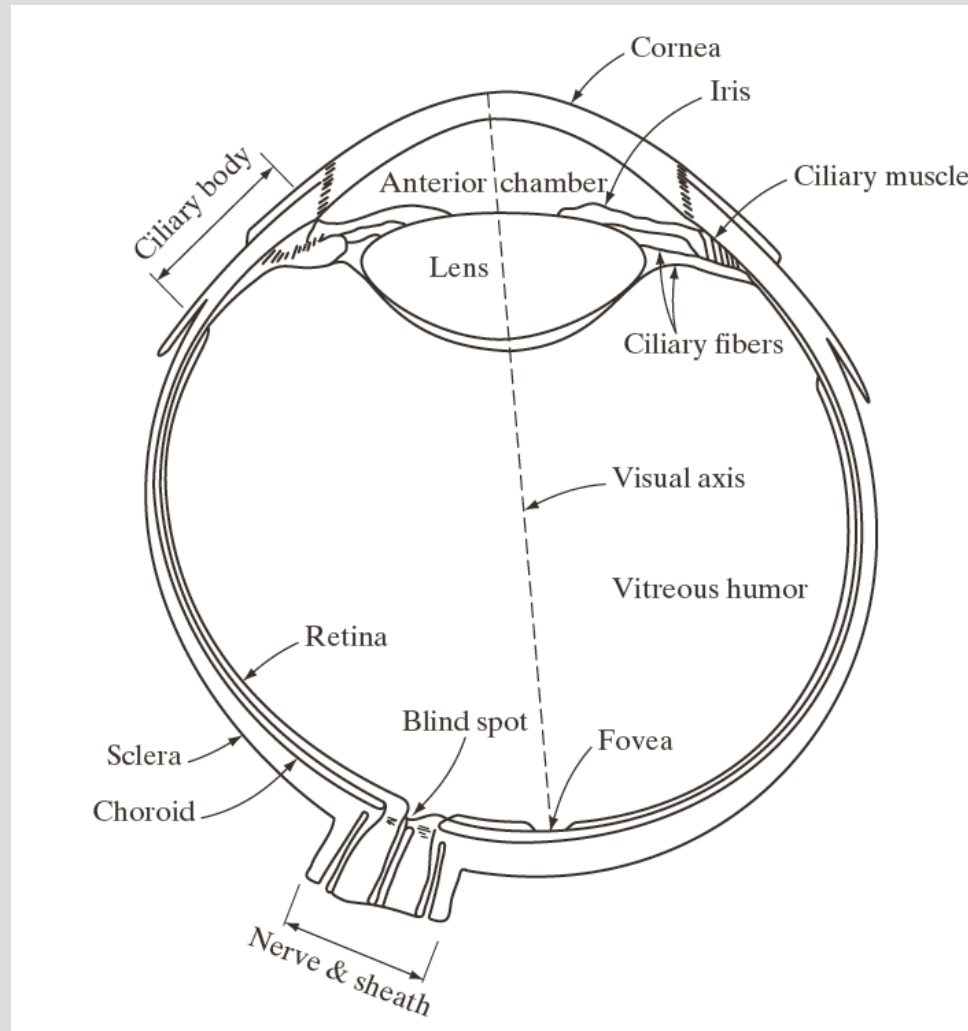


# **SYDE 575: Introduction to Image Processing**

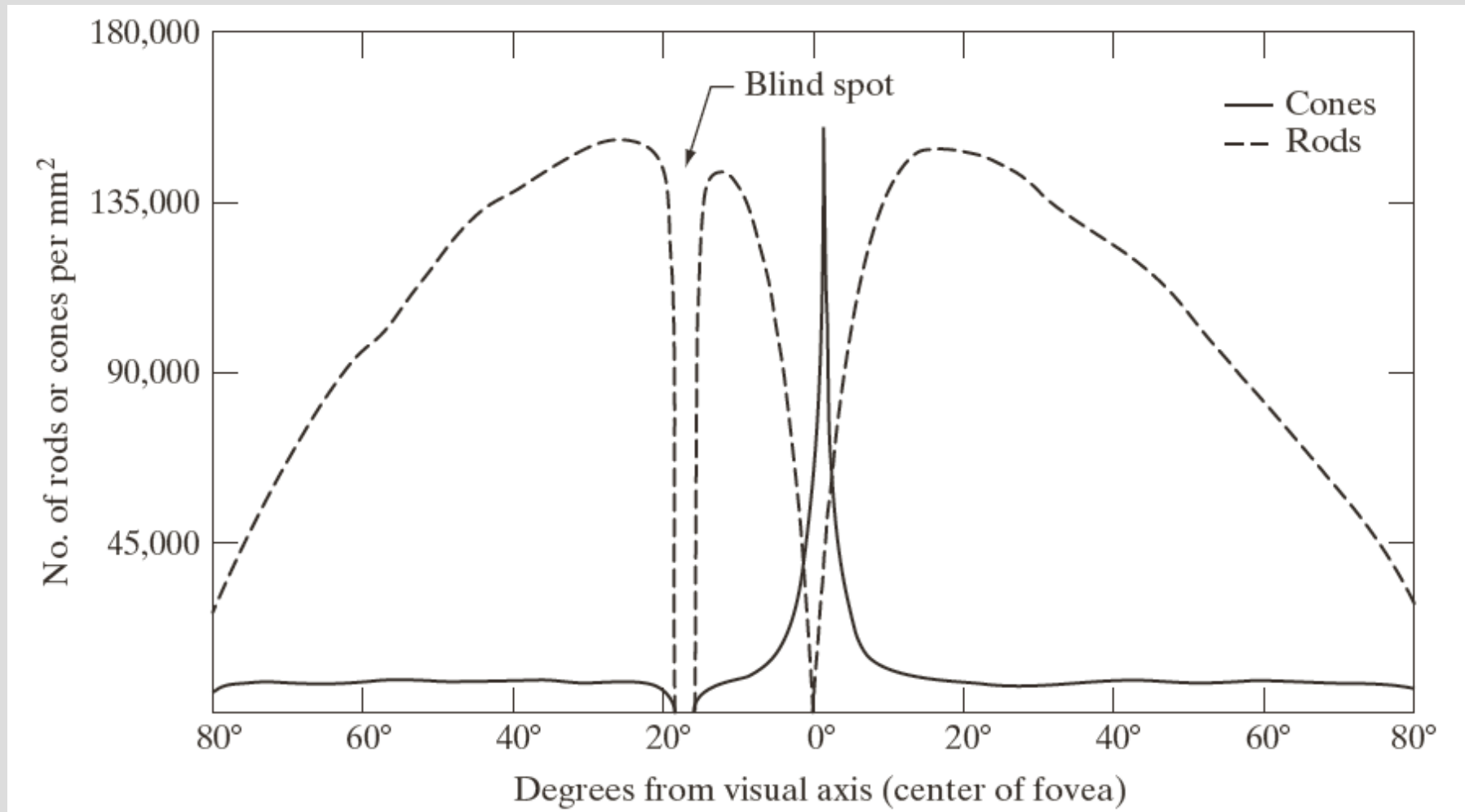
Foveation Image Compression

# Recap: Human Eye



Source: Gonzalez and Woods

# Recap: Distribution of Rods and Cones



Source: Gonzalez and Woods

# Observations

- Based on the distribution of cones, the spatial resolution of the human vision system is at its peak near the fovea.
- As we move from the fovea towards the peripheral regions, the spatial resolution decreases significantly.

# Idea

- Since spatial resolution decreases as we move towards to peripheral regions, there is a lot of high frequency information redundancy in those areas.
- Idea: instead of displaying and compressing an image with equal spatial resolution and detail in all areas, what we can try to do is display and compress an image differently depending on where the information falls upon in our vision!

# Foveation Image Processing

- Suppose we are able to determine where the point of fixation is on the particular image, e.g., based on
  - Eye tracking
  - Location of mouse cursor
- What we want to accomplish is to modify the image in such a way that it is not possible to distinguish the original uniform resolution image from the foveated image at the point of fixation.

