SGN-4010 Puheenkäsittelyn Menetelmät
Speech Processing Methods
exam 1.2.2007

You may answer either in Finnish or English.

Problem 1. Explain briefly what the following terms mean (1 point/term): **a)** unit selection synthesis, **b)** simple inverse filter tracking (SIFT), **c)** formant bandwidth (formantin kaistanleveys), **d)** discrete-time Fourier transform (DTFT), **e)** harmonic spectrum (harmoninen spektri), **f)** frame (kehys).

Problem 2.

a) What 3 properties can be used to classify how vowels are produced (eli minkä ominaisuuksien perusteella vokaalit voidaan luokitella)? (3 points)

b) What 3 properties can be used to classify how consonants are produced (sama kysymys konsonanteille)? (3 points)

Problem 3. The FFT of the signal [15 4 0 1 0 4] is [24 18 12 6 12 18]. Draw a sketch (hahmotelma) of the FFT of the signals

a) [15 4 0 1 0 4 0 0 0 0 0 0 0 0 0 0 0 0]. (2 points)

b) [15 4 0 1 0 4 15 4 0 1 0 4 15 4 0 1 0 4]. (2 points)

Problem 4. The samples $x(k)$ of a short frame of speech are

k	0	1	2	3	4	5	6
$x(k)$	1	3	2	-2	0	2	1

a) What is the autocorrelation function for this frame? (1 point)

b) What is the optimal 1st-order prediction-error filter (eli optimaalinen ensimmäisen asteen ennustusvirhesuodatin)? (1 point)

c) What is the energy of the prediction error with the optimal 1st-order prediction-error filter (tätä vastaava ennustusvirheen energia)? (1 point)

d) What is the energy of the prediction error with the optimal 3rd-order prediction error filter? (kolmannen asteen ennustusvirheen energia)? (2 points)

e) What are the reflection coefficients k_1, k_2, k_3 (heijastuskertoimet)? (2 points)

$$[1, 3, 2, -2, 0, 2, 1]$$
$$[1, 3, 2, -2, 0, 2, 1]$$
$$[1, 3, 2, -2, 0, 2, 1]$$