COMP 576 Spring 2018

Midterm Correction

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- Question 5:

  Which of the following is not a property of the sinusoids used as basis images when a shift-invariant, linear operator is to be applied?

  Correct Answer: They capture the position of an object in an image well

  Sinusoids use a global aperture. They are in some sense global funtions. They do not reflect information at some particula location. Therefore, they do not capture the position of a object in an image well.

  My Answer: At each frequency there are more than one sinusoid, which differ in phase

  At each frequency, there are two sinusoids that differ in phase. To be exact, for each k, they are $\sin\left(2\pi\frac{k}{N}x\right)$ and $\cos\left(2\pi\frac{k}{N}x\right)$.

- Question 12:

  Which is not a reason for requiring an aperture to be Gaussian?

  Correct Answer: The Fourier transform of a Gaussian is proportional to a Gaussian.

  Desired properties of an aperture are:

  - Unbiased re spatial scaling, translation and rotation
  - Cascading apertures gives a legal aperture
  - Do not create structure, only eliminate it
  - Have finite integral

  The Fourier transform of a Gaussian being proportional to a Gaussian is not directly related to any of the above.

  My Answer: A Gaussian with double the RMS width of another Gaussian applied to an image spatially scaled by 2, with the result scaled by $\frac{1}{2}$ is equivalent to applying the original Gaussian to the original image.

  This is due to the fact that Gaussian is unbiased with respect to spatial scaling, which is indeed a desired property of an aperture. Along the same line, we also want the aperture to be unbiased with respect to translation and rotation.

- Question 15:

  Consider an image whose values are the result of convolution of a Gaussian of RMS width σ with a diagonal line. That image will look like a blurry diagonal bar. If you wanted a kernel that when convolved with the image had highest values along the diagonal (along the center of the bar), what would be the best kernel to use?

Correct Answer: The Gaussian of RMS width σ applied to a bar of some length along that diagonal.

The highest response is achieved when we convolve the image with the matched filter.

My Answer: The second derivative, twice in the direction orthogonal to the diagonal along which the bar lies, of a Gaussian of RMS width σ

Although this option does give some indication of barness along the diagonal, it's not the highest.

- Question 24:

  State which is true about image basis sets that are non-orthogonal.

  Correct Answer: Derivative operators fall into that class.

  The derivatives, when viewed as basis images, are indeed non-orthogonal. Some of the orthogonal basis images we have learnt are Fourier transform, SVD, and orthogonal wavelets.

  My Answer: None of the above.

  Since derivatives are indeed non-orthogonal, we cannot choose none of the above.