CS4495/6495
Introduction to Computer Vision

3B-L2 *Epipolar geometry*

Depth from disparity

image I(x,y)

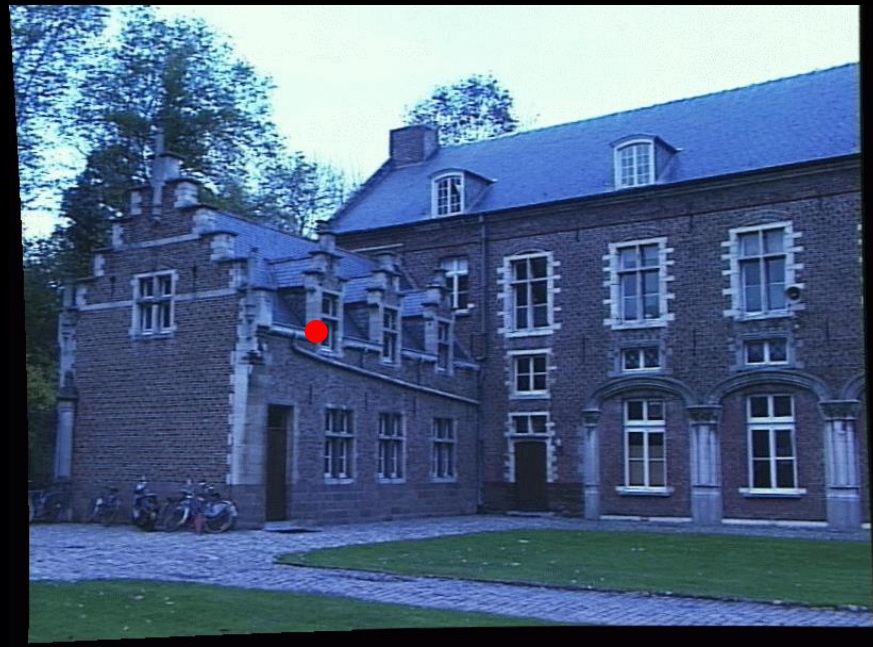
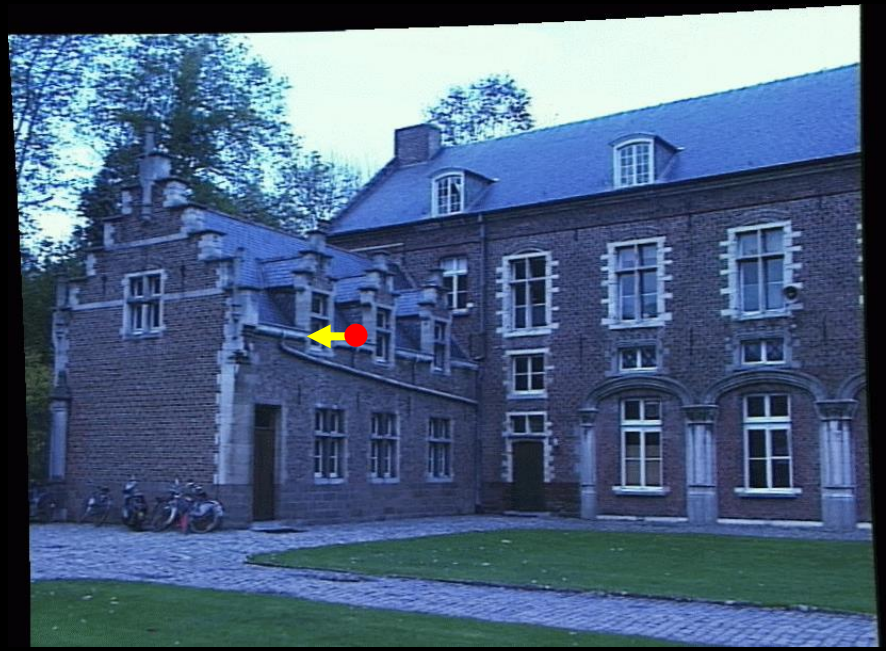


image I'(x,y)



