

## Introduction to Features

CS 510  
Lecture #20  
4/08/02

## What is a Feature? (redux)

- According to your text (p. 68) a feature is anything that is:
  - Localized
  - Meaningful
  - Detectable
- Features are also *intermediate*; a means, not an end
- Q: Are features subimages or structures?

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## Corners

- Are corners good features?
  - Localized? Yes (not a lot of discussion here)
  - Map to scene attributes?
    - ...
  - Useful?
    - Useful for (sub)image-like features?
    - Useful for more classical symbolic features?

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## Corners

(Intuitive Definition)

- A corner is where two *scene* edges meet
  - Two discontinuities
  - A discontinuity and a surface marking
  - Etc.
- If the edges are at different orientations
  - If the edges have the same source and are aligned, they form a line segment.
  - If same source, almost aligned: local curve?
  - Different sources, aligned: accidental event

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## Corners

(Thomasi's Formalization)

- Compute the partial derivatives

$$\begin{bmatrix} \frac{\partial I}{\partial x} & \frac{\partial I}{\partial y} \end{bmatrix}$$

- Now, compute the outer product

$$C = \begin{bmatrix} \left[ \frac{\partial I}{\partial x} \right]^2 & \frac{\partial I}{\partial x} \frac{\partial I}{\partial y} \\ \frac{\partial I}{\partial x} \frac{\partial I}{\partial y} & \left[ \frac{\partial I}{\partial y} \right]^2 \end{bmatrix}$$

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## Corners (cont.)

- Note that the previous matrix is the covariance matrix for the partial derivatives
- So, use singular value decomposition to compute the eigenvalues and eigenvectors:

$$C = R^T \begin{bmatrix} \lambda_1 & 0 \\ 0 & \lambda_2 \end{bmatrix} R$$

- What is the meaning of the eigenvectors (columns of R)?
- What is the meaning of the eigenvalues?

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## Corners (III)

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- Sort eigenvalues so that  $\lambda_1 > \lambda_2$
- Three cases:
  - If  $\lambda_1 = \lambda_2 = 0$ , image surface is smooth
  - If  $\lambda_1 > \lambda_2 = 0$ , then the pixel is an edge
  - If  $\lambda_1 > \lambda_2 > 0$ , then the pixel is a corner
- How can we distinguish a corner from a curve?
- Is it useful to distinguish a corner from a curve?