Fundamentals of Music Processing

Chapter 1: Music Representations

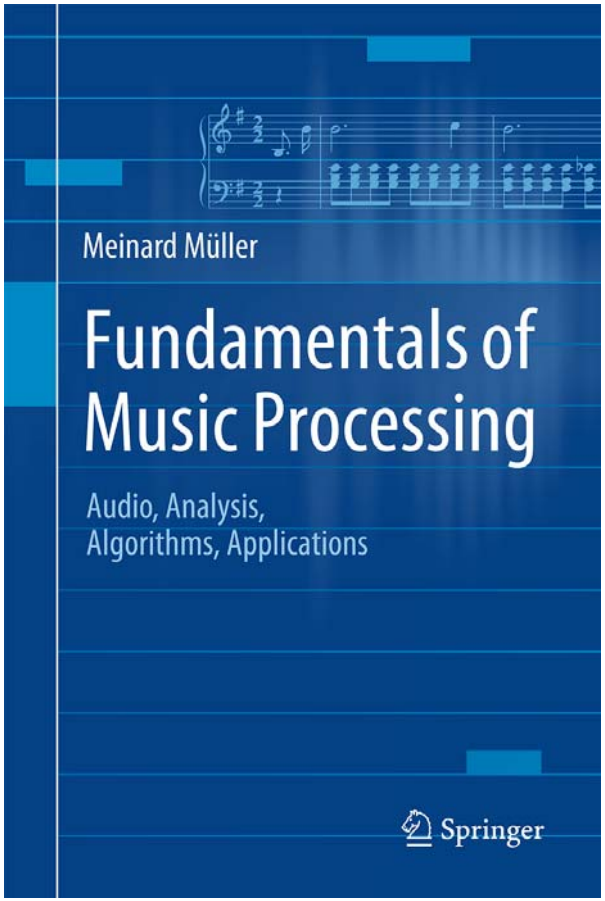
Meinard Müller
International Audio Laboratories Erlangen

www.music-processing.de

Springer

AUDIO LABS

Book: Fundamentals of Music Processing



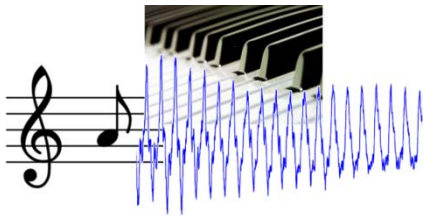
Meinard Müller
Fundamentals of Music Processing
Audio, Analysis, Algorithms, Applications
483 p., 249 illus., 30 illus. in color, hardcover
ISBN: 978-3-319-21944-8
Springer, 2015

Accompanying website:
www.music-processing.de

© Springer International Publishing Switzerland, 2015

Chapter 1: Music Representations

1.1 Sheet Music Representations
1.2 Symbolic Representations
1.3 Audio Representation
1.4 Further Notes

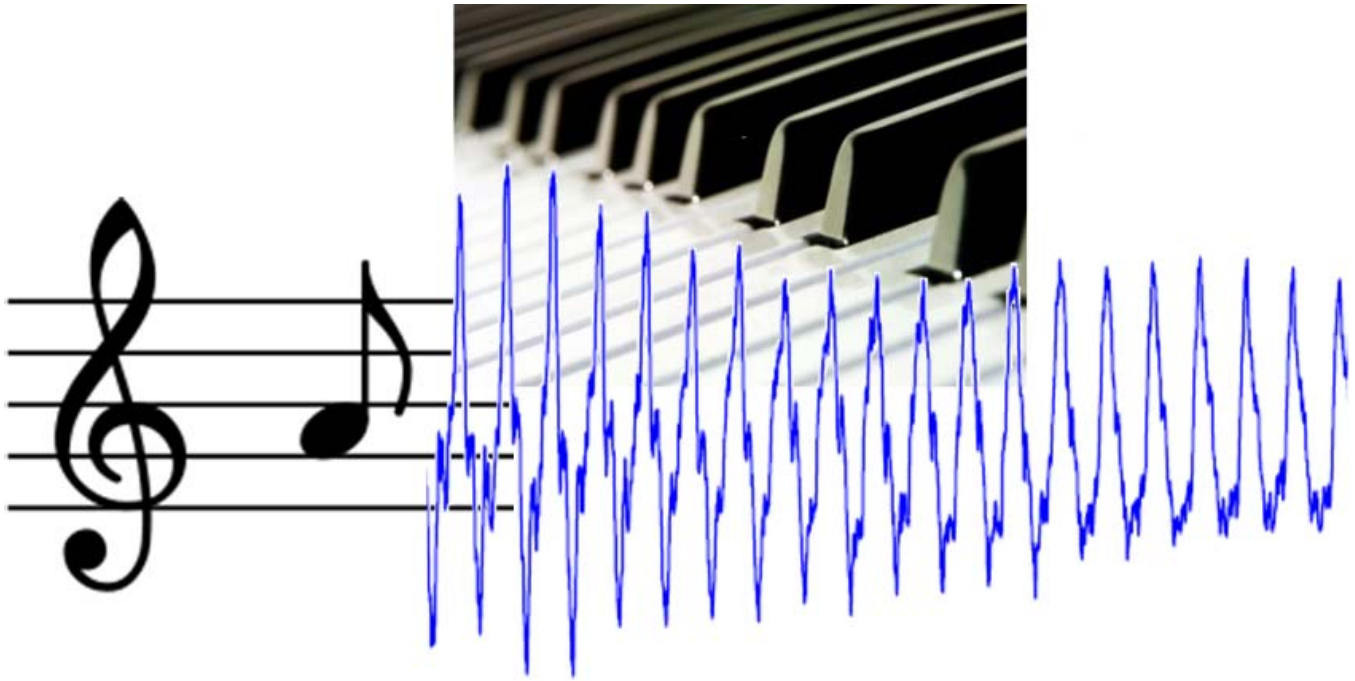


Musical information can be represented in many different ways. In Chapter 1, we consider three widely used music representations: sheet music, symbolic, and audio representations. This first chapter also introduces basic terminology that is used throughout the book. In particular, we discuss musical and acoustic properties of audio signals including aspects such as frequency, pitch, dynamics, and timbre.

