

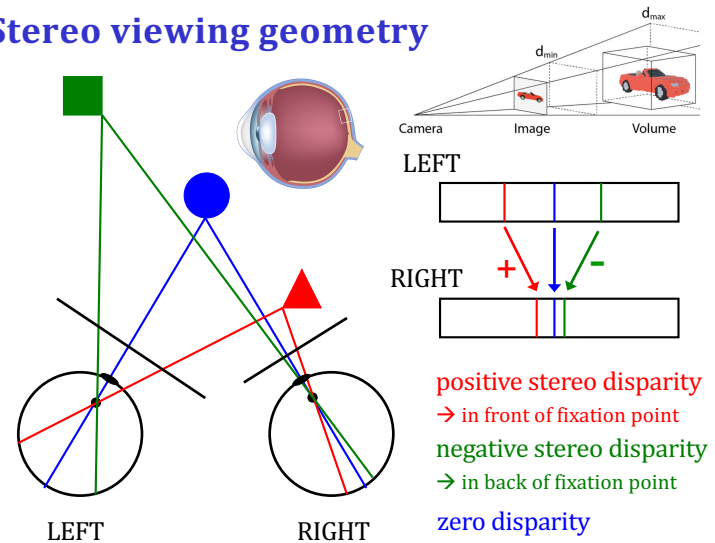
Who has stereo vision?



Nityananda, V. & Read, J. C. A. (2017) *Stereopsis in animals: evolution, function and mechanisms*, J. Exp. Biol. 220(14), 2502-2512

1

Stereo viewing geometry



2

Stereo disparity

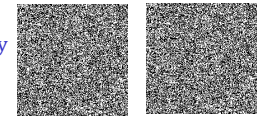


3

Constraints on stereo correspondence

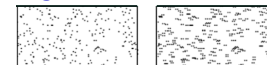
- uniqueness

each feature in the left image matches with only one feature in the right (and vice versa...)



- similarity

matching features appear "similar" in the two images



- continuity

nearby image features have similar disparities

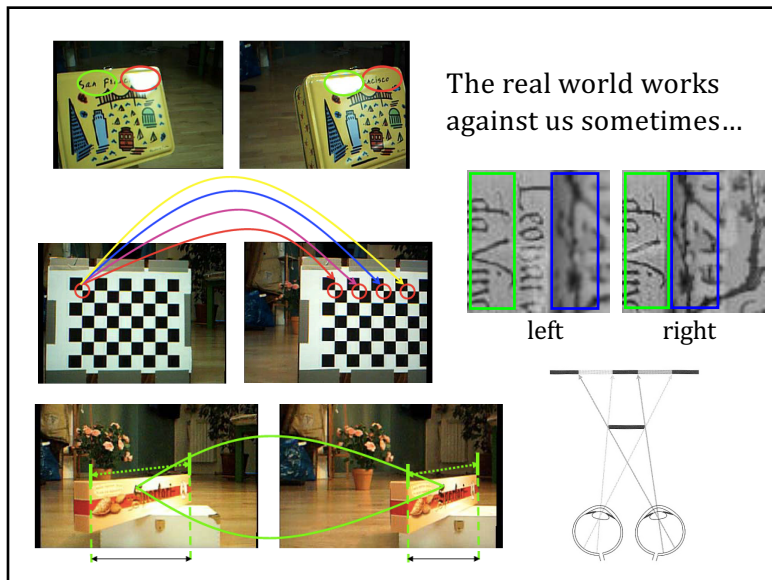


- epipolar constraint

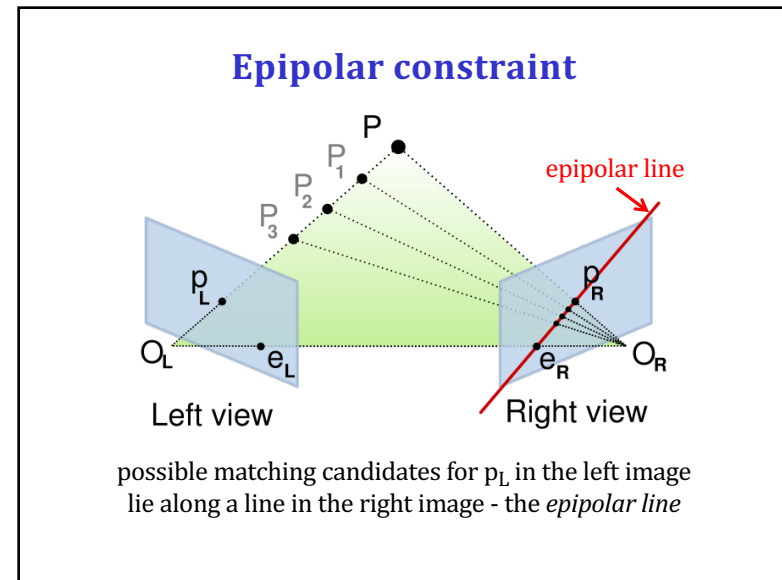
simple version: matching features have similar vertical positions, but...



