

Introduction to Time-Frequency Analysis and Wavelet Transforms

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Assignment 1: Lectures 1.1 to 2.3

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1. Which of the following is **not** an example of a multi-scale process ?
 - a. Movement of the hands of a clock.
 - b. A pedestrian crossing a road.
 - c. A PEM fuel cell.
 - d. A stack containing 6 PEM fuel cells.

2. Which of the following statements is false?

- a. Analyzing functions in Fourier Transforms span the entire time axis.
- b. Wigner-Ville Distribution is ideally suited to detect discontinuities in the signal.
- c. The spectrogram is free of interference terms.
- d. None of the above.

3. Which of the following methods directly computes the joint energy distribution of a signal without using a transform?
- a. Wavelet Transforms.
 - b. Wigner-Ville Distribution.
 - c. Short Time Fourier Transforms.
 - d. None of the above.

4. Which of the following statements is true regarding wavelet transforms?
- a. They are suited to analyze signals with long lasting high frequency components.
 - b. They are suited for signals with short lived low frequency components.
 - c. Both (a) and (b).
 - d. None of the above.

5. Which of the following statements is true?
- a. Stochastic signals have multiple values at a given time instant.
 - b. Stochastic signals are always entirely absolutely unpredictable.
 - c. The values of a stochastic signal fall out of a probability distribution.
 - d. None of the above.

6. The continuous time signal $x(t) = \sin(2\sqrt{7\pi}t)$ is
- a. Aperiodic
 - b. Constant
 - c. Periodic
 - d. None of the above

7. The period of the discrete time signal $x[k] = \sin(2\sqrt{7\pi}k)$
- a. is equal to 7 samples.
 - b. is equal to 49 samples.
 - c. does not exist.
 - d. None of the above.

8. The continuous signal $x(t) = \cos(4t)$ is sampled every $\frac{\pi}{2000}$ seconds. The period of the discrete analogue $x[k]$ is
- 250 samples.
 - 500 samples.
 - 1000 samples.
 - 2000 samples.

9. Consider the two discrete time signals $x_1[k] = \sin(0.2\pi k)$ and $x_2[k] = \sin(1.7\pi k)$. Then,
- a. x_2 is an alias of x_1 .
 - b. x_1 is an alias of x_2 .
 - c. They are different signals.
 - d. None of the above.

10. Which of the following sampling rates would not be appropriate for the following signal?

$$x(t) = \sin(20\pi t) + \sin(35\pi t)$$

- a. 35 Hz.
- b. 75 Hz.
- c. 100 Hz.
- d. All of the above.

11. For the signals $x_1[k] = \sin(2\pi k)$ and $x_2[k] = \pi \sin(2\pi(k + 2))$, the
- Cross correlation at all lags is 0.
 - Cross correlation is 0 only for lags 1 and 2.
 - Cross correlation is 1 at lag 0.
 - None of the above.

For questions **12** to **15**, the answer is of the form of an integer, to be filled in the blank space

12. The polar representation of the number $z = 3 + 4j$ is _____ $e^{j \arg(z)}$

13. The vector space \mathbb{R}^4 has _____ linearly independent basis vectors

14. If a 5×5 matrix has two linearly independent rows, then the dimension of its null space is _____

15. If a 12×10 matrix has column rank 6, then the number of linearly independent rows is _____