© Springer International Publishing Switzerland, 2015

1 Music Representations

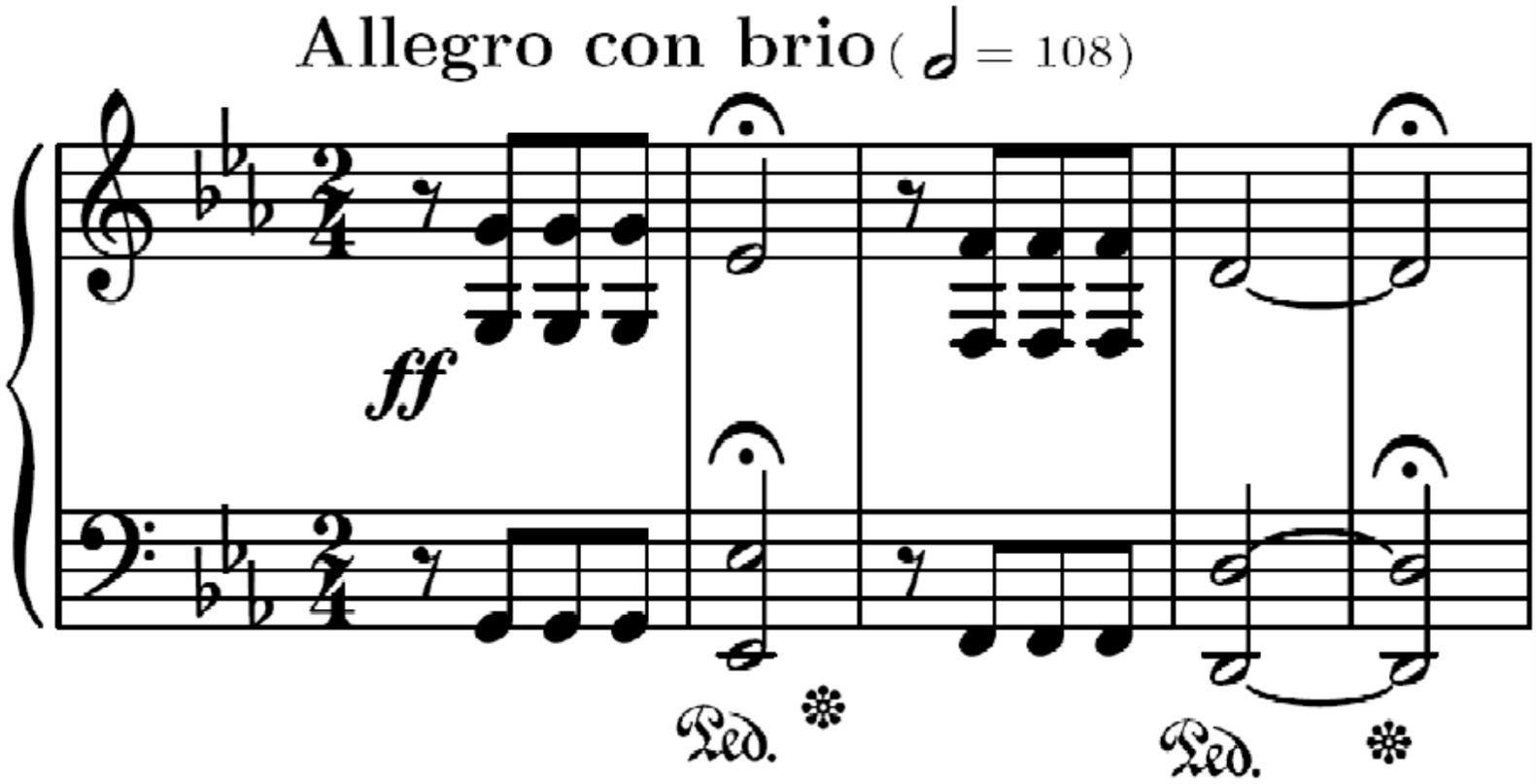
Teaser



© Springer International Publishing Switzerland, 2015

1.1 Sheet Music Representations

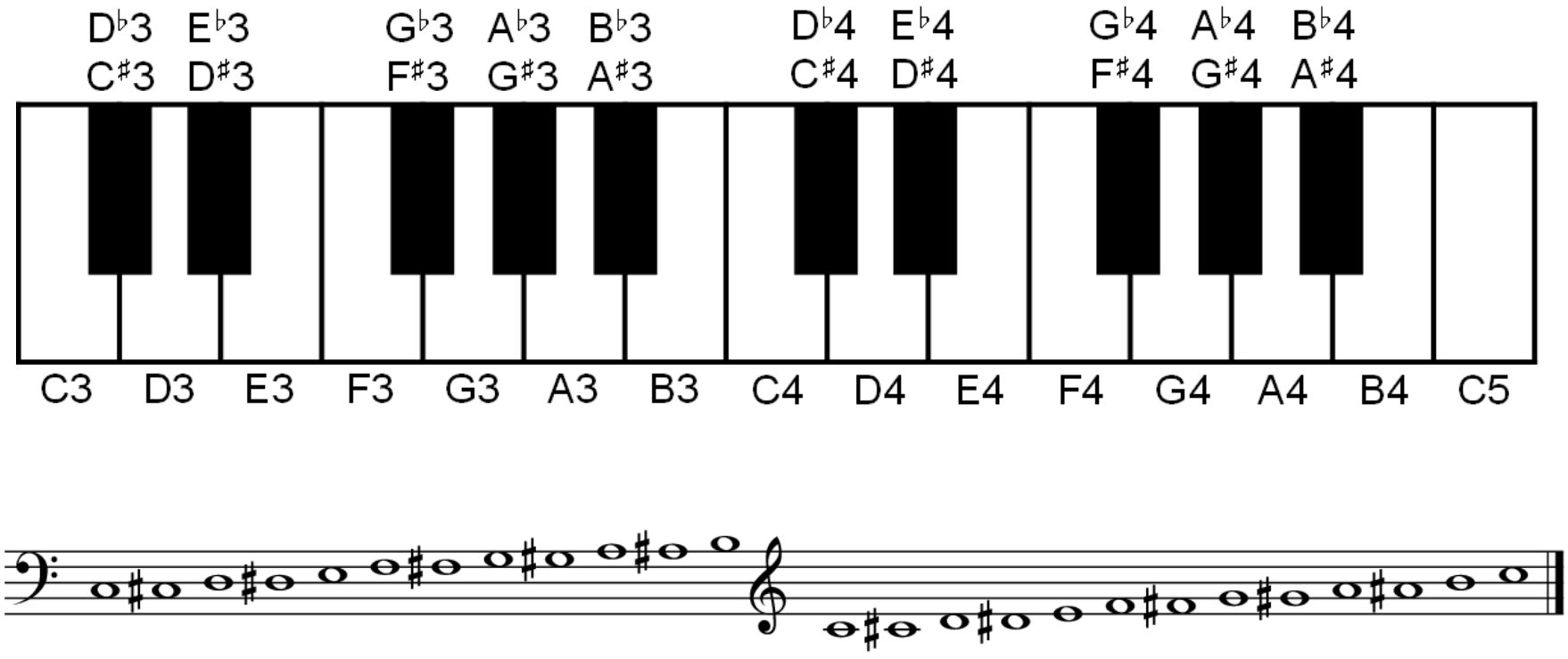
Fig. 1.1



© Springer International Publishing Switzerland, 2015

1.1 Sheet Music Representations

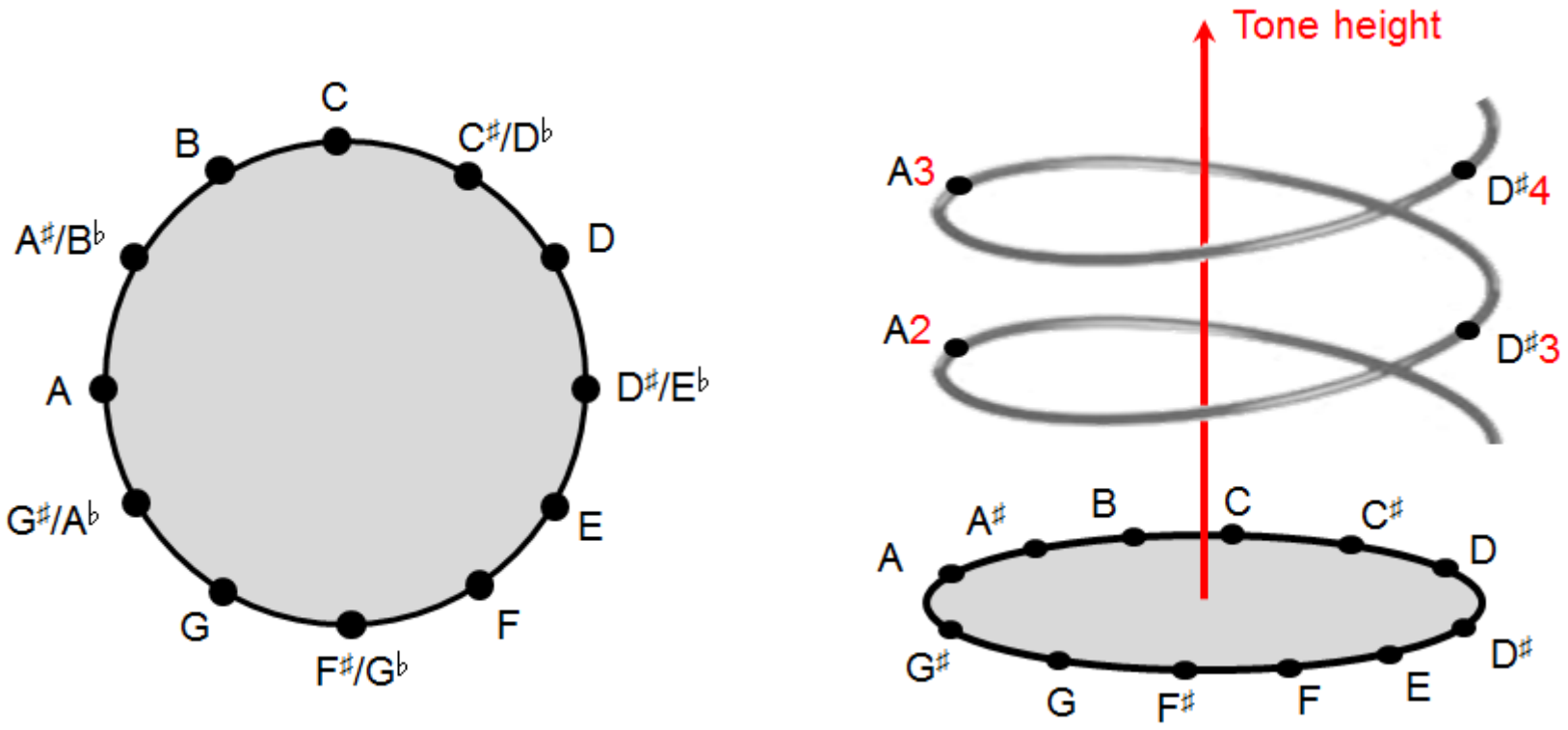
Fig. 1.2



© Springer International Publishing Switzerland, 2015

1.1 Sheet Music Representations

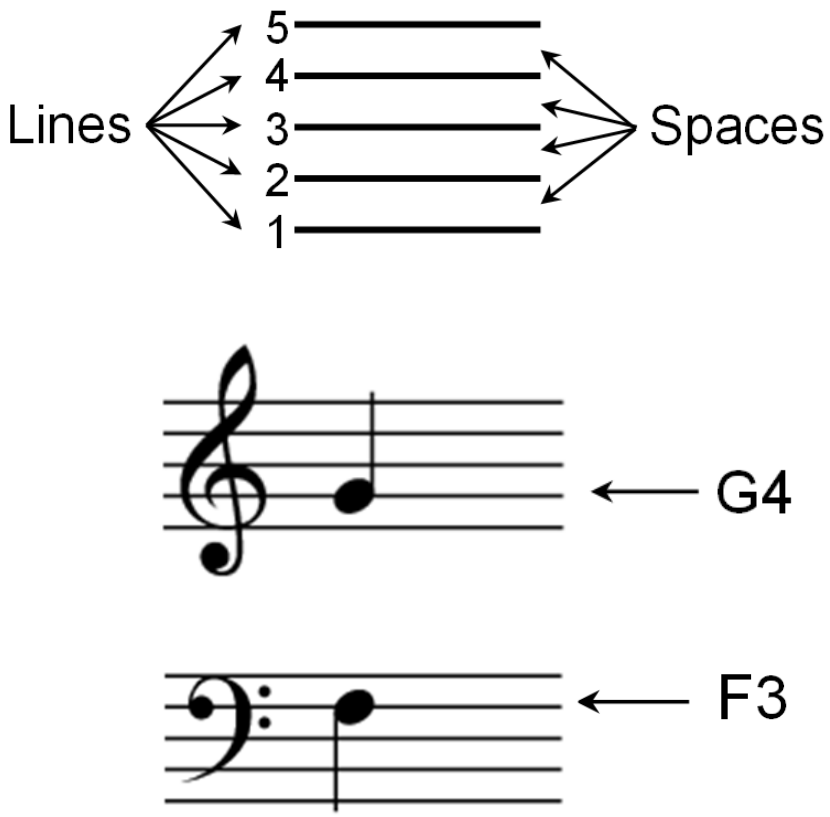
Fig. 1.3



© Springer International Publishing Switzerland, 2015

