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Courses » Introduction to Time-Frequency Analysis and Wavelet Transforms

Announcements　　**Course**　　Ask a Question　　Progress

Unit 9 - Week 4: Short-time Fourier transform

Course outline

Registration for MATLAB Exam

How to access the portal

MATLAB Online Access

MATLAB Tutorials created by MathWorks

Week 1: Introduction, Basic definitions and Concepts

Week 2: Fourier transforms (a review)

Week 3: Duration and Bandwidth

Week 4: Short-time Fourier transform

● Lecture 5.1: Short-time Fourier transform

● Lecture 5.1 Auxiliary: MATLAB demonstration

● Lecture 5.2: Properties of STFT

● Lecture 5.3: Practical aspects of STFT

● Lecture 5.4: Closing remarks

● Data files

● Solutions to Week 4 Assignment

○ Quiz : Week 4 Assignment

Week 5: Wigner-Ville Distributions

Week 6: Wigner-Ville Distributions (Contd..)

Week 7: Continuous Wavelet Transforms

Week 8: Continuous Wavelet Transforms (Contd..)

Week 9: Discrete Wavelet Transforms

Week 10: Discrete Wavelet Transforms (Contd..)

Week 11: Discrete Wavelet Transforms (Contd..)

Week 12: DWT (Contd..) and Closing Summary

Week 4 Assignment

The due date for submitting this assignment has passed.
As per our records you have not submitted this assignment.

Due on 2016-08-22, 23:59 IST

1) 　　　　　　　　　　　　　　　　　　　　　　　　　　　*1 point*

1. Which of the following correctly describe the STFT of a continuous–time signal x (

(a) It is the Fourier transform of the sliced signal $x(t)\,w(t-\tau)$.
(b) It is the inner product of the windowed signal with the time frequency atom
(c) It is the inner product of $x(t)$ with frequency modulated sinusoids.
(d) It is the inner product of $x(t)$ with amplitude modulated sinusoids.

☐ a
☐ b
☐ c
☐ d

No, the answer is incorrect.
Score: 0

Accepted Answers:
a
d

2) 　　　　　　　　　　　　　　　　　　　　　　　　　　　*1 point*

2. Choose the incorrect statement(s) regarding the choice of windows for STFT.

(a) Narrow bandwidth windows are suitable for sinusoidal signals.
(b) Broad bandwidth windows are suitable for impulse like signals.
(c) Narrow bandwidth windows are suitable for both sinusoidal and impulse signals.
(d) Both broad and narrow bandwidth windows are suitable for sinusoidal signals.

☐ a
☐ b
☐ c
☐ d

No, the answer is incorrect.
Score: 0

Accepted Answers:
c
d

3) 　　　　　　　　　　　　　　　　　　　　　　　　　　　*1 point*

3. Select the correct **statement(s)** from the following.

(a) The time and frequency spreads of STFT are dependent on the center time and cente frequency of the window function.
(b) Spectrogram can take negative values in the T-F plane.
(c) Spectrogram generally do not satisfy the marginality property.
(d) The energy of spectrogram and signal are equal when a window of unit energy is used

☐ a
☐ b
☐ c
☐ d

No, the answer is incorrect.
Score: 0

Accepted Answers:
c
d

4)   *1 point*

4. Which of the following qualifies to be a window function for STFT ?

(a) $w(t) = \begin{cases} \frac{1}{\sqrt{T}}, & |t - \tau| \le \frac{T}{2} \\ 0, & \text{elsewhere} \end{cases}$

(b) $w(t) = \left(\frac{\alpha}{\pi}\right)^{\frac{1}{4}} e^{-\alpha(t-\tau)^2}, \quad \alpha > 0$

(c) $w(t) = t \sin(\omega t)$

(d) None of the above

- a
- b
- c
- d

No, the answer is incorrect.
Score: 0

Accepted Answers:
a
b

5)   *1 point*

5. A window is chosen for STFT such that it is symmetric in time and its spectrum is symmetric in frequency. Select the correct **statement(s)** from the following:

(a) The duration of spectrogram is same as that of the signal.

(b) The bandwidth of the spectrogram is same as that of the signal.

(c) The duration of spectrogram can never be lower than the duration of signal.

(d) The bandwidth of the spectrogram can sometimes be lower than bandwidth of signal.

- a
- b
- c
- d

No, the answer is incorrect.
Score: 0

Accepted Answers:
c

6)   *1 point*

6. Select the incorrect **statement(s)** from the following:

(a) The STFT is sensitive to time shifts up to a modulation.

(b) The STFT is sensitive to frequency shifts without modulation factor.

(c) The STFT preserves both time and frequency shifts without modulation.

(d) None of these.

