Colorado School of Mines
Image and Multidimensional Signal Processing

Professor William Hoff
Department of Electrical Engineering and Computer Science
http://inside.mines.edu/~whoff/
Region Descriptors

and extracting them using Matlab
Region Properties

• Basic features
  – Area
    \[ A = \sum_{(r,c) \in R} 1 \]
  – Centroid
    \[ \bar{r} = \frac{1}{A} \sum_{(r,c) \in R} r, \quad \bar{c} = \frac{1}{A} \sum_{(r,c) \in R} c \]
  – Bounding box
    • The smallest rectangle containing the region
    • Can be specified by
      – The location of the upper left corner
      – The width and height

• Matlab function `regionprops(L)`
  – This function computes region properties
  – You pass in a “label” image, produced by “bwlabel”
  – It returns an array of structures – each contains the properties for one region
Matlab Structures

• A structure is an object with named “fields”

• Example

```matlab
>> I = imread('Fig9.16(a).jpg');
>> BW = im2bw(I);
>> [L,n] = bwlabel(BW);
>> blobs = regionprops(L);

>> blobs
blobs =
17x1 struct array with fields:
    Area
    Centroid
    BoundingBox

>> blobs(1)
an =
    Area: 2058
    Centroid: [15.7216 179.8717]
    BoundingBox: [0.5000 133.5000 34 93]
```
Properties from “regionprops”

>> blobs(5)
ans =

    Area: 2369
    Centroid: [93.5293 157.4690]
    BoundingBox: [65.5000 129.5000 57 57]

- Centroid is represented as \([xc, yc]\)
- Bounding box is represented as \([x0 y0 w h]\), where
  - \(x0, y0\) are the coordinates of the upper left point
  - \(w, h\) are the width and height
Filtering Blobs

• Let’s say that we want to make a list of all areas
• We can use the Matlab command \texttt{cat}

\begin{itemize}
  \item \texttt{cat(dim, A1, A2, A3, ...)} – concatenate multiple arrays along dimension \texttt{dim}
  \item \texttt{M = cat(1, A, B, C);} \quad = M
  \item So we can do
    \begin{itemize}
      \item \texttt{areas = cat(1, blobs(:).Area);}\end{itemize}
\end{itemize}
Filtering Blobs

• Let’s say we want to form a list of only the large blobs
• We can use the Matlab command `find`

• `find(X)` – find nonzero elements of array X, and return their indices

  ```matlab
  >> x = [5, 0, 0, 6]
  x =
      5     0     0     6
  >> ind = find(x)
  ind =
       1     4
  ```

• So you can do
  – Example: `indices = find(areas > 5);`

• You can then form another list of the large blobs
  – Example: `blobsLarge = blobs(indices);`
Matlab Graphics

rectangle('Position', [x y w h]), 'EdgeColor', 'r');

line([x1 x2], [y1 y2], 'Color', 'r');
Matlab Example

- Draw bounding box around largest blob
- Draw cross hair on its centroid

```matlab
I = imread('Fig9.16(a).jpg');
BW = im2bw(I);
L = bwlabel(BW);
blobs = regionprops(L);
areas = cat(1, blobs(:,).Area); % concatenate along dimension 1
[value, index] = max(areas)
imshow(I)
rectangle('Position', blobs(index).BoundingBox, 'EdgeColor', 'r');

x0 = blobs(index).Centroid(1);
y0 = blobs(index).Centroid(2);
line([x0-5 x0+5], [y0 y0], 'Color', 'r');
line([x0 x0], [y0-5 y0+5], 'Color', 'r');
```