

CS 534 – Spring 2005  
Sample Questions for the Midterm

- Given a thin lens with a focal length  $f$ , an object at a distance  $p$  in front of the lens and an image plane at a distance  $q$  from the optical center, use simple geometry to drive the thin lens equation (the relation between  $p, q, f$ )
- What is a weak perspective model? and what is the relation between  $(X, Y, Z)$  and  $(x, y)$  under this model (Given a scene point  $(X, Y, Z)$  projected to image point  $(x, y)$  on an image plane at distance  $f$  from the pinhole. ) ?
- How many free parameters in a general  $3 \times 4$  perspective projection matrix ?
- Given  $4 \times 4$  geometric transformation matrix  $T$  in 3D described in homogenous coordinates, What are the constraints on  $T$  to be a rigid body transformation? How many degrees of freedom? Are the lengths and angels preserved under this transformation?
- What is a stationary independent additive Gaussian noise model?
- Given a Gaussian pyramid  $P_G(I)_n$ ,  $n=1, \dots, m$  where  $P_G(I)_1$  is the bottom level, How to obtain a Laplacian pyramid  $P_L(I)_n$ ,  $n=1, \dots, m$
- Now, Given the Laplacian Pyramid, how to obtain the original image
- Explain Why:
  - a) Human vision is color blind in low illumination
  - b) In edge detection using zero crossing why we need to check for large gradient magnitude?
  - c) Although Fourier Transform is rotation invariant applying it to an image doesn't seem to be similar to applying it to a rotated version of the same image.
- What is:
  - a) Depth of field
  - b) Vignetting

c) Parallax shift

Short answers questions

- a) The number of rods in human retina is approximately:  
10<sup>6</sup>            10<sup>8</sup>            10<sup>10</sup>
- b) Which photoreceptors are more sensitive to low level of lights  
Rods            Cones
- c) Which Retinal Ganglion cells have higher temporal resolution  
M cells            P cells
- d) Give an example of Geometric aberrations
- e) In linear camera calibration, what is the minimum number of points needed to recover the full intrinsic and extrinsic camera parameters
- f) (True or False) Magnitude spectrum of an image DFT holds the spatial information