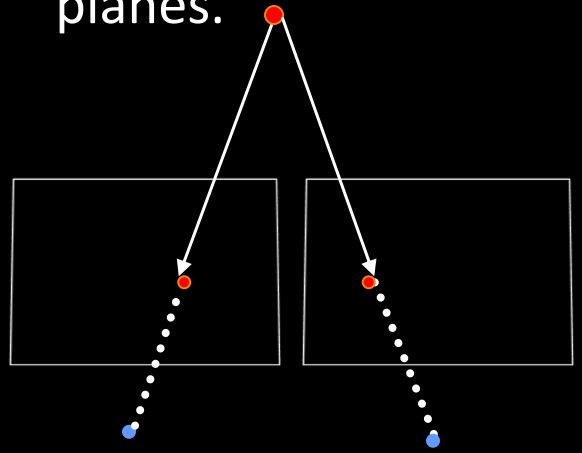
Depth from disparity

image I(x,y)

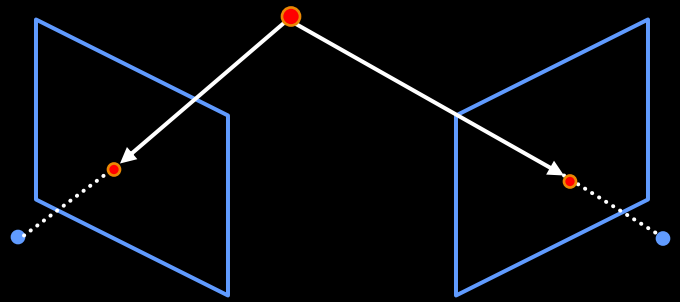
Disparity map D(x,y)

General case, with calibrated cameras

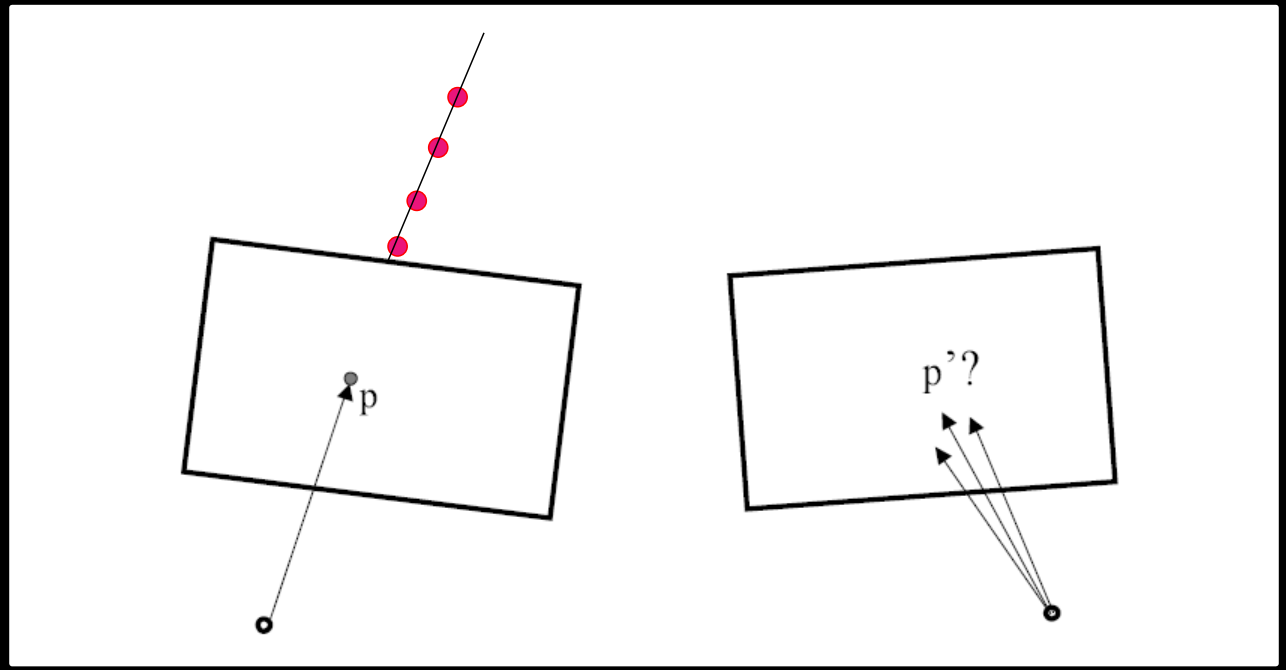
- The two cameras need not have parallel optical axes and image planes.



vs.