1.1 Sheet Music Representations

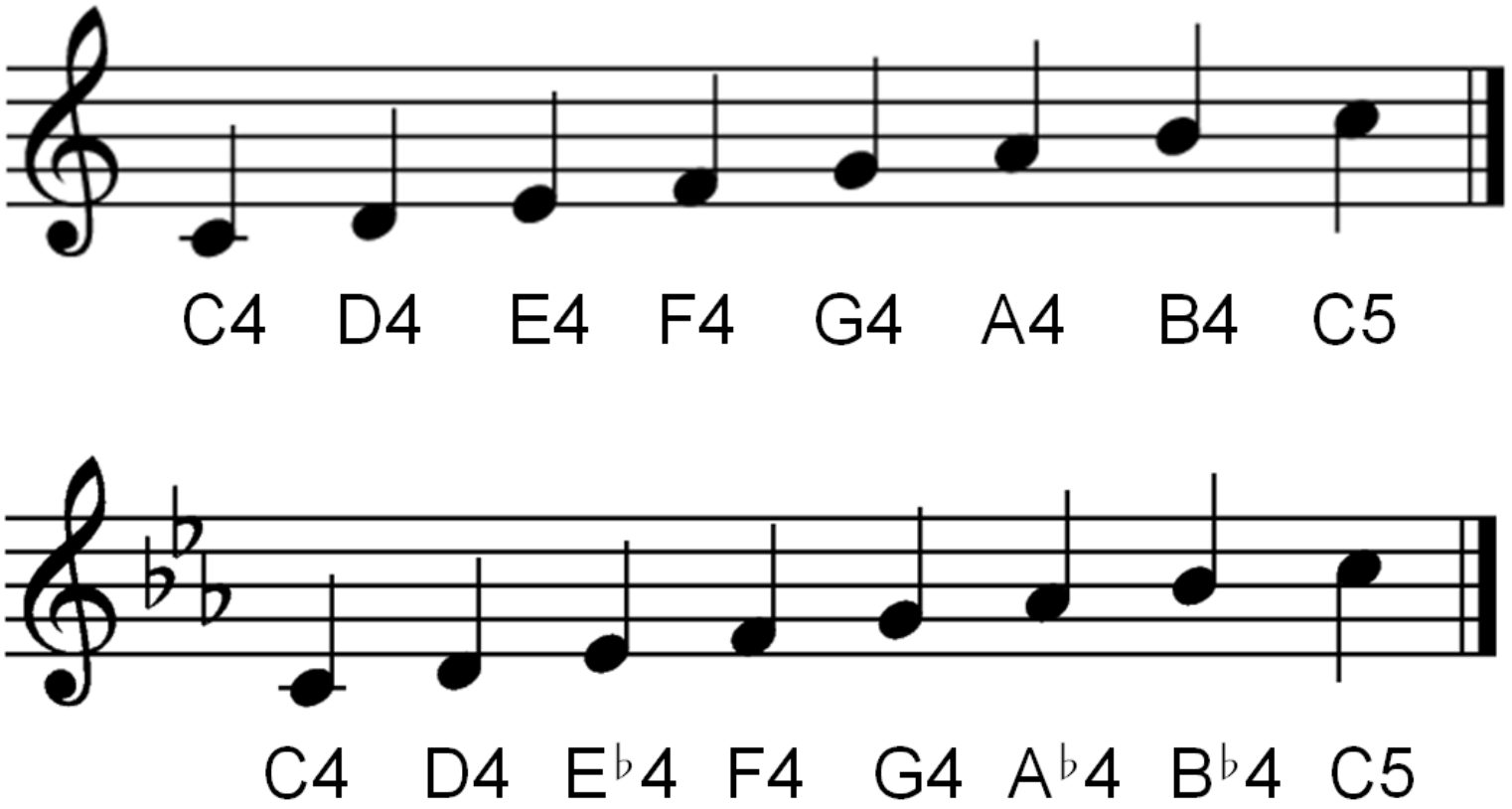
Fig. 1.4



© Springer International Publishing Switzerland, 2015

1.1 Sheet Music Representations

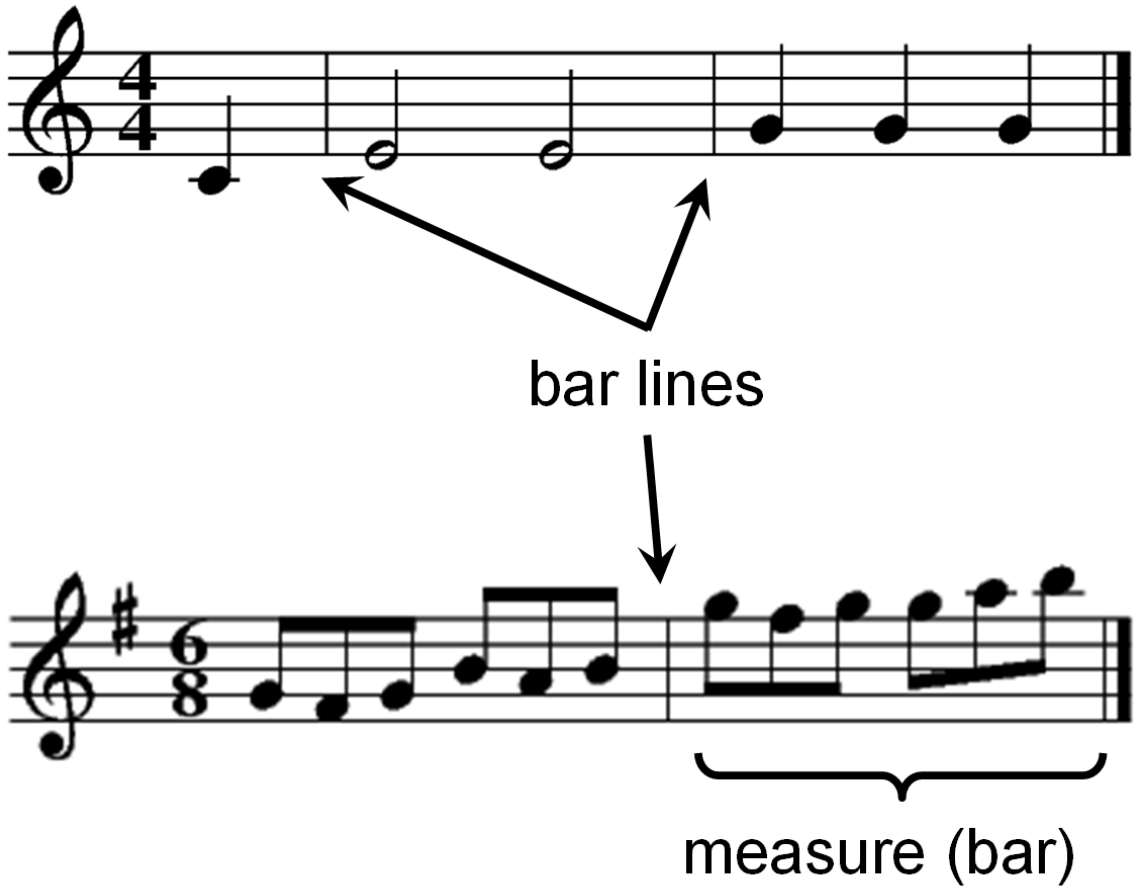
Fig. 1.5



© Springer International Publishing Switzerland, 2015

1.1 Sheet Music Representations

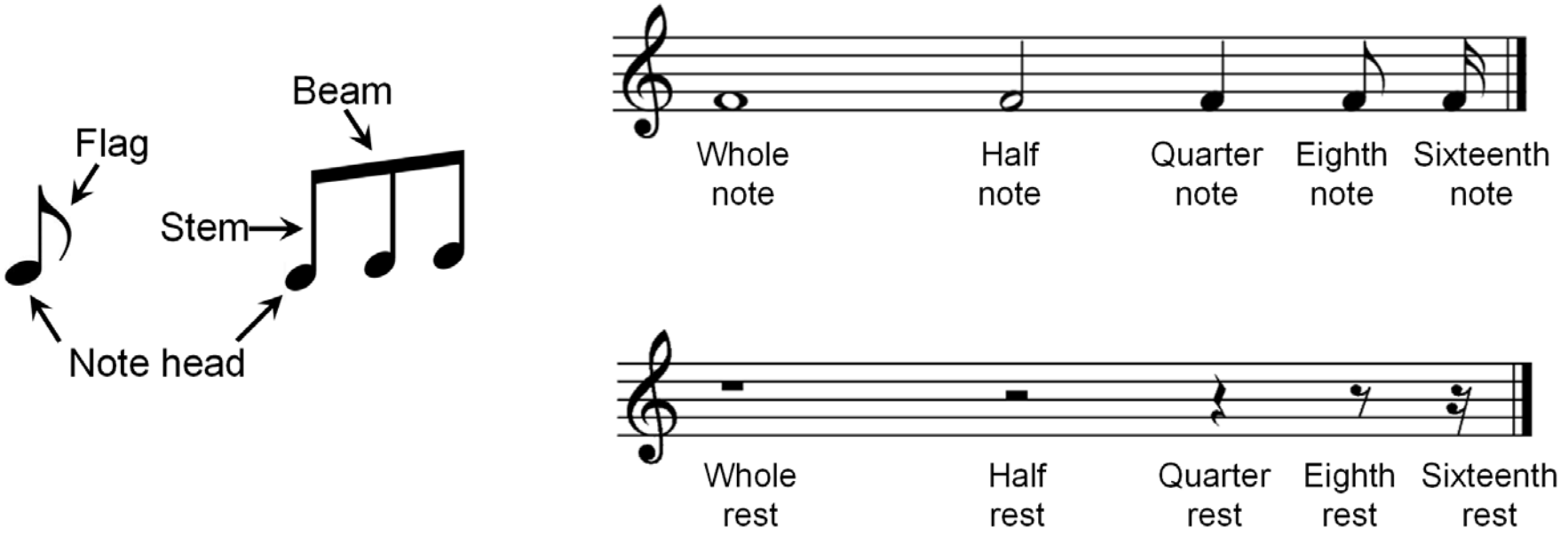
Fig. 1.6



© Springer International Publishing Switzerland, 2015

1.1 Sheet Music Representations

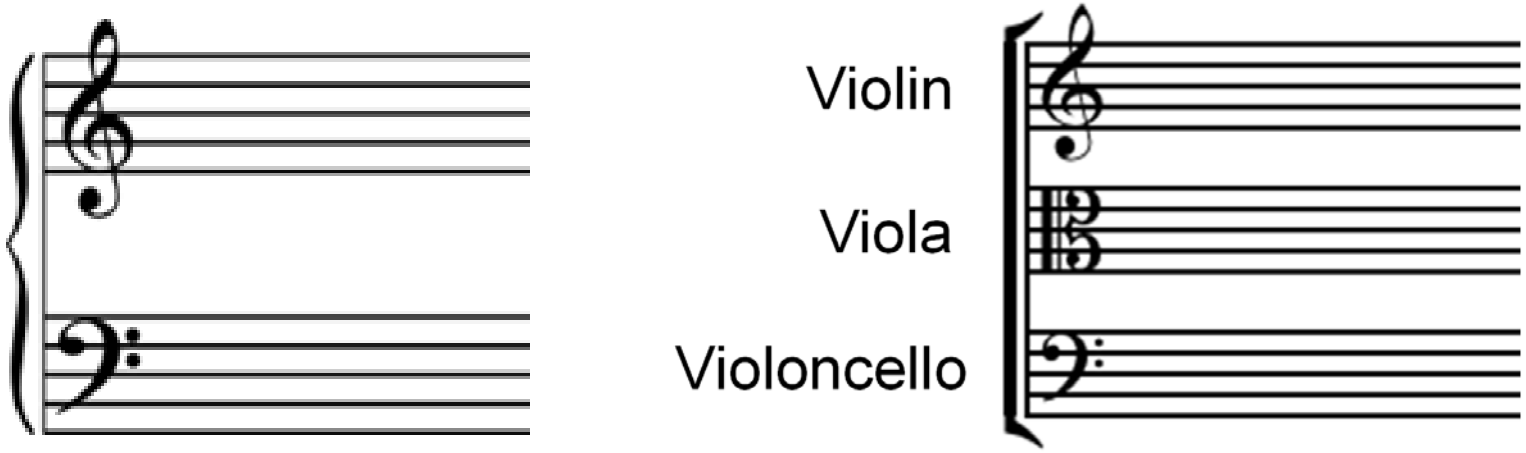
Fig. 1.7



© Springer International Publishing Switzerland, 2015

1.1 Sheet Music Representations

