

# Edge Detection

- Discrete approx. of a derivative
- Threshold the derivative image
- Second derivative, zero crossing detect
  - Weak edges (gradual variation) detected better, less chance of multiple edge responses
- Derivative: enhances noise
- Band-pass filtering: some smoothing followed by differentiation

- Sobel, Roberts, Prewitts operators
  - Smooth in one direction, differentiate in the other
- Marr-Hildreth operator
  - Gaussian prefiltering, Laplacian (LoG), zero crossing detect
  - Works better when grey level transitions are smooth
  - Faster: Mexican hat (difference of Gaussians of different variance)
- Compass: directional edge detection

- Spatial convolution
- Edge localization
- Canny edge detector
  - 1983, MS student at MIT
  - Designed operator that minimizes probability of missing an edge, probability of false detection of edges, good localization, restricted solution to linear shift-invariant operators

- Smooth the image (reduce false alarms)
- Find gradients
- Non-maximal suppression
  - Move along current edge direction, choose signal maxima as edges,
  - Hysteresis: choose 2 thresholds – TL, TH
  - TL lower – reduces misses
  - TH higher – reduces false alarms
  - If magnitude between TL & TH – declare “edge” if this pixel connects 2 neighboring “edges”

- Convolution