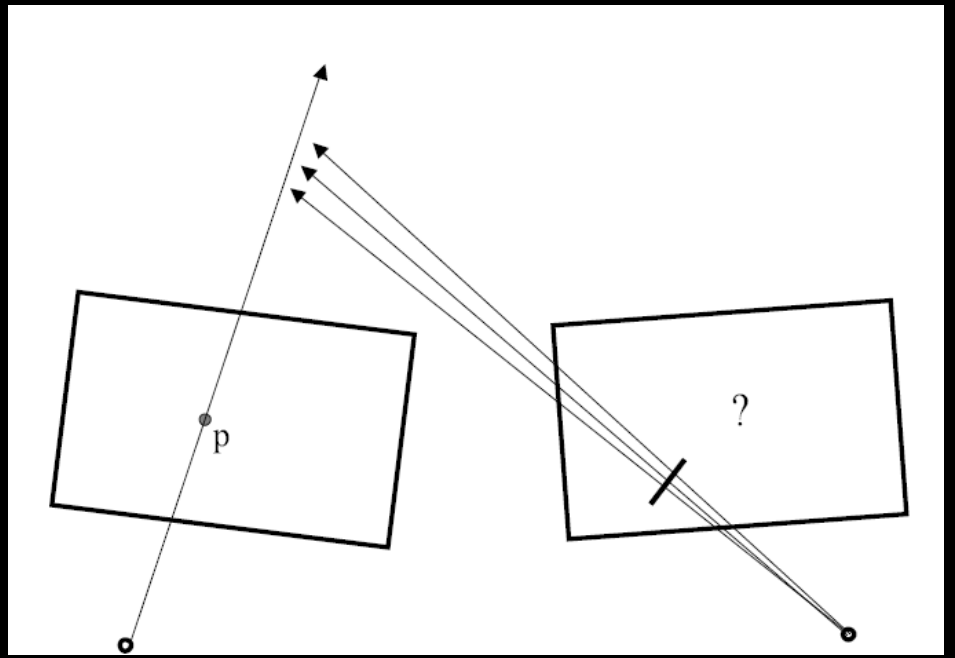
Stereo correspondence constraints



Given p in left image, where can corresponding point p' be?