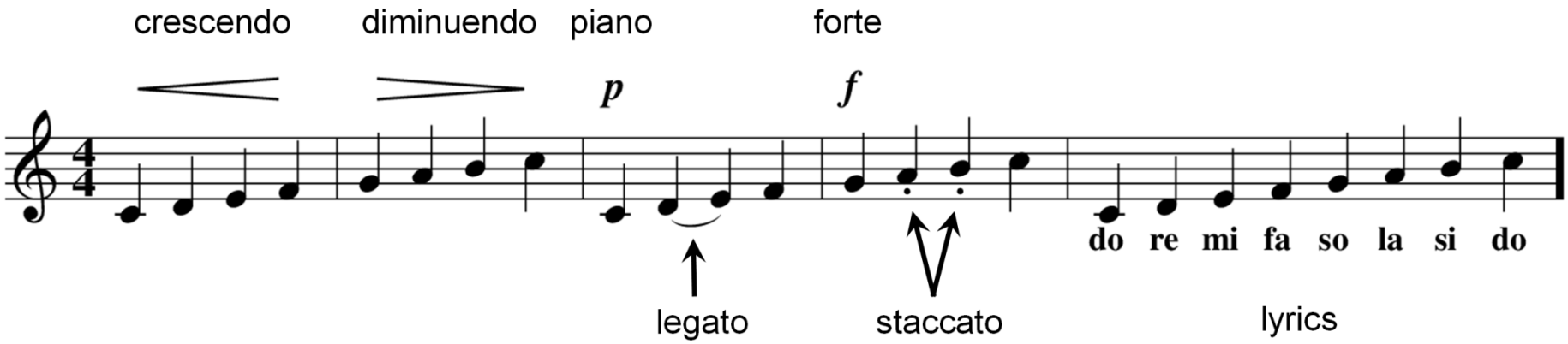
Fig. 1.8



© Springer International Publishing Switzerland, 2015

1.1 Sheet Music Representations

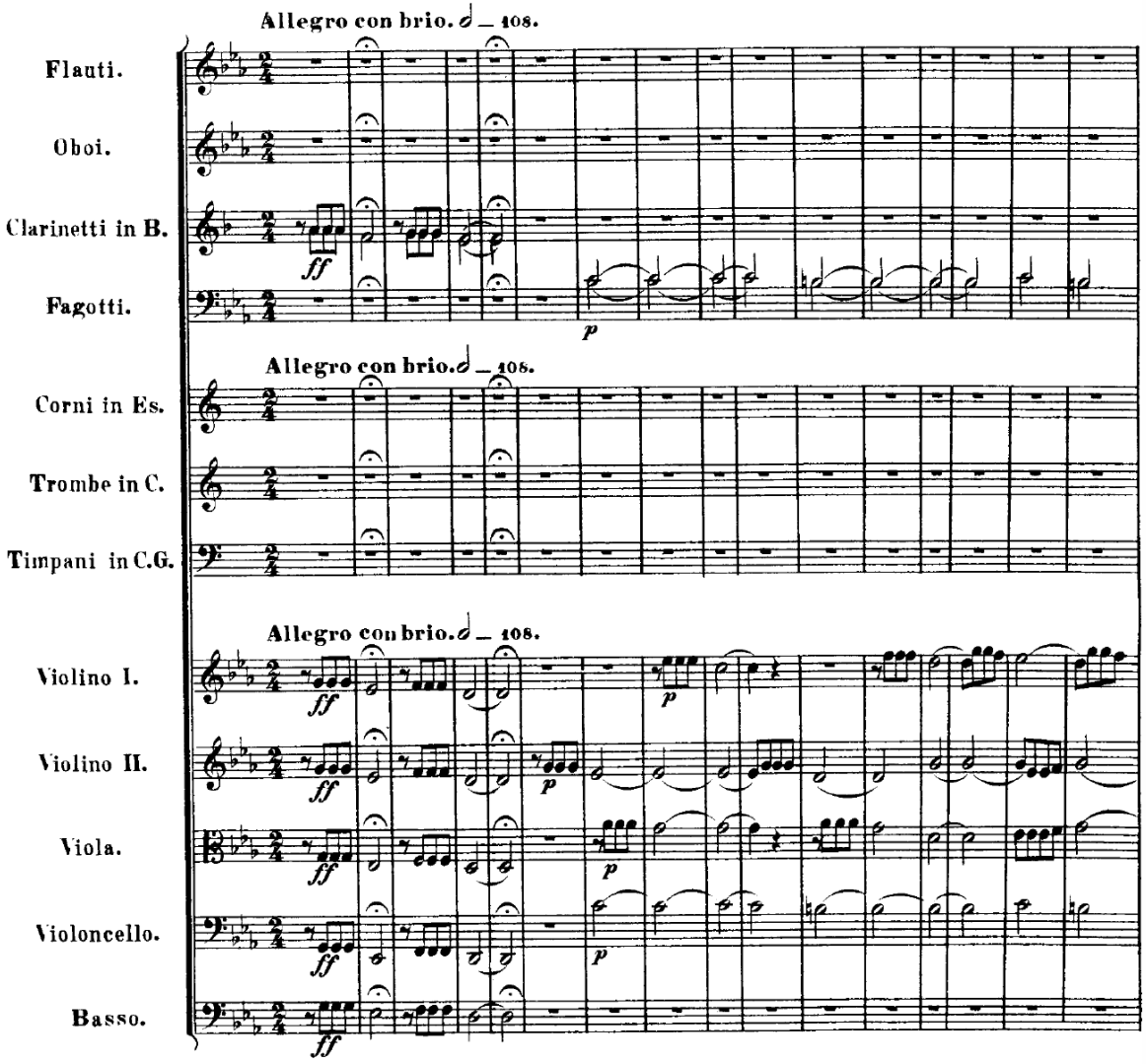
Fig. 1.9



© Springer International Publishing Switzerland, 2015

1.1 Sheet Music Representations

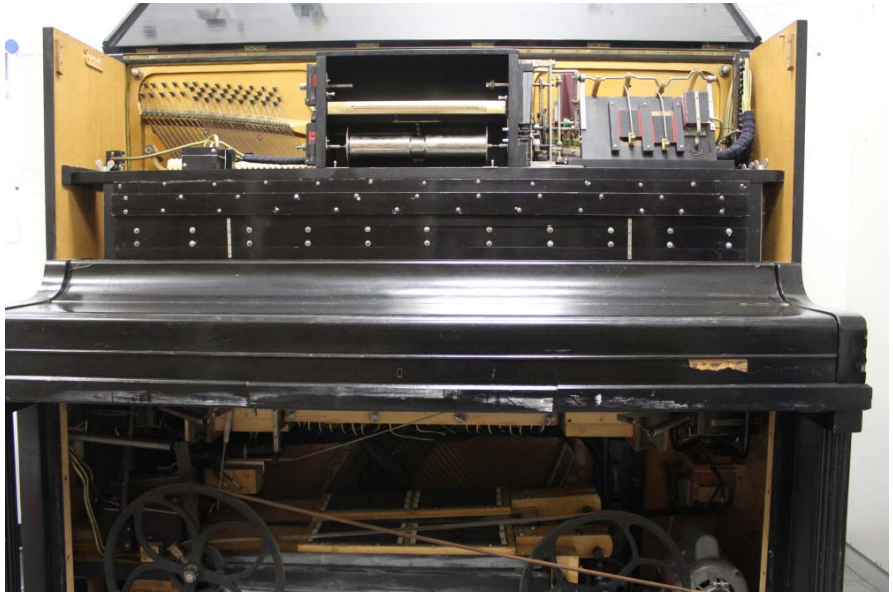
Fig. 1.10

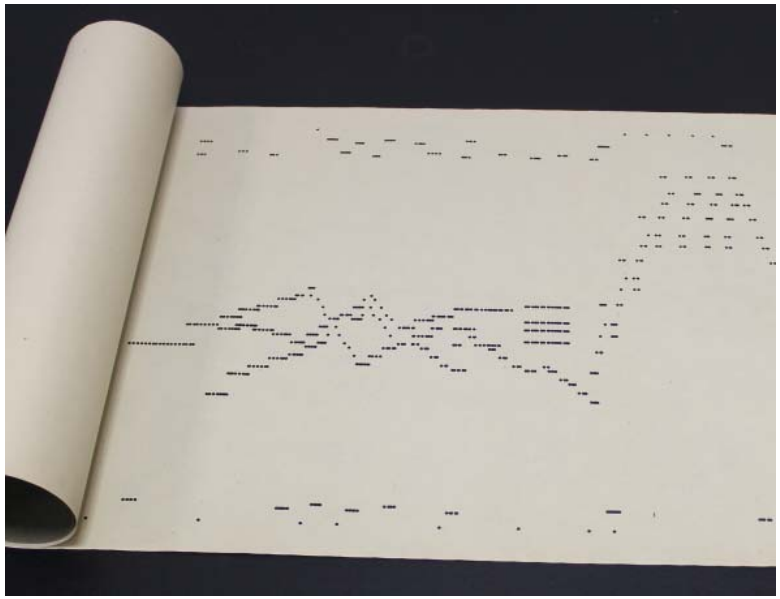


© Springer International Publishing Switzerland, 2015

1.2 Symbolic Representations

Fig. 1.11



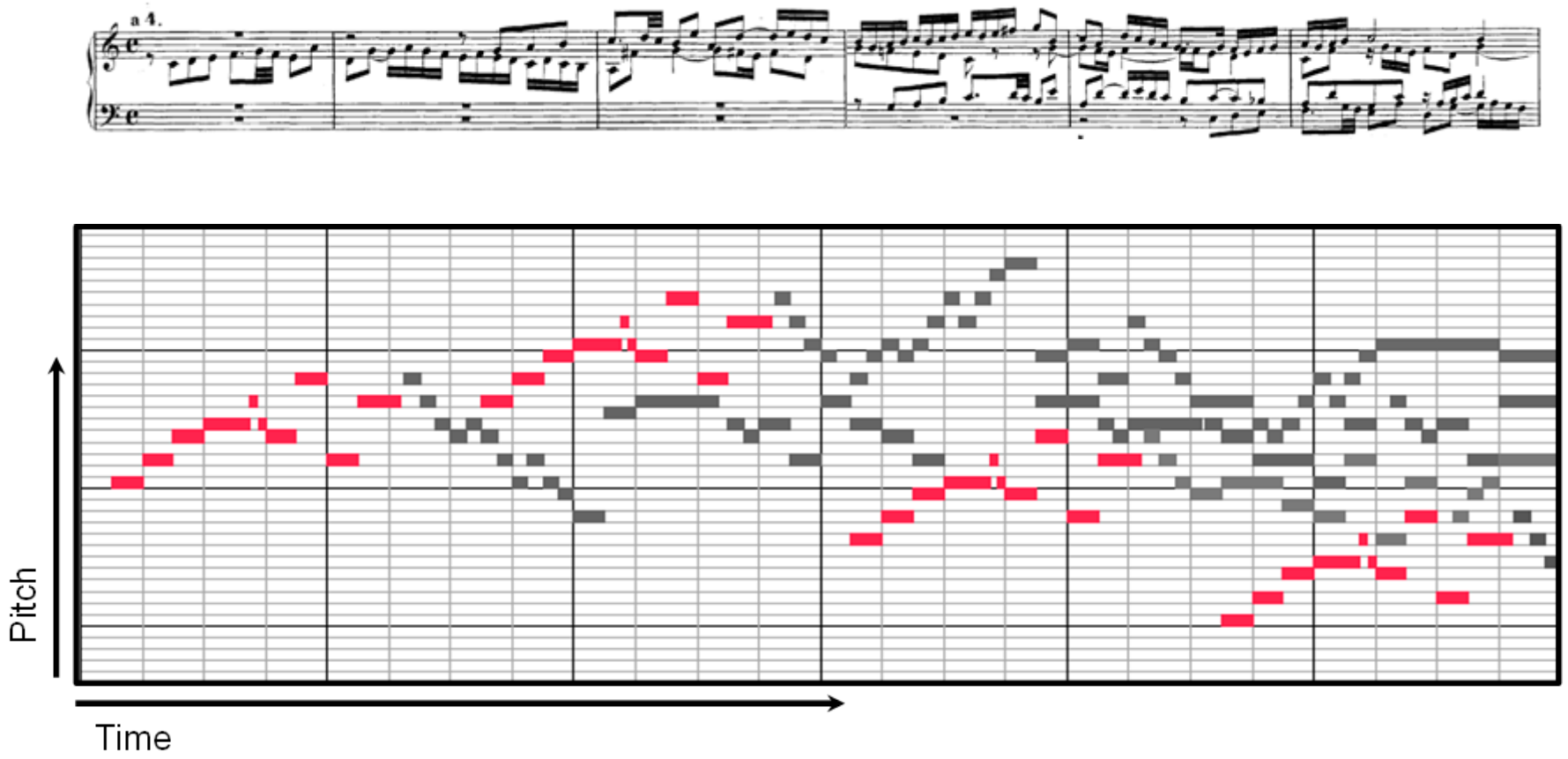


Reprinted by kind permission of
the Institut für Musikwissenschaft
der Goethe-Universität Frankfurt

