

Low-level Vision Algorithms for Localization, Classification, and Tracking

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Problem: Automated understanding of a time sequence of images

Problem

- Camera networks produce images that vary in perspective and level of obstruction.
- The network doesn't understand visual events



Hardware

- Wireless network of actuator-mounted camera nodes



"Where is it?" - Object segmentation and localization

Background subtraction and region growing

Background



Visual event

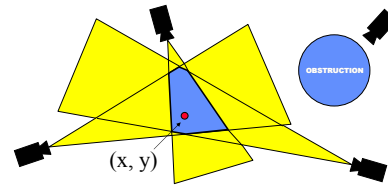
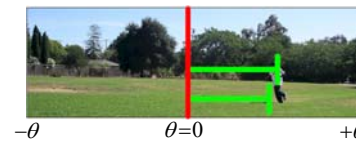


Change detection



- Significant intensity changes labeled as object pixels
- Region growing distinguishes multiple objects as separate

Localization



- Pan actuator uncertainty angle prevents accurate triangulation, and defines a detection triangle
- Centroid of intersection region estimates object location

"What is it?" - Classification by minimum distance of feature vectors

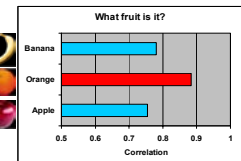
Mean Feature Vector: What does an apple look like?

Training set



- Supervised learning by a given training set
- Feature calculation: area, average pixel intensity, color pattern
- Mean feature vector used as a template to represent a category

Classification: What fruit is it?



- Minimum Euclidean distance classifier
- Features classified despite obstruction

"Where is it going?" - Multiple object tracking within a time-sequence of images



- Unsupervised learning by training from previously detected objects



- Segmentation by region-growing and nearby regions



- Individual features computed and classified among previously detected objects



- Separate identities maintained throughout a time sequence