

Introduction

• The goal:

To recognize a motion of objects





Motivation

- Video processing
- Image recognition
 - Separate objects from the background
- Tracing objects in video segment
- Our assumption:
 - Two input images are similar to each other

The idea

- When an object moves all pixels that belong to this object, move in the same direction
- The main steps:
 - Recognize pixels of the object
 - Each pixels "votes" to a possible direction
 - The "winner" determines an object motion



How to do it?

- Link each pixel of i_1 to the corresponding region in i_2
- Boundary detection by edge collapse
- Group pixels into objects
- Find representative vector for each object



Initialization

- Smoothing
 - Reduce the effect of the noise
 - Avoid recognition of false objects
- Graph construction
 - Nodes are pixels of the image
 - Close neighbors are the adjacent pixels
 - Far neighbors are pixels in the corresponding region in *i*₂





Edge collapse

- Fixed node:
 - node on the image boundary or on the object boundary
- Collapsible edge (*u*,*v*):
 - *u* and *v* have similar color
 - *u* or *v* is fixed node
- Edge collapse
 - Fixed node v "pulls" the other node u





Edge detection

- While there is collapsible edge
 - collapse the shortest collapsible edge











Perceptual organization

- Based on Canny edge detection
- Start from the first unlabeled node *v*
- For each close neighbor *u*
 - If *u* and *v* have similar color
 - If length(*u*,*v*) < threshold
- Add *u* to the object and recursively check its close neighbors



Motion vector

- Each object consists of the pixels on its boundary
- Far neighbors of a pixel all the possible movements for this pixel
- List of vectors merging of all possible vectors of all pixels
- The motion vector of object is the major direction of all vectors
 - Clustering
 - Accumulation

Clustering

- Init: each vector forms a cluster
- Pick to closest clusters
- Merge them if the resulting cluster is not too large
- The motion vector is the center of the biggest cluster



Accumulation

- Similar to the Hough transform for line detection
- Each direction has a bin (initialized to zero)
- Each pixel votes for each possible motion vector
- The object motion is the direction with the maximal value in its bin
- Variation:
 - Each pixel has only one vote
 - The vote is equally divided between all possible directions



Results











Results











Conclusions

- Works on simple images
- Very sensitive to object changes
- The results of clustering and accumulation method are similar
- Accumulation method is more efficient