© Springer International Publishing Switzerland, 2015

1.2 Symbolic Representations

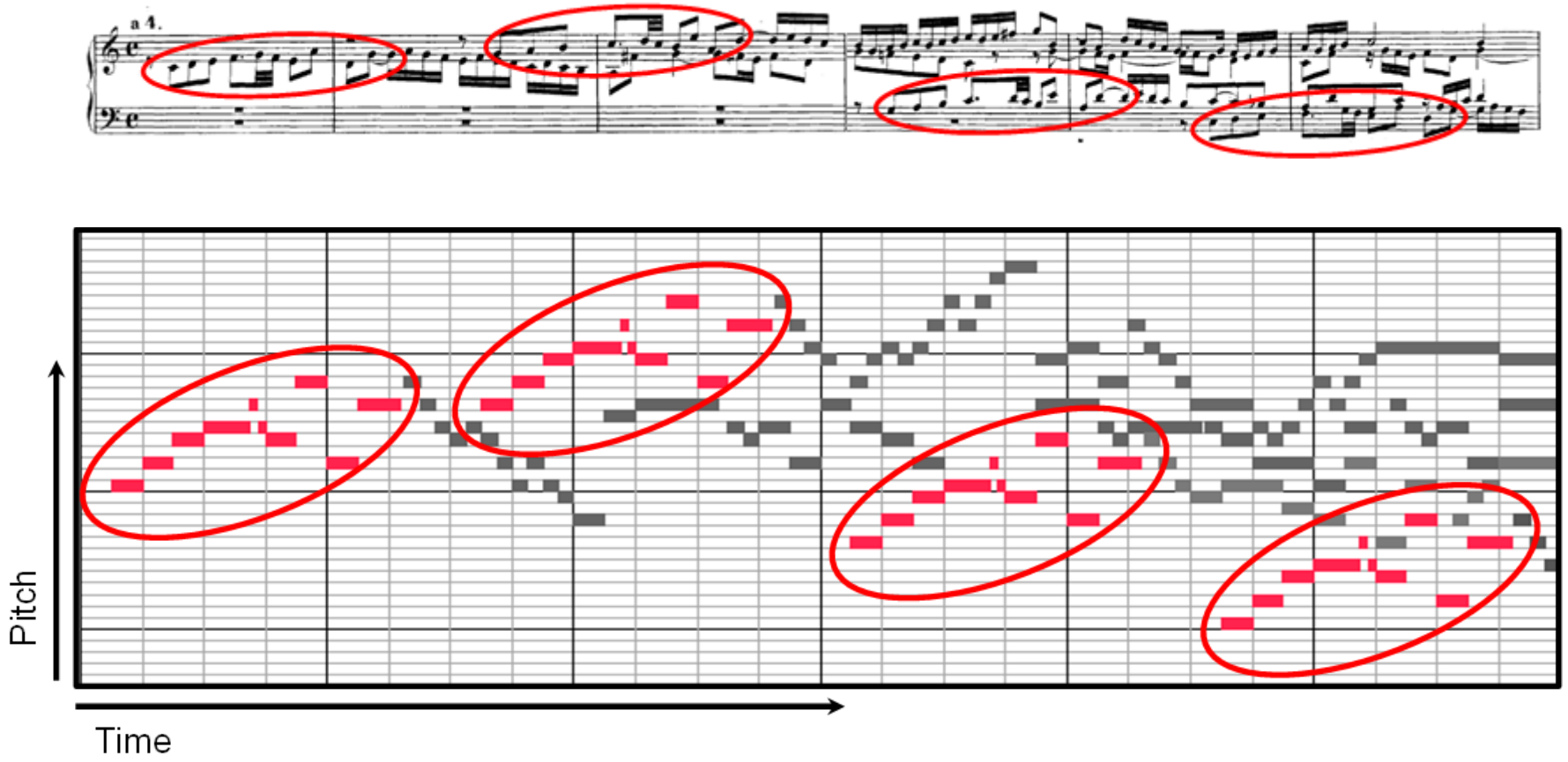
Fig. 1.12



© Springer International Publishing Switzerland, 2015

1.2 Symbolic Representations

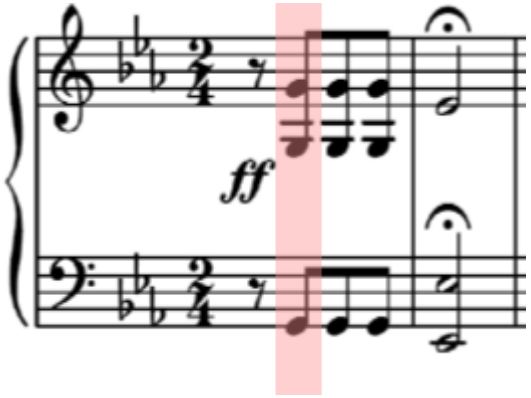
Fig. 1.12



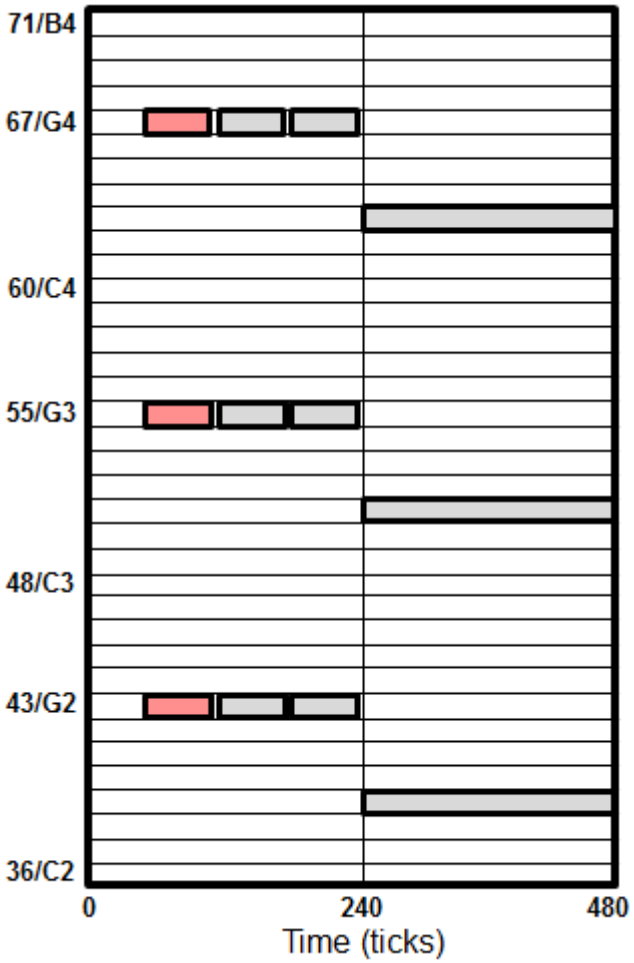
© Springer International Publishing Switzerland, 2015

1.2 Symbolic Representations

Fig. 1.13



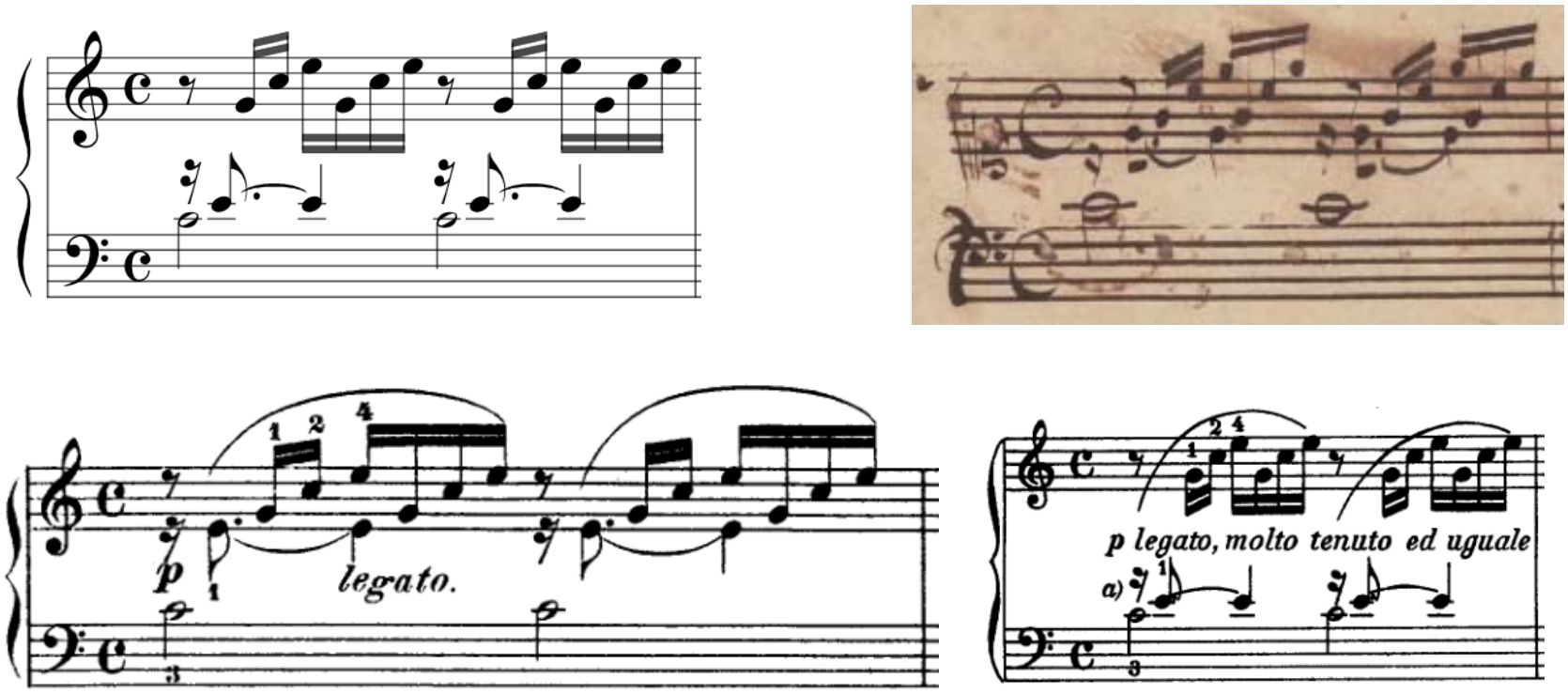
Time (Ticks)	Message	Channel	Note Number	Velocity
60	NOTE ON	1	67	100
0	NOTE ON	1	55	100
0	NOTE ON	2	43	100
55	NOTE OFF	1	67	0
0	NOTE OFF	1	55	0
0	NOTE OFF	2	43	0
5	NOTE ON	1	67	100
0	NOTE ON	1	55	100
0	NOTE ON	2	43	100
55	NOTE OFF	1	67	0
0	NOTE OFF	1	55	0
0	NOTE OFF	2	43	0
5	NOTE ON	1	67	100
0	NOTE ON	1	55	100
0	NOTE ON	2	43	100
55	NOTE OFF	1	67	0
0	NOTE OFF	1	55	0
0	NOTE OFF	2	43	0
5	NOTE ON	1	63	100
0	NOTE ON	2	51	100
0	NOTE ON	2	39	100
240	NOTE OFF	1	63	0
0	NOTE OFF	2	51	0
0	NOTE OFF	2	39	0