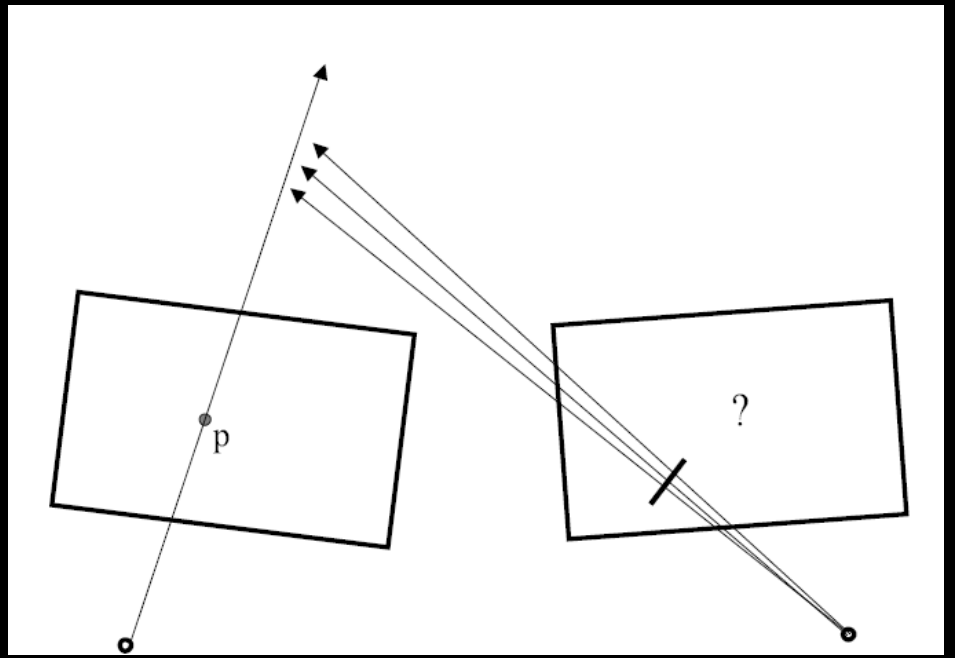
Stereo correspondence constraints

Remember: in perspective projection, lines project into lines.

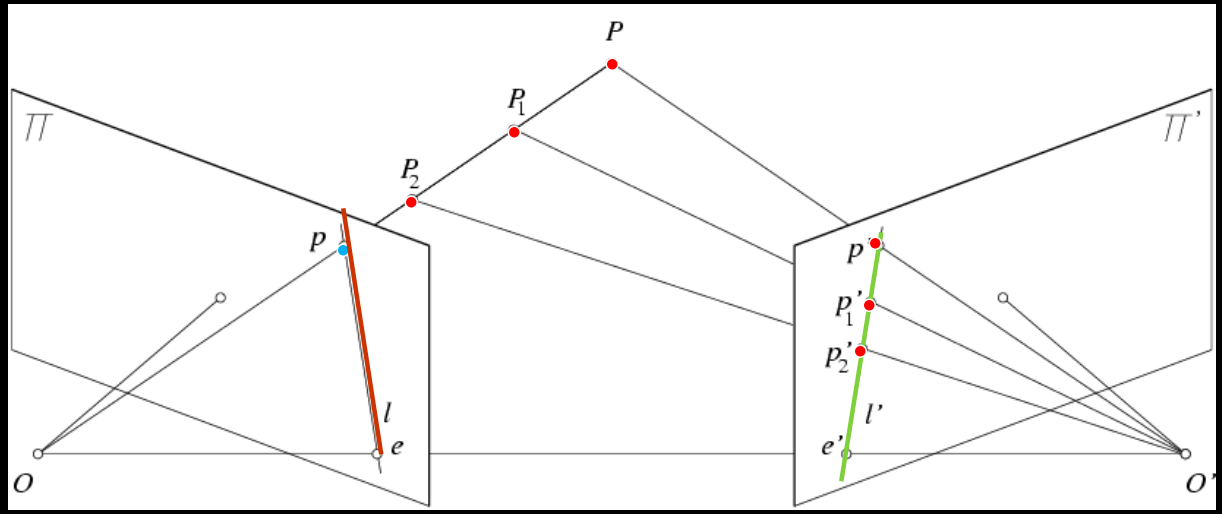


Stereo correspondence constraints

So the ***line*** containing the center of projection and the point P in the left image must project to a ***line*** in the right image.



