Exercise Multimedia Technology
# WS 2003/2004

Sheet 5 (November 20th, 2003)

Exercise 5.1   Digitizing, coding and audio

In order to be digitized an audio signal is first captured by a microphone. The resulting amplitude oscillates between $-3*U_0$ and $3U_0$ volt. U_0 denotes the size of a quantization interval in volt while t_0 denotes the quantization interval in the time domain.

1. How many bits are needed to store a single sample?

2. How many bits are used in the delta modulation?

3. Code the signal from the following diagram using delta-modulation (draw right into the figure).

4. What are the disadvantages of delta coding?

5. Provide an optimal code which reproduces the signal as well as in (1) but that uses less bits.

6. Another coding method is pulse-code modulation using logarithmic quantization (or unequal
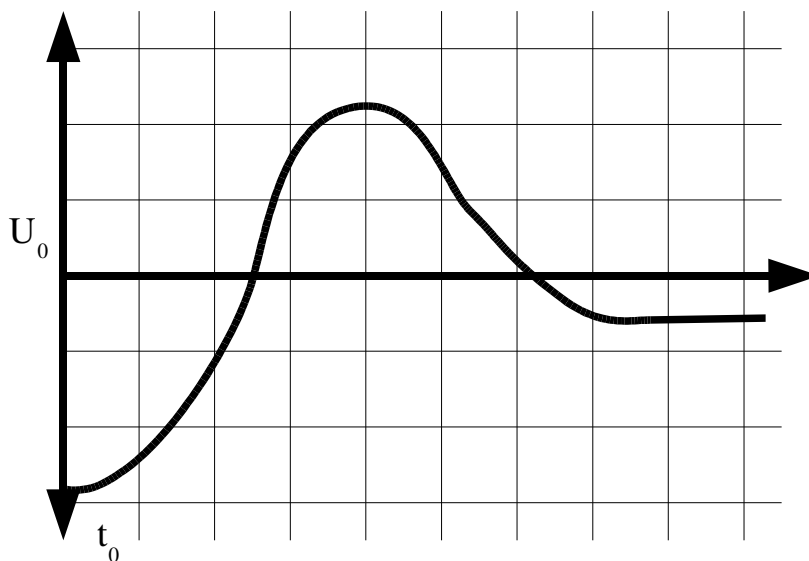
quantization). What are the advantages does that kind of coding as opposed to equal quantization?

7. Explain the difference between quantization and discretization.

8. Human beings can perceive frequencies between 16 Hz and 20 kHz. What does that tell us about the temporal resolution of the ear?

9. How large is the bitrate of an audio CD (44100 Hz sample rate and 16 bit quantization, stereo)?

Exercise 5.2   Linear predictive coding

The idea of LPC (linear predictive coding) is to linearly combine the last i-k samples in order to predict sample i.

1. Explain the idea of LPC (linear predictive coding).

2. What coefficients are needed to predict the following pattern without a residual (with no error): -1, 1, -1, 1, -1, ... and so on

3. Find out the 4 coefficients with which the following pattern can be losslessly encoded. The first four numbers are given, the rest should be predicted: 32, 32, 32, 32, -32, 0, -48, 24, -20, 46, -21, 31.5, ...