© Springer International Publishing Switzerland, 2015

1.2 Symbolic Representations

Fig. 1.14

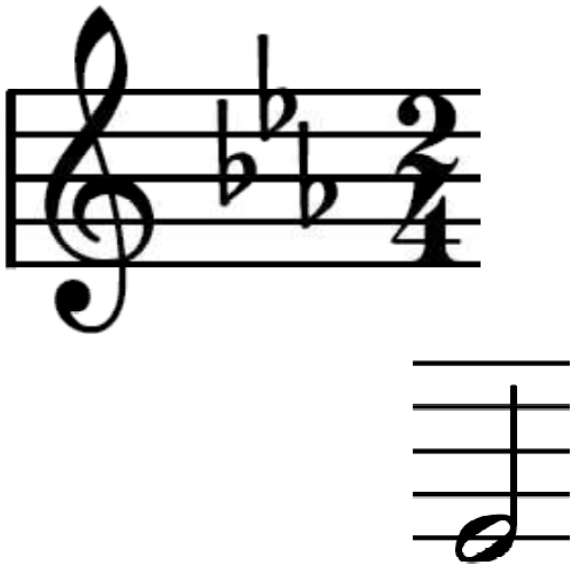


© Springer International Publishing Switzerland, 2015

1.2 Symbolic Representations

Fig. 1.15

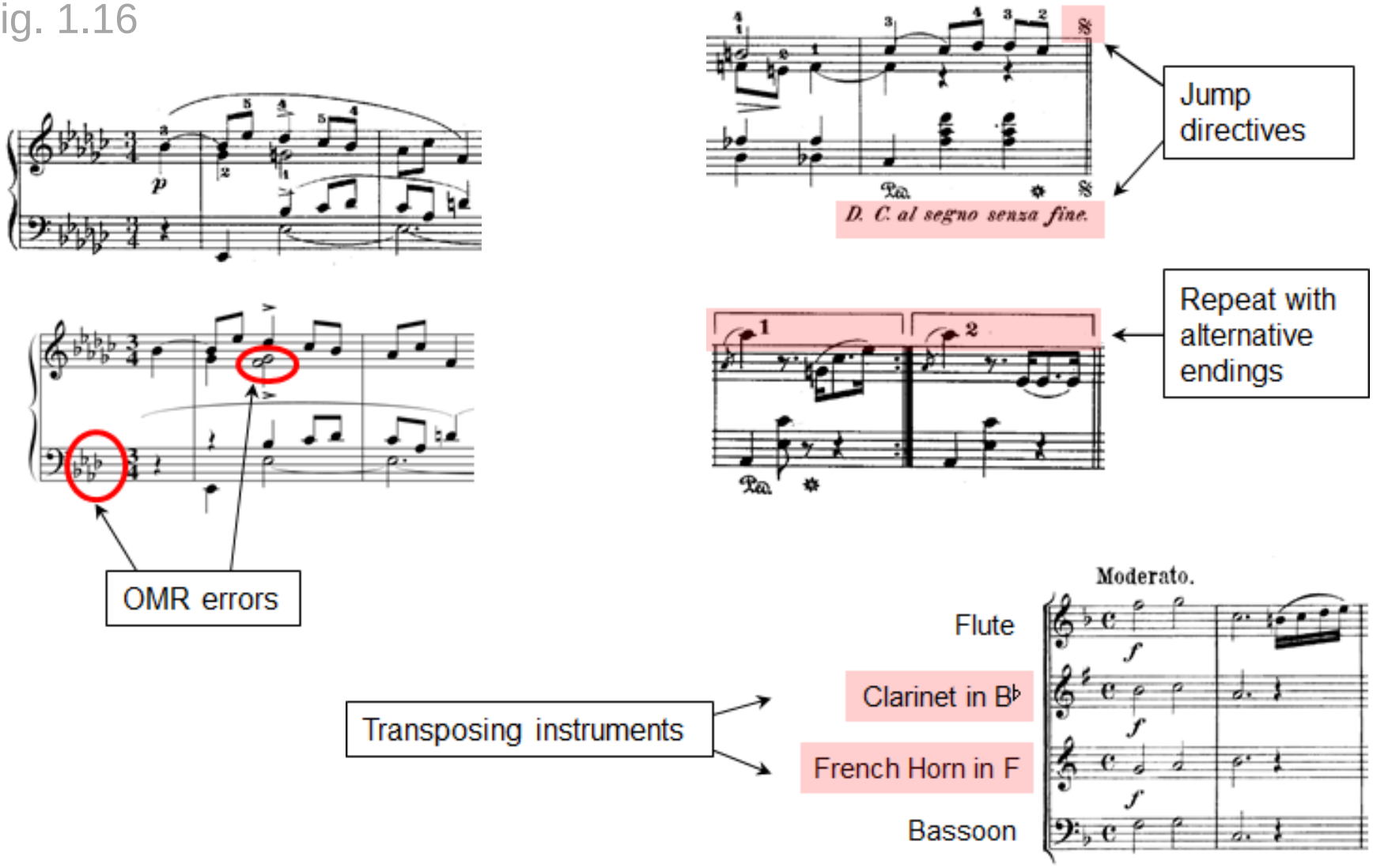
```
<note>
  <pitch>
    <step>E</step>
    <alter>-1</alter>
    <octave>4</octave>
  </pitch>
  <duration>2</duration>
  <type>half</type>
</note>
```



