Exam

Introduction to signals and systems

Signals

- analog signals, examples
- discrete signals, examples
- digital signals

Systems

- linear
- time invariant
- realizable
- stable

Introduction to signals and systems cont.

Filters

- definition
- the special role of the trigonometric system
- transfer function, impulse response function
- filters in the time domain (convolution)
- filters in the frequency domain (multiplication)

Examples

- the RC circuit
- Butterworth filters
- the discrete version of the RC circuit

Fourier transforms

Periodic case

- Fourier coefficients
- Fourier transform
- basic properties

Discrete Fourier transform

- definition
- connnection with the periodic case
- basic properties
- fast Fourier transform

Fourier transform cont.

Aperiodic case

definition of the Fourier transform

basic properties

examples: ideal filter, sinc, rect functions etc.

AD conversion

Discretization

- uniform sampling
- the effect of sampling in the frequency domain
- the alias phenomenon
- the Nyquist frequency
- antialias filters: analog, discrete

AD conversion cont.

Quantization

linear quantization

nonlinear quantization

quantization as a compression technique

logarithmic quantization in the telephone standard: companders

the role of quantization in the JPEG image compression algorithm

Windowing

the need for windowing

definition of window functions

rectangular window: the bad properties

the points of view of window construction

triangular window: construction, properties

Hahn window: construction, properties

Music compression

MPEG

- sound as a physical phenomenon
- the psychoacoustic model
- hearing threshold
- frequency masking
- temporal masking
- the Bark scale, critical bands
- the steps of mpeg compression

Analog filters

the ideal filter, the RC filter

the mathematical model of analog filters

the transfer function

stable filters in view of the transfer function

stable filters in view of the transfer function

Discrete filters

FIR and IIR filters

the mathematical model of discrete filters

stable filters in view of the transfer function

realizable filters in view of the transfer function

Simple transforms

rotation, bilinear, bicubic transforms

transforms of the intensity function

histogram equalization

Filtering in the space domain

- the general model
- masks
- linear and nonlinear smoothing
- image sharpening: gradient, Laplace operator
- applications

Filtering in the frequency domain

- the general model
- spectrum, phase
- which types of noise can be detected, filtered
- applications

Edge detection

edge types, the role of the derivative

gradient, Laplace

examples for simple masks: Sobel, Prewitt, Laplace

how to treat noise

the LoG transform

the Marr-Hildreth algorithm

the Canny algorithm

Still image compression, JPEG

light

eye: receptors

the steps of the JPEG algorithm

the RGB-YCbCr color space transform

the modified discrete cosine transform