

Music Processing

Summer Term 2009

Meinard Müller

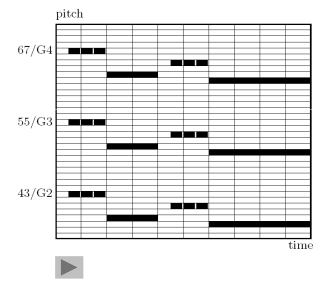
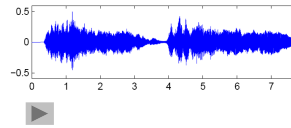
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Music Representations



Music Representations

Allegro con brio ($\text{♩} = 108$)



Score Representation

Allegro con brio ($\text{♩} = 108$)

Score Representation

Symphony No. 5 C minor

LUDWIG VAN BEETHOVEN (1770-1827)
Op. 67 (1809)

Allegro con brio ($\text{♩} = 108$) Piano Solo

Score Representation

Allegro con brio, $\text{♩} = 108$.

Score Representation

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



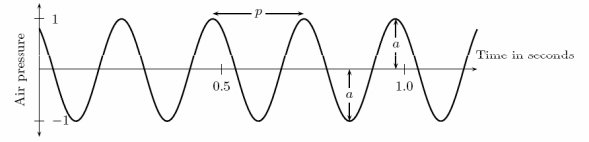
Audio Representation

Various interpretations – Beethoven's Fifth

Bernstein	▶
Karajan	▶
Scherbakov (piano)	▶
MIDI (piano)	▶

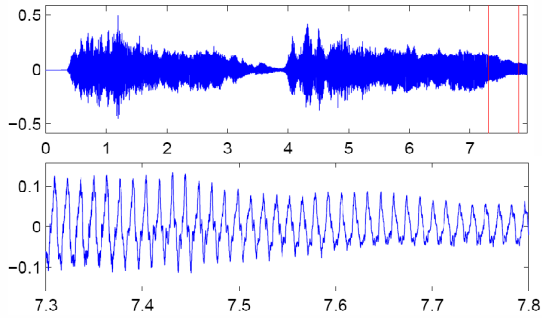
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Audio Representation: Waveform



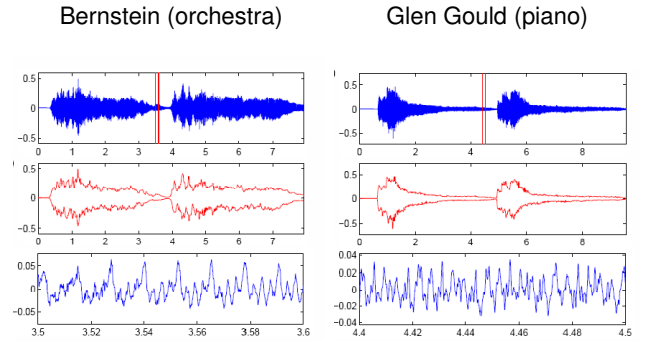
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Audio Representation: Waveform



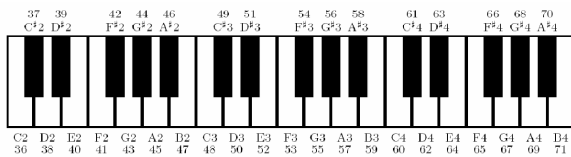
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Audio Representation: Waveform



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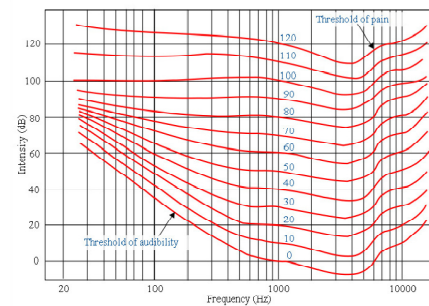
Audio Representation: Pitch



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Audio Representation: Loudness

Equal-loudness contours (phone)



(from en.wikibooks.org/wiki/Physics_Study_Guide/Sound)

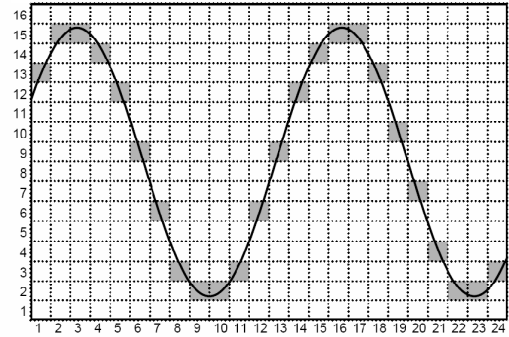
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Audio Representation: Decibel

Source	Intensity	Intensity level	# Times TOH
Threshold of hearing (TOH)	10^{-12}	0 dB	0
Whisper	10^{-10}	20 dB	10
Pianissimo	10^{-9}	30 dB	10^2
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}

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Audio Representation: Discretization



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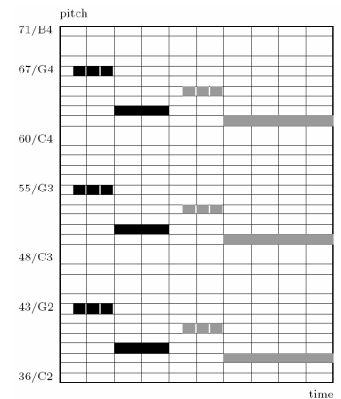
MIDI Representation



Ticks	Message	Ch.	MN	Vel
60	NOTE ON	1	67	100
0	NOTE ON	2	55	100
0	NOTE ON	2	43	100
55	NOTE OFF	1	67	0
0	NOTE OFF	2	55	0
0	NOTE OFF	2	43	0
5	NOTE ON	1	67	100
0	NOTE ON	2	55	100
0	NOTE ON	2	43	100
55	NOTE OFF	1	67	0
0	NOTE OFF	2	55	0
0	NOTE OFF	2	43	0
5	NOTE ON	1	67	100
0	NOTE ON	2	55	100
0	NOTE ON	2	43	100
55	NOTE OFF	1	67	0
0	NOTE OFF	2	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

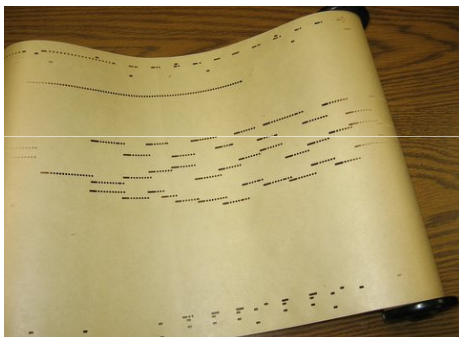
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MIDI Representation: Piano Roll



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MIDI Representation: Piano Roll



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MIDI Representation: Piano Roll



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