© Springer International Publishing Switzerland, 2015

1.3 Audio Representations

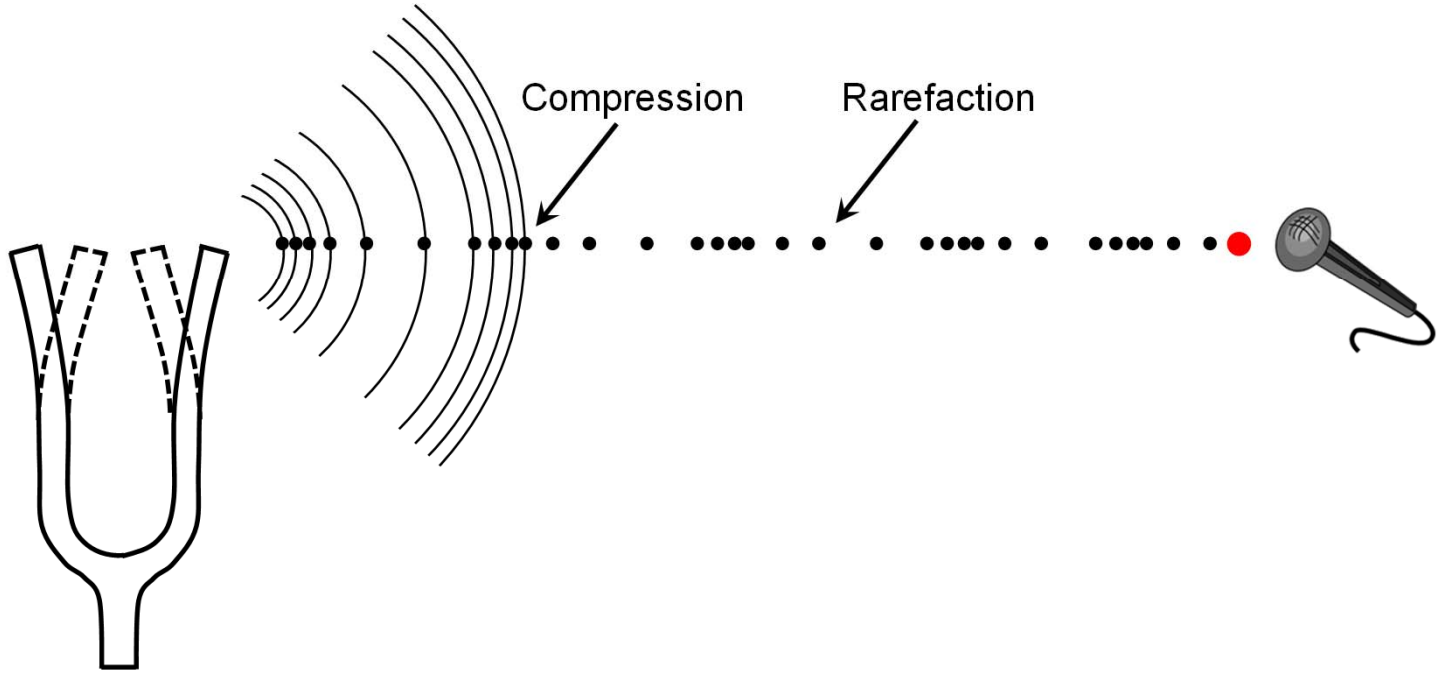
Fig. 1.16



© Springer International Publishing Switzerland, 2015

1.3 Audio Representations

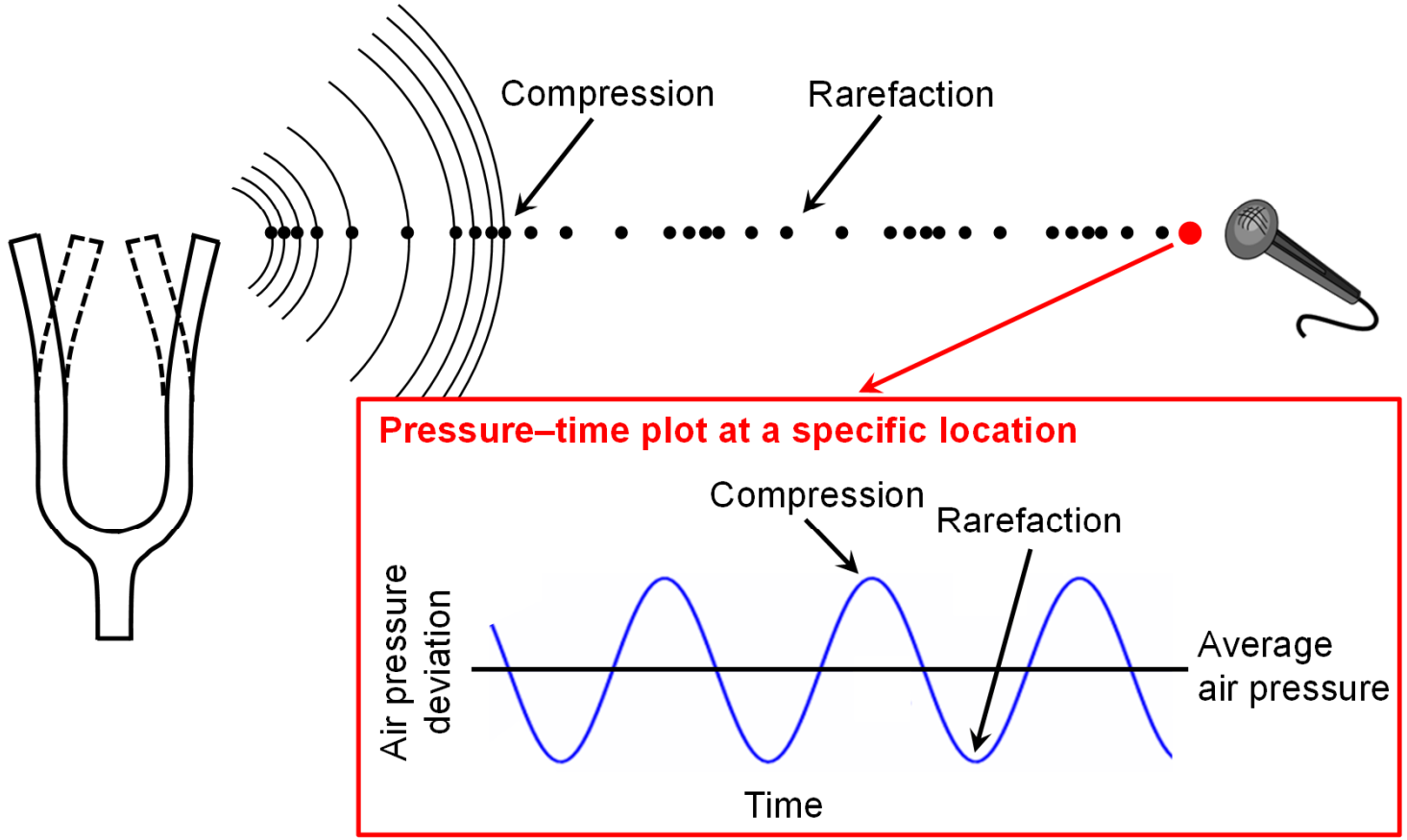
Fig. 1.17



© Springer International Publishing Switzerland, 2015

1.3 Audio Representations

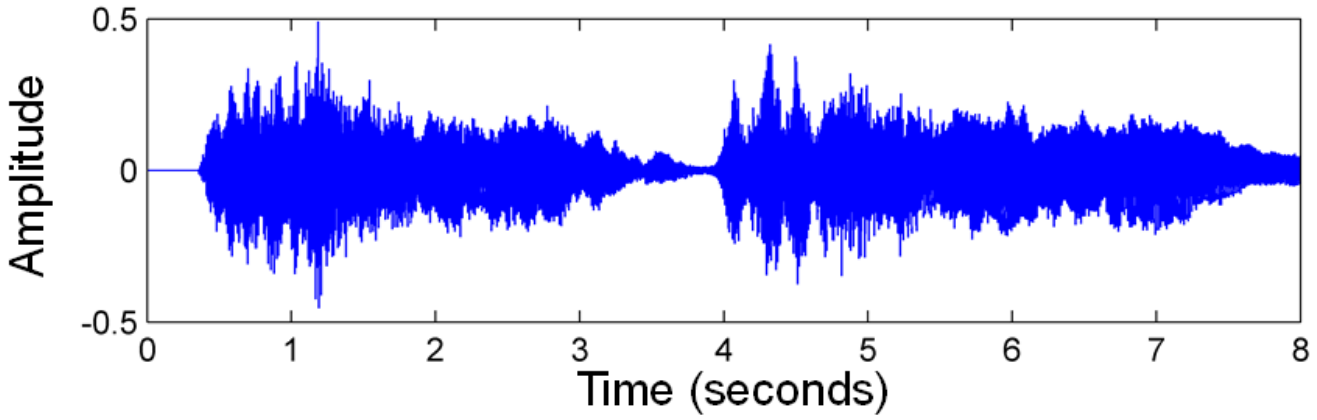
Fig. 1.17



© Springer International Publishing Switzerland, 2015

1.3 Audio Representations

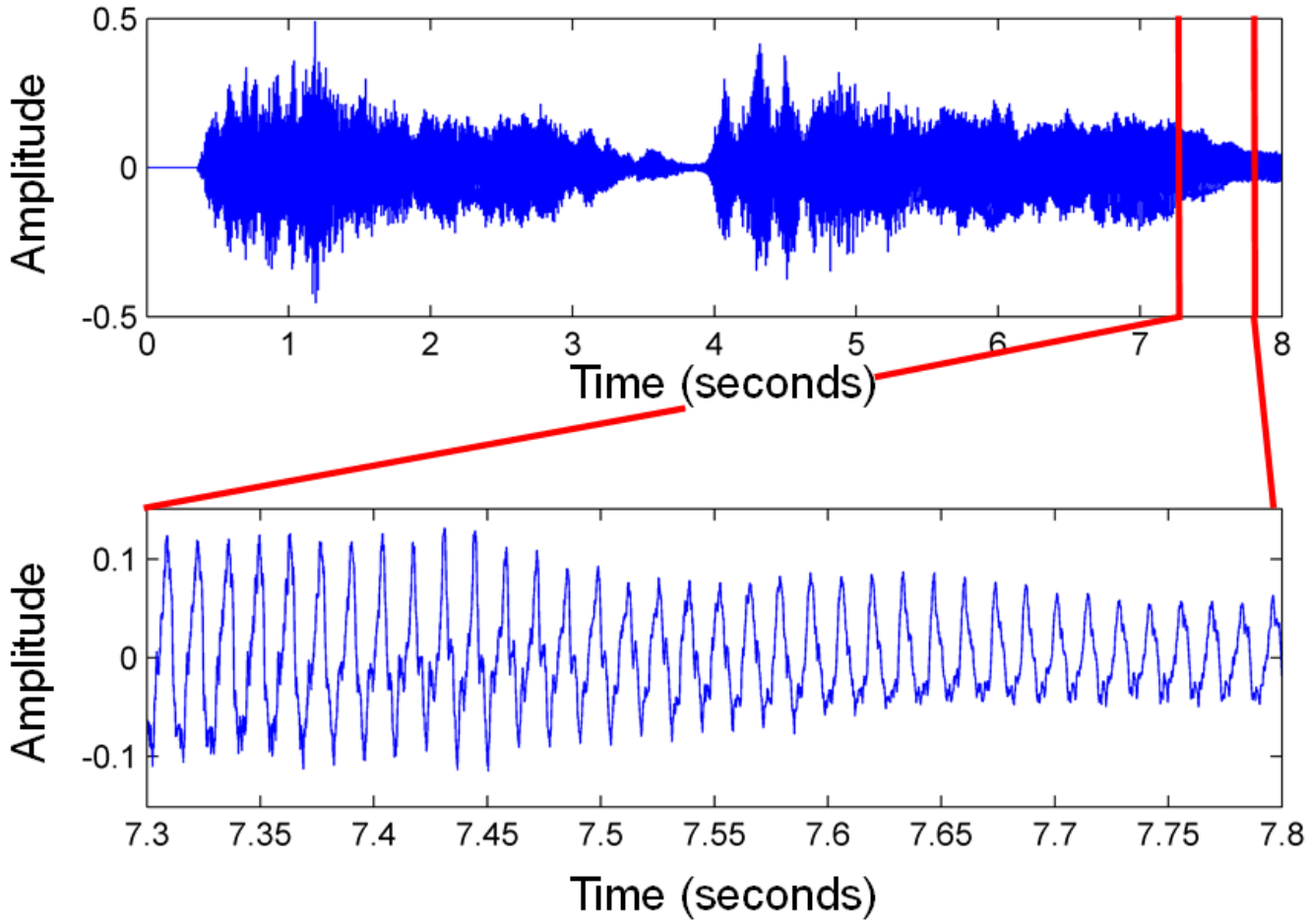
Fig. 1.18



© Springer International Publishing Switzerland, 2015

1.3 Audio Representations

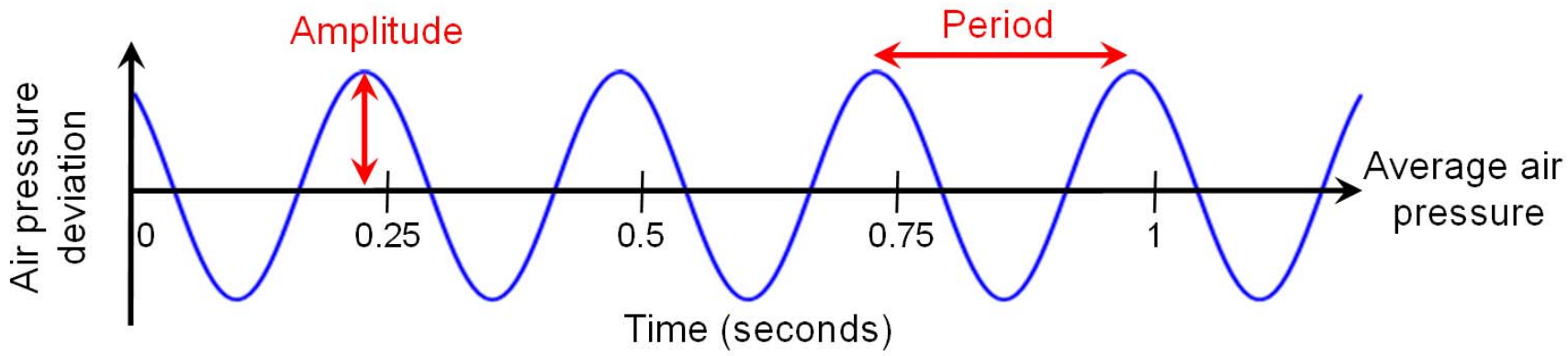
Fig. 1.18



© Springer International Publishing Switzerland, 2015

1.3 Audio Representations

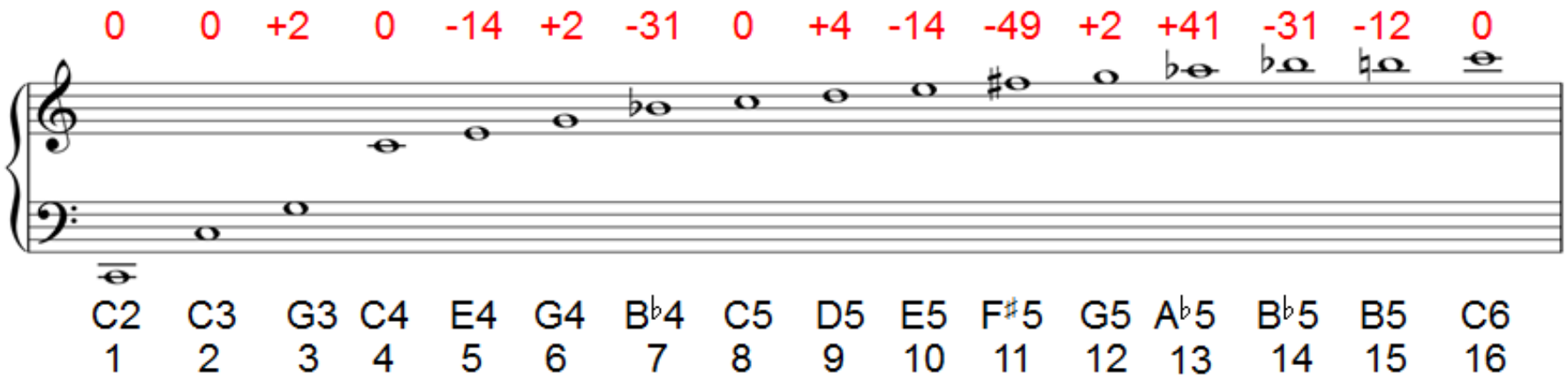
Fig. 1.19



© Springer International Publishing Switzerland, 2015

1.3 Audio Representations

Fig. 1.20



© Springer International Publishing Switzerland, 2015

1.3 Audio Representations

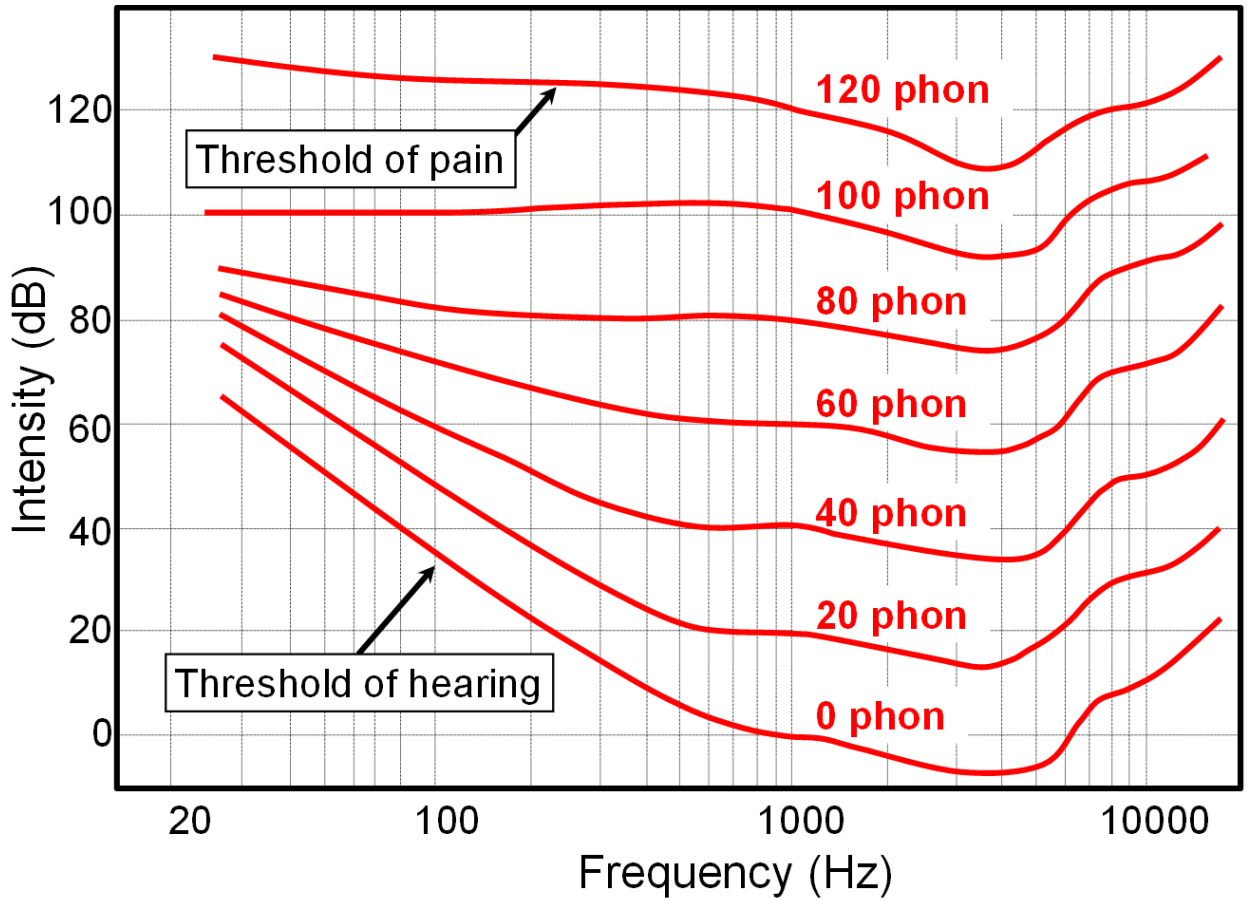
Table 1.1

Source	Intensity	Intensity level	× TOH
Threshold of hearing (TOH)	10^{-12}	0 dB	1
Whisper	10^{-10}	20 dB	10^{2}
Pianissimo	10^{-8}	40 dB	10^{4}
Normal conversation	10^{-6}	60 dB	10^{6}
Fortissimo	10^{-2}	100 dB	10^{10}
Threshold of pain	10	130 dB	10^{13}
Jet take-off	10^{2}	140 dB	10^{14}
Instant perforation of eardrum	10^{4}	160 dB	10^{16}

