibrato and 'V' for lateral vibrato. Pitch bending is signified by the tilde (˜).

Apart from tablature-tokens, `**fret` also permits the encoding of rests and barlines. Rests tokens are denoted simply by the lower-case letter 'r'. Barlines are represented using the "common system" for barlines used by `**kern` and other representations.

Additional Features of ****fret**

Bowing-direction and *strumming* information is prepended to the beginning of the tablature-token. The direction of bowing/strumming is encoded using the left and right angle brackets: > means to bow/strum from the strings on the left side of the representation toward the strings on the right side of the representation. (On most instruments this means strumming "downward" — from the lowest- to the highest-pitched strings.) The left angle bracket: < means to strum in the opposite direction. A rough indication of the speed of bowing/strumming can be represented by duplicating these signifiers. For example, >> means a slower "downward" bow/strum, and <<< means an especially slow "upward" bow/strum. The percent sign (%) is used to signify the so-called *rasgueado* — or flamboyant Spanish strum. Once again these signifiers appear at the beginning of a tablature-token — whenever they are encoded. Strumming all 6 open strings downward on a commonly-tuned guitar is represented as:

```
*AT:E2
*RT:0:5:10:15:19:24
>| | | | | |
```

Notice that there is no space between the right angle bracket and the first vertical bar.

The `**fret` representation also permits the optional encoding of *fingering* information. For the plucking-hand (normally right hand), traditional musical abbreviations are used: *P* (pollex) for the thumb, *I* (index) for the index finger, *M* (medius) for the middle finger, *A* (annularis) for the ring finger, and *Q* (quintus) for the little finger. In addition, the lower-case letter *p* is used to signify the palm of the hand. Note that these letters are applied only to the 'plucking' hand. In the case of the 'fret-board' hand, the lower-case letters *a-e* are used to denote the thumb, index finger, middle finger, ring finger, and little fingers, respectively. Like the fret information, fingering information is encoded immediately to the right of the string to which the information applies. By way of illustration, the finger actions used in the above example may be made explicit as follows:

```
>|P |2bP |2cP |P |P |P
```

The strum is carried out by the thumb, while the index and middle fingers of the fret-hand stop the second and third courses/strings at the second fret. In the following continuation of this representation, the first course/string is replucked by the thumb. With the exception of the second and third courses/strings, the other strings are allows to ring.

```
>|P |2bP |2cP |P |P |P
>|P xIM xIM :  :  :
```

Notice that in damping the vibrations of the second and third strings, both the index and middle

fingers of the 'pluck' hand are used on both strings.

On rare occasions, guitarists will substitute fingers on the fret-board while a string remains sounding. The following example illustrates such a finger-substitution where the middle finger is replaced by the ring finger:

```
|  |2b |2c |  |  |
:  :2b :2d :  :  :
```

Note that in the `**fret` representation, no special signifiers are provided for so-called 'hammer-on' or (ascending-slur), nor for the so-called 'pull-off' or (descending-slur). During the ascending-slur, the sound is produced simply by engaging the next fret. This can be represented in `**fret` by using the "let ring" signifier (:) in conjunction with the appropriate fret notation. The descending-slur can be similarly notated.

Four types of "percussion effects" can be represented using `**fret`. The two most common *tambours* involve tapping on the bridge (represented by the lower-case letter 'u') and tapping on the strings near the bridge (represented by the upper-case letter 'U'). A simple 'tap' on the top-plate is represented by the lower-case letter 'y', whereas a lower-pitched 'thump' on the top-plate is represented by the upper-case letter 'Y'. When sounded alone, these signifiers appear on a line by themselves. When sounded in conjunction with a plucked or (uncommonly) bowed string, these signifiers appear at the beginning of the tablature-token.

The complete system of signifiers used by `**fret` is summarized in Table 18.1.

Table 18.1. Signifiers used by `**fret`.

Fret-board (left) Hand

1	first fret position
2	second fret position, ...
11	eleventh fret position, etc.
0	open string (not necessarily sounded)
~	bend up in pitch
v	vibrato (transverse)
V	vibrato (lateral)
t	trill (1 fret distance)
T	trill (2 frets distance)
m	mordent (1 fret distance)
D	mordent (2 frets distance)
w	inverted mordent (1 fret distance)
W	inverted mordent (2 frets distance)
S	turn
$	inverted (Wagnerian) turn
a	thumb (of fret hand)
b	index finger (of fret hand)
c	middle finger (of fret hand)

d	ring finger (of fret hand)
e	little finger (of fret hand)
n	no finger (of fret hand)

Pluck (right) Hand

-	unplucked or unactivated string
|	plucked string (normal)
/	plucked string — near bridge (ponticello)
\\\\	plucked string — near tone-hole (sul tasto)
#	tremolo (plucked, ala mandoline)
z	pizzicato
:	let string ring
x	damp string
o	natural harmonic
O	artificial harmonic
+	bow (normal)
(	bow — near bridge (ponticello)
)	bow — toward fret-board (sul tasto)
{	spiccato
}	col legno (with wood of the bow)
&	tremolo (bowed)
>	strum from low notes to high notes (= down-bow)
<	strum from high notes to low notes (= up-bow)
>>	slower down-strum; slower down-bow
>>	slower up-strum; slower up-bow
>>>	very slow down-strum; very slow down-bow
<<<	very slow up-strum; very slow up-bow
%	rasgueado (Spanish strum)
P	pollex: thumb (of pluck hand)
I	index: index finger (of pluck hand)
M	medius: middle finger (of pluck hand)
A	annularis: ring finger (of pluck hand)
Q	quintus: little finger (of pluck hand)
p	palm (of pluck hand)
N	no finger (of pluck hand)
u	tambour (tap on bridge)
U	tambour (tap on strings near bridge)
y	'tap' on top-plate
Y	'thump' on top-plate

Summary of ****fret** *Signifiers*

A number of pitch-related Humdrum commands accept `**fret` encoded data as inputs, including **cents, freq, kern, pitch, semits, solfg,** and **tonh**.

Reprise

In this chapter we have tried to reinforce the lesson that `**kern` is only one of an unbounded number of existing and possible Humdrum representations. As a Humdrum user, you are free to concoct your own representations to better address the kinds of information you are interested in manipulating. As long as the resulting representation conforms to the Humdrum syntax, the most important Humdrum tools can still be used to manipulate your data.