

# ECE 417/598: Depth from stereo

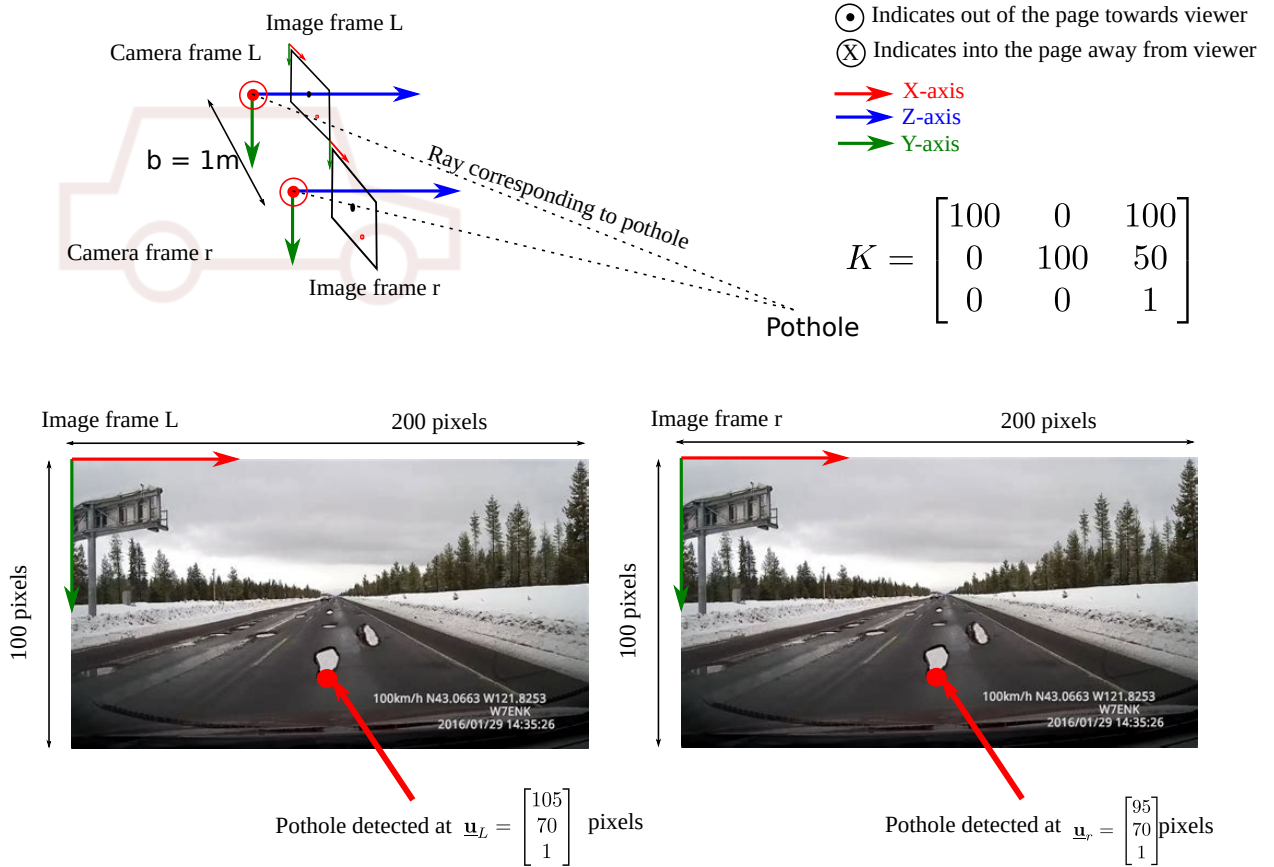
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(1) Student name:

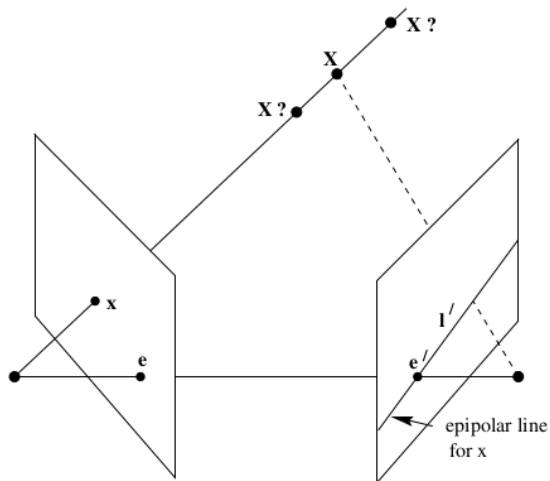
Student email:

**Problem 1** Find the 3D position of the pothole give that the right camera  $r$  is moved along  $X$ -axis by  $b = 1m$  with respect to the left camera  $L$ .



1. Find the equation of ray corresponding to the pothole in the left image. In other words, write the equation of the ray corresponding to the point  $\underline{\mathbf{u}}_L$ , in camera frame  $L$ .
  
2. Find the rotation matrix  ${}^rR_L$  and translation vector  ${}^r\mathbf{t}_L$ , so that they transform any point in the coordinate frame  $L$  to a point in the coordinate frame  $r$ . ( $\mathbf{X}_r = {}^rR_L\mathbf{X}_L + {}^r\mathbf{t}_L$ ).
  
3. Transform the equation of ray from coordinate frame  $L$  to coordinate frame  $r$ .
  
4. Find the equation of ray corresponding to the pothole in the right image. In other words, write the equation of the ray corresponding to the point  $\underline{\mathbf{u}}_r$ , in camera frame  $r$ .
  
5. Find the intersection of rays (lines) 4 and 3.

**Problem 2** When the depth corresponding to the point  $\mathbf{x}$  is unknown, the possible pixels ( $\mathbf{x}'$ ) on the right image that can correspond to the point form a line. What is the equation of that line?



1. Find the equation of ray corresponding to the pothole in the left image. In other words, write the equation of the ray corresponding to the point  $\mathbf{x}$ , in the first camera frame.
  
2. Assume the rotation matrix  $R$  and translation vector  $\mathbf{t}$ , so that they transform any point in the left coordinate frame to a point in the right coordinate frame. ( $\mathbf{X}' = R\mathbf{X} + \mathbf{t}$ ). Transform the equation of ray from the left coordinate frame to the right coordinate frame.
  
3. Project the equation of ray to the right camera.