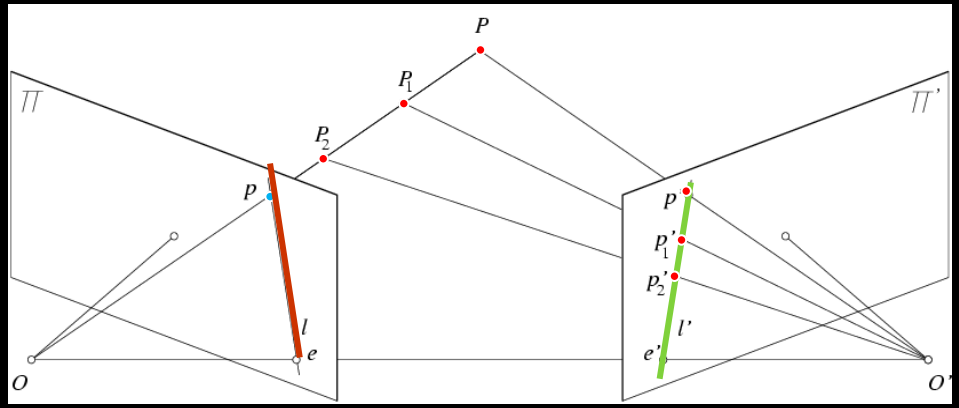
Epipolar constraint



Geometry of two views constrains where the corresponding pixel for some image point in the first view must occur in the second view.

Epipolar geometry: Terms

- ***Baseline***: line joining the camera centers
- *Epipolar plane*: plane containing baseline and world point
- *Epipolar line*: intersection of epipolar plane with the image plane – come in pairs
- *Epipole*: point of intersection of baseline with image plane



Why is the epipolar constraint useful?

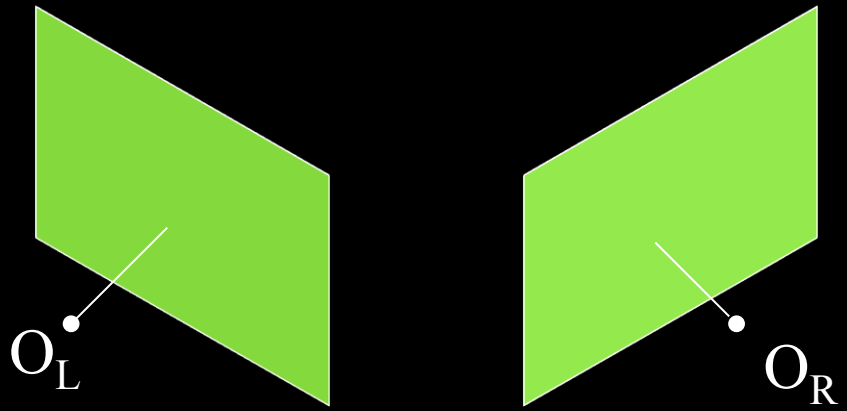
Epipolar constraint

The *epipolar constraint* reduces the correspondence problem to a 1D search along an epipolar line.

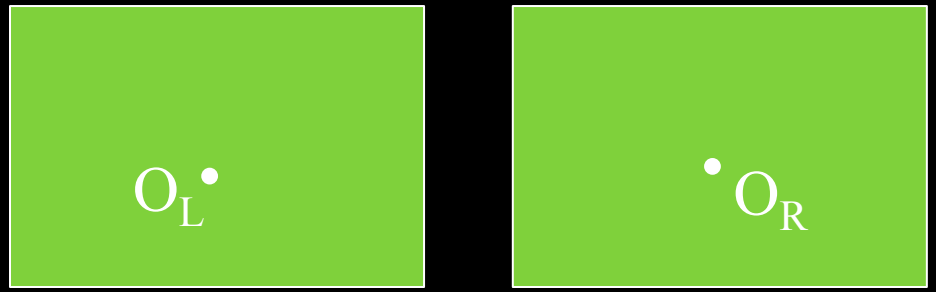
Image from Andrew Zisserman

What do the epipolar lines look like?

1.



2.