- a
- b
- c
- d

No, the answer is incorrect.
Score: 0

Accepted Answers:
c

7)   *1 point*

7. The signal recovery from discrete STFT, $X[m, l]$ is possible

(a) only for orthogonal representations

(b) only for redundant representations.

(c) both for orthogonal and redundant representations

(d) both for orthogonal and redundant representations only when the window is rectangula

○ a

○ b

○ c

○ d

No, the answer is incorrect.
Score: 0

Accepted Answers:
c

8)   *1 point*

8. Which of the following is/are TRUE w.r.t. rectangular and Hanning windows f

   (a) Resolving ability of rectangular windows is poorer compared to Hanning windows.

   (b) Peak of side lobe is much higher for rectangular window than Hanning window.

   (c) The side lobes decay quickly for rectangular windows when compared to Hanning

   (d) All of the above.

○ a

○ b

○ c

○ d

No, the answer is incorrect.
Score: 0

Accepted Answers:
b

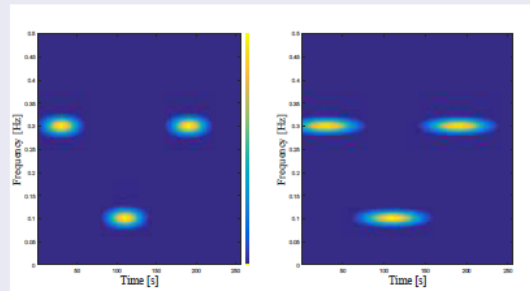9)   *1 point*

9. Spectrograms of a signal with different window lengths are shown below (spectrogr
   on left and spectrogram **2** on right side). Which of the following inferences are TR

   (a) A wider window in time has been used in **1** compared to **2**

   (b) A narrower window in time has been used in **1** compared to **2**

   (c) Time localization in **1** is better than in **2**.

   (d) Window function is symmetric since time and frequency centers in **1** and **2** are same.

☐ a

☐ b

☐ c

☐ d

No, the answer is incorrect.
Score: 0

Accepted Answers:
b
c
d

10)   *1 point*

Questions **10** and **11** are based on the following signal and window function:

$$x(t) = \sqrt{2\pi}\delta(t-2)$$

$$w(t) = \left(\frac{1}{\pi}\right)^{\frac{1}{4}} e^{-\frac{t^2}{2}}$$

10. The obtained spectrogram is independent of frequency.

    (a) True
    (b) False

○ a
○ b

No, the answer is incorrect.
Score: 0

Accepted Answers:
a

11)

11. The value of the spectrogram at $t = 2$ sec and $\omega = \frac{3}{2}$ rad/sec is _____(round off t answer to two decimal places)

[   ]

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: String) 0.56
(Type: String) 0.57

                                                                                                             1 point

12)   *1 point*

Questions **12** and **13** requires the use of data file `a4_sigData.mat`. It contains signal i 1st column and corresponding time stamps in the 2nd column. For your analysis use the function `spectrogram` in MATLAB with a Hamming window of length 63 and number overlaps as 60. Specify the number of frequency points as 64 and sampling time (sec) a determined from the data set.

12. Which of the following is/are TRUE for the given signal?

    (a) The signal is a linear chirp.
    (b) The frequency content of the signal monotonically increase with time.
    (c) The frequency content of the signal monotonically decreases with time.
    (d) The frequency content of the signal is a non linear function of time.

☐ a
☐ b
☐ c
☐ d

No, the answer is incorrect.
Score: 0

Accepted Answers:
b
d

13)   *1 point*

13. At time $t = 1.4$ sec, the frequency band observed in the spectrogram is (closest ran

    (a) $150 - 250$ Hz
    (b) $250 - 350$ Hz
    (c) $300 - 400$ Hz
    (d) $350 - 450$ Hz

○ a
○ b
○ c
○ d

No, the answer is incorrect.
Score: 0

Accepted Answers:
b

14)   *1 point*

14. The `fft` of a signal is given in the data file `a4_fftData.mat`. Which of the fo i
inferences are correct for the given data?

Note: Use a Hamming window of length 39 for your analysis.

(a) The signal contains 2 different frequencies at two different time regimes.
(b) The signal contains 3 different frequencies spread through out the signal length.
(c) The initial segment of the signal is occupied by highest frequency sinusoid.
(d) The final segment of the signal is occupied by lowest frequency sinusoid.
(e) The initial and final parts of signal have sinusoids with same frequency.

○ a
○ b
○ c
○ d
○ e

No, the answer is incorrect.
Score: 0

Accepted Answers:
c

15)

15. The STFT of a signal is given in the data file `a4_stftData.mat`. The value of max
amplitude present in the signal is _____(round off the answer to one decimal places
Note: Use a Hamming window of length 39 for your analysis.

No, the answer is incorrect.
Score: 0

Accepted Answers:
(Type: String) 0.9

1 point

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