# Example: Foveation Filtering



Source: Wang and Bovik

# Foveation Image Compression

- Contrast sensitivity and spatial resolution drops off sharply going from fovea to peripheral
- Therefore, the amount of compression can be increased as we go towards the peripheral based on cone densities due to the high psycho-visual redundancies in these regions

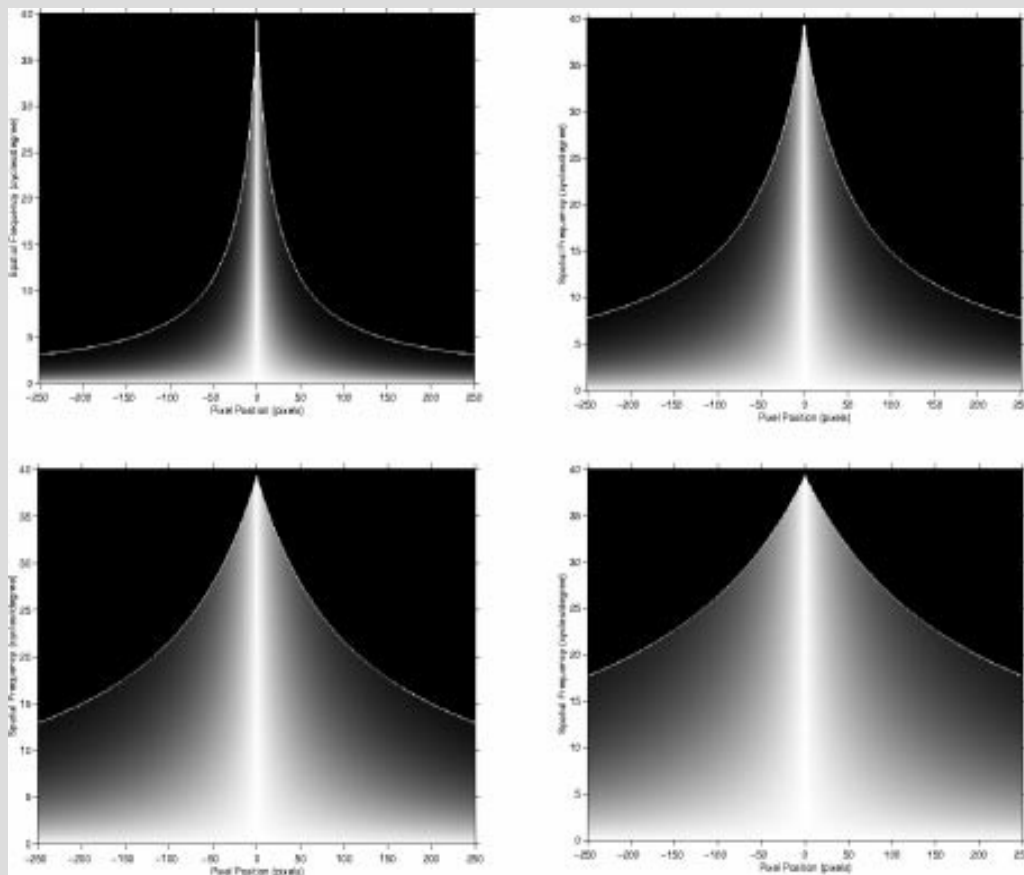


# Foveation Image Compression

## Steps:

- 1. Locate point of fixation in the image either by:
  - Locating focus of attention of a user's eye on the image
  - Locating the focus of attention that you WANT the user to focus on
- 2. Calculate normalized contrast sensitivity based on the viewing distance of the user

# Normalized Contrast Sensitivity at Different Viewing Distances



As viewing distance increase, the contrast sensitivity across an image increases since more of it falls on the center of the eye

Source: Wang and Bovik

# Foveation Image Compression

## Steps:

- 3. Perform foveation filtering based on the computed normalized contrast sensitivity
  - e.g., logmap superpixel method
    - Group neighboring pixels
    - Average the pixels into a superpixel
    - Size of superpixel based on the contrast sensitivity
      - Large superpixels for regions of low contrast sensitivity
- 4. Apply adaptive compression based on contrast sensitivity
  - High compression at areas with low contrast sensitivity

# Example: Foveation Image Compression



Source: Bovik

# Example: Foveation Image Compression



Uniform compression (128:1)



Foveation compression (128:1)

Source: Bovik

# Example: Foveation Image Compression



Uniform compression (256:1)



Foveation compression (256:1)

Source: Bovik