# Tfy-99.3275 – Biosignal Processing

## Exam 14.05.09

For each question a maximum of 6 points can be earned (thus: 5 \* 6 = 30 points in total). Possible points from the exercises will be added to these points.

You may answer the questions in English as well as in Finnish.

#### 1.

Explain the following terms: (1 point to be gained per correct answer)a) linearity;b) causality;c) stationarity;d) quantization;e) stochastic signal;f) transient signal

## 2.

a) A researcher uses the derivative operator (filter) specified as w(n) = x(n) - x(n-1), where x(n) is the input and w(n) is the output. The result is then passed through a moving-average filter y(n) = 1/3 (w(n) + w(n-1) + w(n-2)), where y(n) is the final output.

1 – Does it matter which filter is placed first? Why? (1 p)

2 - Derive the impulse response of each filter and that of the combination. (1 p)

3 – The signal  $z(n) = \{0, 0, 0, 0, 0, 0, 6, 6, 6, 6, 6, 6, 6, 6, 0, 0, 0, 0, 0\}$  is applied to the system. Derive the values of the final output signal. Explain the effect of the operation on the signal. (2 p)

b) Give one advantage and one disadvantage of a FIR filter when compared to an IIR filter (2p)

### 3.

- a) Many biosignal recording devices have built-in artefact detection features that reject data if the amplitude of the input signal exceeds a certain preset value; the artefact detection threshold. Describe 2 problems associated with using such an approach. (3p)
- b) Give one example of a biological artefact and one example of a physical artefact, and describe for each of them a way how to detect them (2p)

c) For removal of what type of noise is a median filter best suited? (1p)

4.

- a) Measuring data over long-term during daily living has as typical problem that one has to deal with missing data. Describe one way to calculate the power spectral density of a signal that has missing data. (2p)
- b) Describe how a return map (Poincaré plot) is constructed. Give an example of its usage. (2p)
- c) Explain what is meant with 'segmentation of a signal', and describe one example of a way to perform segmentation (2p)

5.

- a) Explain the difference between sensitivity and specificity (2p)
- b) Explain how Sequential Forward Selection (SFS) works (2p)
- c) Suppose you have developed 2 different biosignal interpretation systems for detecting a certain patient state in a hospital. One uses neural networks and the other one uses an expert system. Supposing they have exactly the same performance and functionality - which one would be easier to 'sell' to the hospital staff? Why? (2 p)

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