Samara Holmes

2/18/25

Pattern Recognition & Computer Vision

1. Dichromatic Reflection Model Speed Round:

    A. True or False: body reflection depends on the viewer's location.

true

    B. True or False: surface reflection depends on the viewer's location.

true

    C. True or False: Surface reflection is usually highly directional and depends on the viewer's location.

true

    D. True or False: the intensity of Lambertian reflection is proportional to the dot product of the surface normal and the viewing direction.

False, its proportional to the color and intensity of the light source, the color and intensity of the pigment particles, and the cosine of the angle between the surface normal and the light source direction

    E. True or False: metals do not exhibit body reflection.

False, they primarily exhibit surface reflection but can also exhibit body reflection

    F. True or False: body reflection is caused by photons penetrating the surface and interacting with pigment particles inside the material.

true

    G. True or False: velvet looks different because of quantum interactions in the material.

false

    H. True or False: velvet looks different because the surface normals of the fibers are perpendicular to the overall surface normal.

true

2. How do you find the primary orientation of a 2-D shape (axis of least central moment)? What are the steps and what theoretical property of the pixels in the region corresponds to the orientation?

First you need to compute the centroid, which is the mean position of the shape's pixels, then using those centroid values (x and y) you can use those to offset the points in the shape and center it. Then you need to get the covariance matrix and the eigenvalues and eigenvectors. With the eigenvectors you can determine the directions of the principal acxes and the magnitude of the variance.

The theoretical property of the pixels that corresponds to the orientation is the moment of inertia.

3. What is the purpose of the grassfire transform algorithm? Describe the inputs and outputs.

It calculates the Manhattan distance from each pixel in the foreground region F to the closest pixel in the background region B. It takes in a binary image and outputs a distance map.

4. When is it more efficient to grow or shrink using the grassfire transform compared to using a standard morphological filter?

The grassfire transform can be more efficient for larger scale images. For smaller scale images the morphological filter is faster. The morphological filter also handles binary operations better because there isn't a need for a distance calculation.

5. What does top-down versus bottom-up mean when applied to segmentation? Give one example of each type of segmentation algorithm.

Top-down segmentation refers to starting with a high-level understanding of the image and getting into the details later. An example of top-down segmentation is template matching, where a known object is matched against different parts of the image. The bottom-up segmentation refers to beginning with low-level features like edges, colors, and textures, and building up to form segments. K-means clustering is an example of bottom-up segmentation because the algorithm partitions the image and builds the segments up by grouping pixels into clusters.