© Springer International Publishing Switzerland, 2015

1.3 Audio Representations

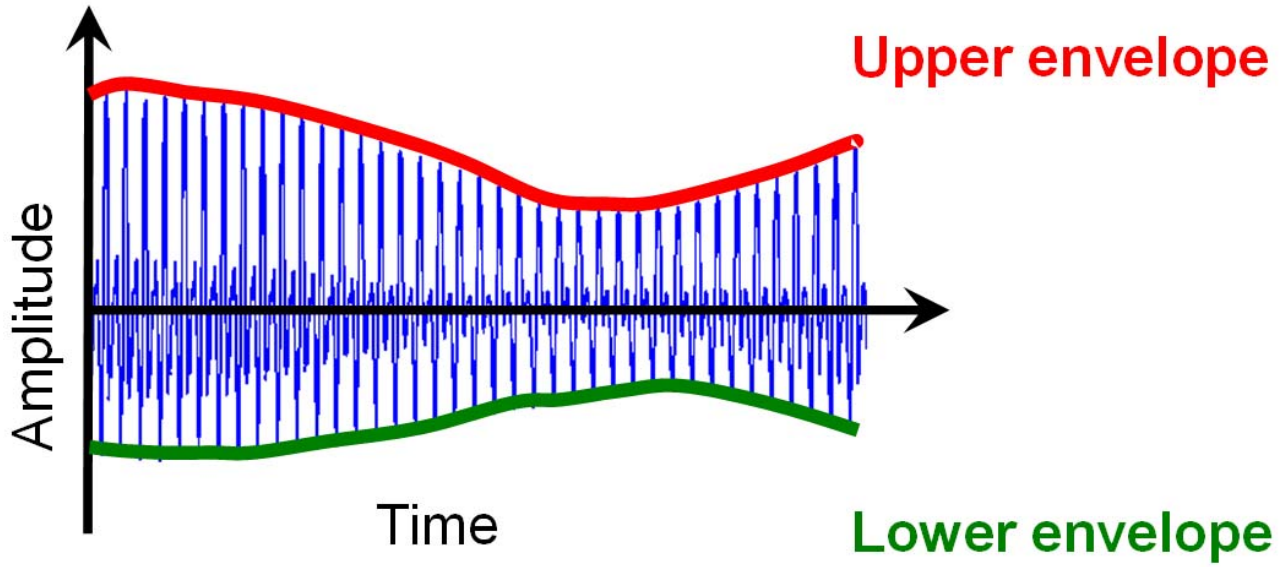
Fig. 1.21



© Springer International Publishing Switzerland, 2015

1.3 Audio Representations

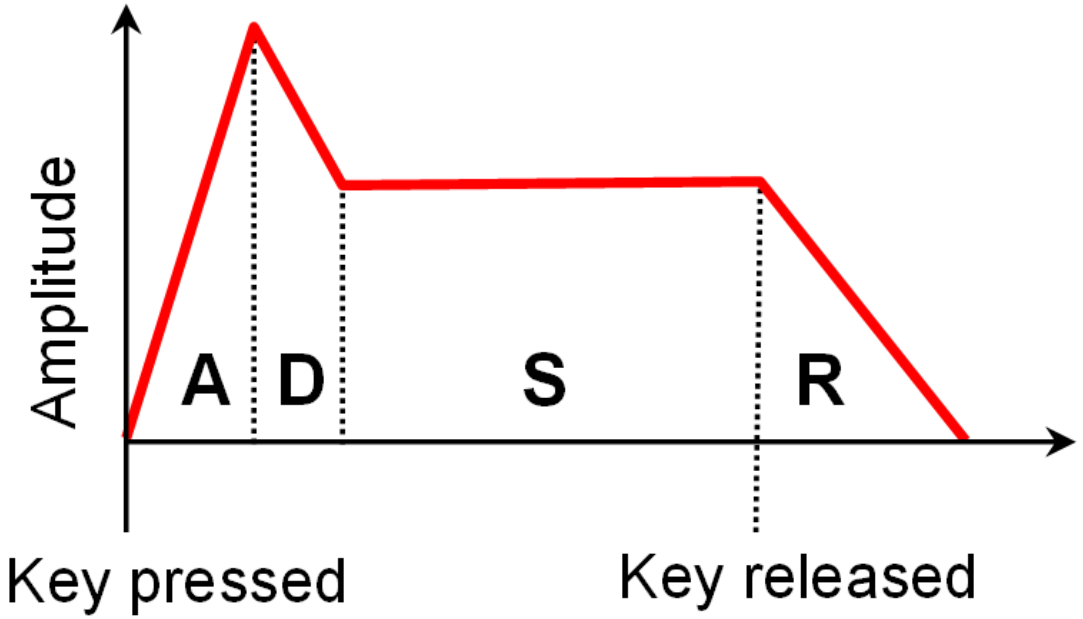
Fig. 1.22



© Springer International Publishing Switzerland, 2015

1.3 Audio Representations

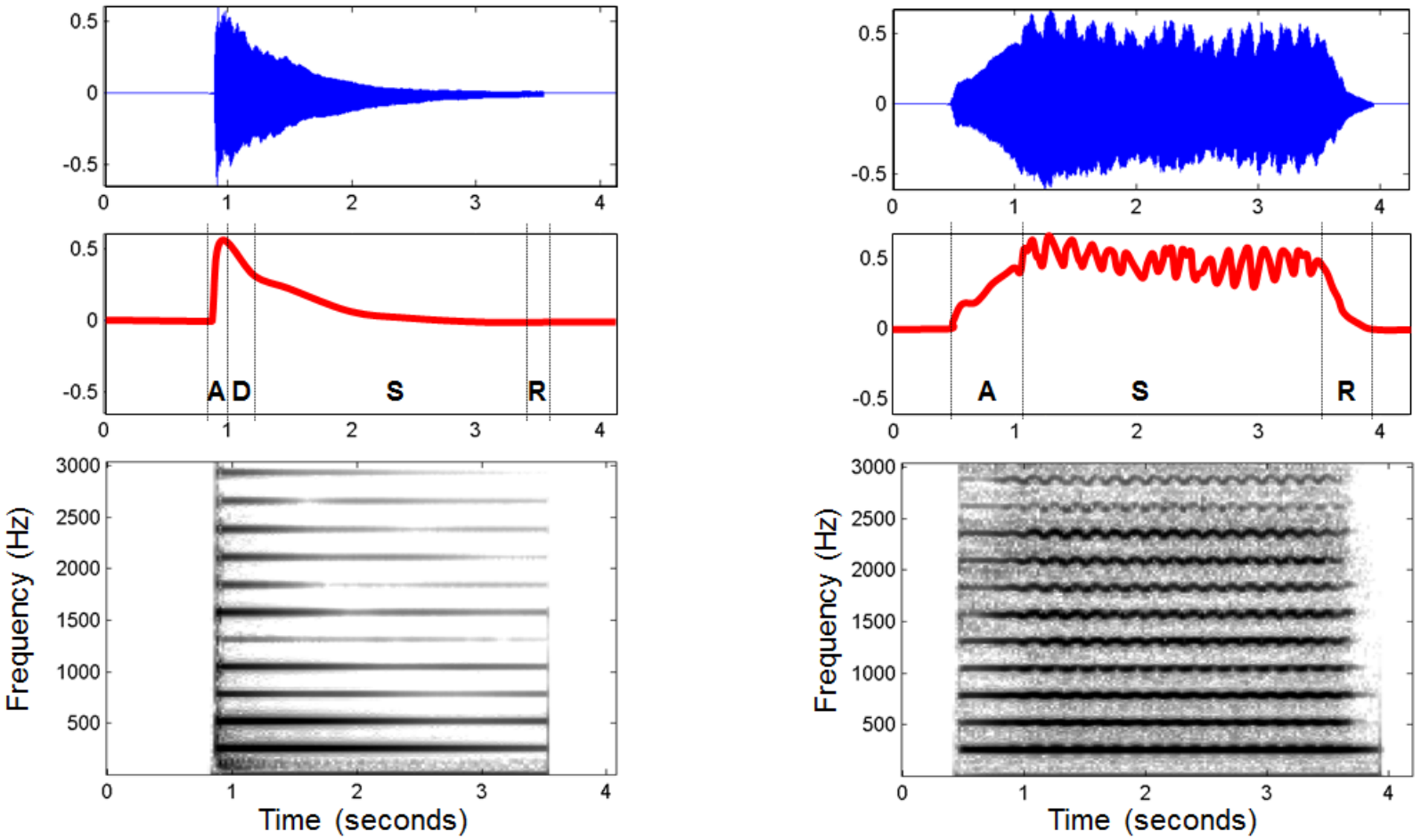
Fig. 1.22



© Springer International Publishing Switzerland, 2015

1.3 Audio Representations

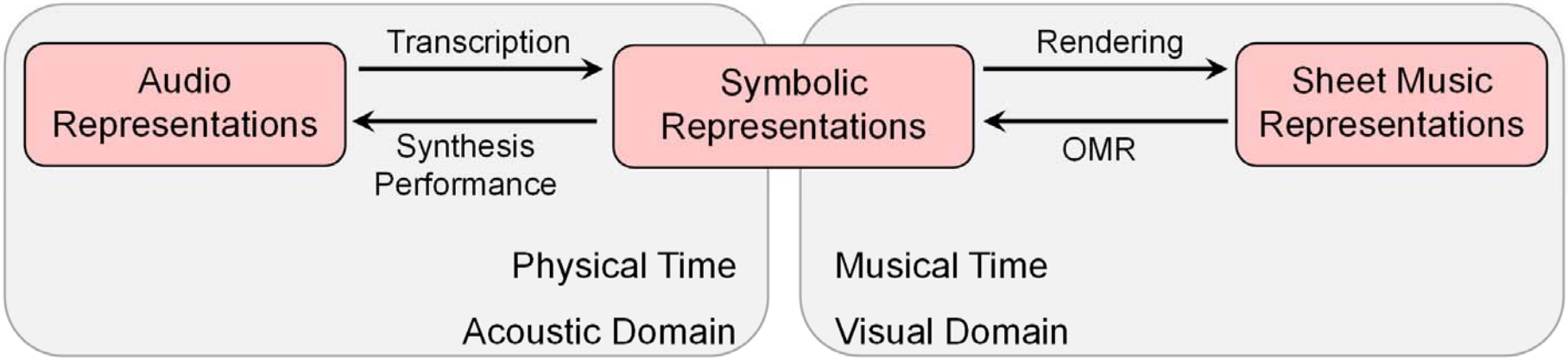
Fig. 1.23



© Springer International Publishing Switzerland, 2015

1.4 Further Notes

Fig. 1.24



© Springer International Publishing Switzerland, 2015