Queen Mary
University of London

EBU6018
Advanced Transform Methods

Tutorial: Filterbanks

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Question 1

Multiresolution Analysis (MRA) is used to separate data into course and fine details

Apply the transform defined by

$$x_{n-1},i = (x_{n,2i}+x_{n,2i+1})/2$$

$$d_{n-1},i = (x_{n,2i}-x_{n,2i+1})/2$$

to the sequence $[x_{n,i}] = [6, 8, 3, 11, 9, 5, 7, 2]$

Where i = 0…..7, is the index position in the sequence, and n is the level. The next level is n-1.

At each level, calculate the sequencies for x_{n-1},i and d_{n-1},i. Continue till no further levels are possible.

Question 1

Question 2

Multiresolution Analysis (MRA) is used to separate data into course and fine details

Apply the transform defined by

$$x_{n-1},i = (x_{n,2i}+x_{n,2i+1})/2$$

$$d_{n-1},i = (x_{n,2i}-x_{n,2i+1})/2$$

to the sequence $[x_{n,i}] = [12, 8, 13, 10, 6, 7, 11, 14]$

Where i = 0…..7, is the index position in the sequence, and n is the level. The next level is n-1.

At each level, calculate the sequencies for x_{n-1},i and d_{n-1},i. Continue till no further levels are possible.

i) State the significance of the first element in the final level.

ii) Has any information been lost in the process?

iii) Comment on how this process could be used to compress the data.

Question 2

Question 3

Given a Haar wavelet transform analysis filterbank which uses a low-pass filter

$$h_0[0] = h_0[1] = \tfrac{1}{2}$$

and a high-pass filter $h_1[0] = \frac{1}{2}$ $h_1[1] = -\frac{1}{2}$

. Use the recursive equations:

$$c_{m-1,n} = \sqrt{2} \cdot \frac{1}{2}(c_{m,2n} + c_{m,2n+1})$$

$$= \frac{1}{\sqrt{2}}(c_{m,2n} + c_{m,2n+1})$$

$$d_{m-1,n} = \frac{1}{\sqrt{2}}(c_{m,2n} - c_{m,2n+1})$$

to calculate the Haar wavelet transform for a sampled signal s[n] = [3 2 5 -2] after 1 and 2 stages of the transform filterbank.

Question 3

Question 4

Given a Haar wavelet transform analysis filterbank which uses a low-pass filter

$$h_0[0] = h_0[1] = \frac{1}{2}$$

and a high-pass filter $h_1[0] = \frac{1}{2}$ $h_1[1] = -\frac{1}{2}$

Using the recursive equations, calculate the Haar wavelet transform for a sampled signal

$$s[n] = [1, 2, 0, -2]$$

after 1 and 2 stages of the transform filterbank.

Calculate the inverse wavelet transform of your result using the resynthesis filterbank, to confirm that the result of the inverse transform is the original sequence.

Question 4

Question 4

Question 4

Thank you

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