Example: converging cameras

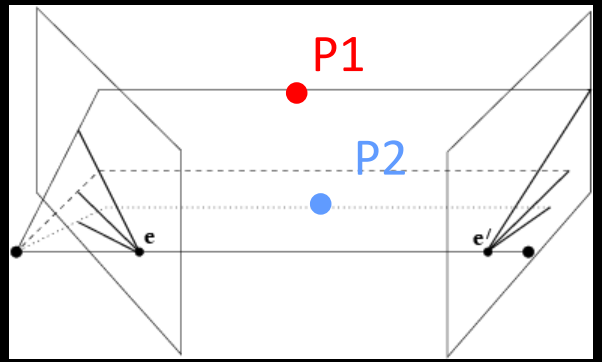
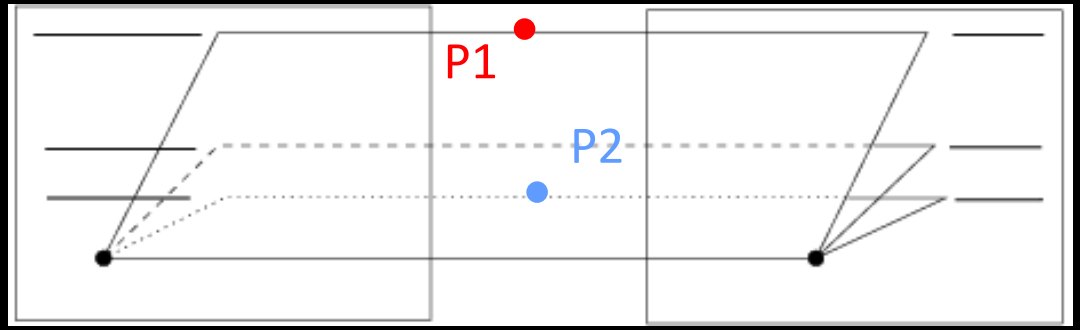


Figure from Hartley & Zisserman

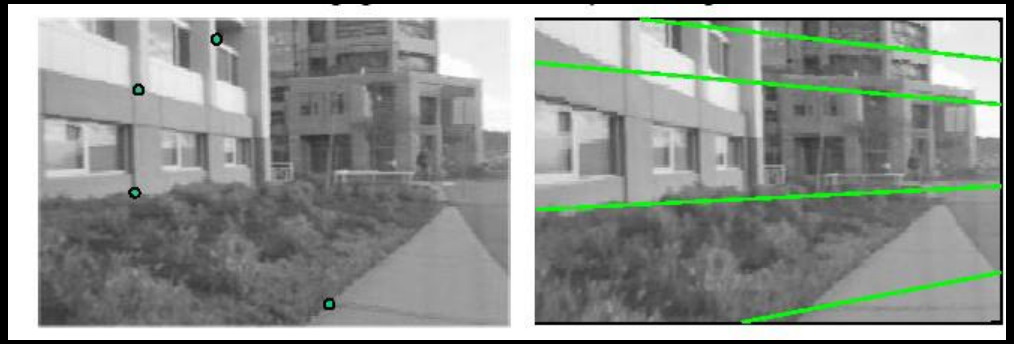
Example: parallel image planes



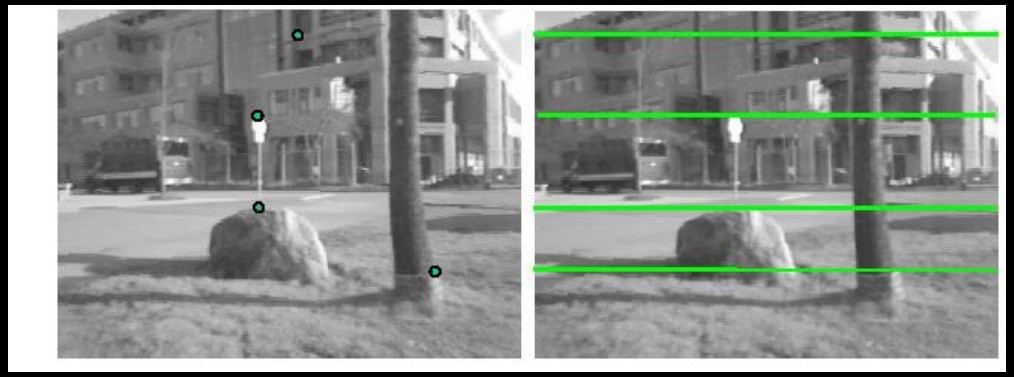
Where are the epipoles?

Quiz: two stereo pairs

a)



b)



Quiz:

How do we know that (B) has parallel image planes

a) The epipolar lines are horizontal
b) The epipolar lines are parallel
c) Because I just said (B) had parallel iimage planes