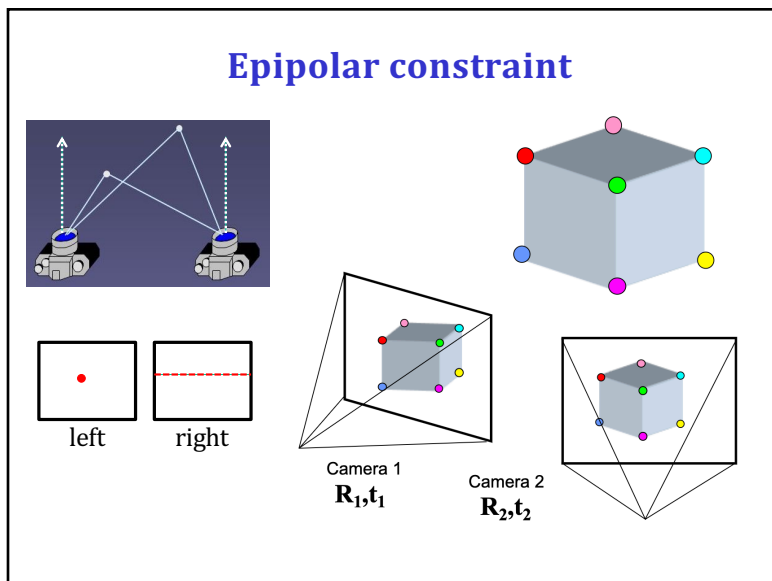
4



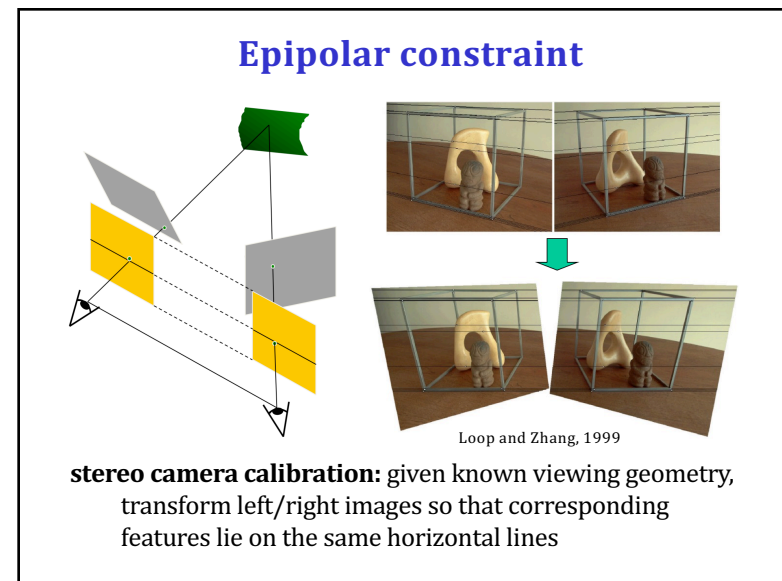
5



6

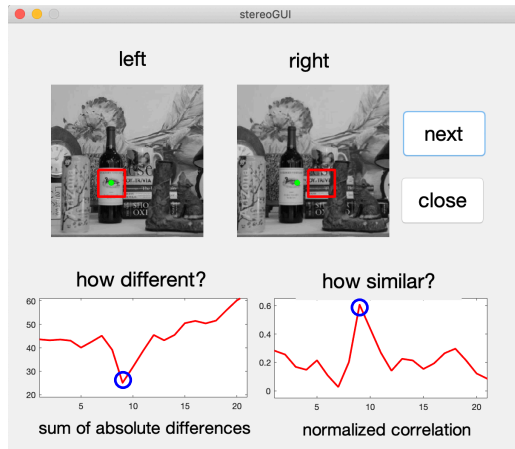


7



8

Solving the stereo correspondence problem

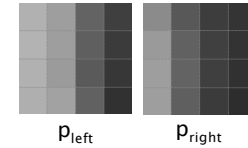


9

Measuring goodness of match between patches

(1) sum of absolute differences

$$(1/n) \sum_{\text{patch}} |p_{\text{left}} - p_{\text{right}}|$$



(2) normalized correlation

$$(1/n) \sum_{\text{patch}} \frac{(p_{\text{left}} - \bar{p}_{\text{left}})(p_{\text{right}} - \bar{p}_{\text{right}})}{\sigma_{p_{\text{left}}} \sigma_{p_{\text{right}}}}$$

optional: divide by
n = number of pixels
in patch

\bar{p} = average of values
within patch
 σ = standard deviation
of values within patch

10

Region-based stereo matching algorithm

```

for each row r
  for each column c
    let  $p_{\text{left}}$  be a square patch centered on (r,c) in the left image
    initialize best match score  $m_{\text{best}}$  to  $\infty$ 
    initialize best disparity  $d_{\text{best}}$ 
    for each disparity d from  $-d_{\text{range}}$  to  $+d_{\text{range}}$ 
      let  $p_{\text{right}}$  be a square patch centered on (r,c+d) in the right image
      compute the match score m between  $p_{\text{left}}$  and  $p_{\text{right}}$ 
        (sum of absolute differences) (normalized correlation)
      if ( $m < m_{\text{best}}$ ), assign  $m_{\text{best}} = m$  and  $d_{\text{best}} = d$ 
    record  $d_{\text{best}}$  in the disparity map at (r,c)
  
```

How are the constraints used??

11