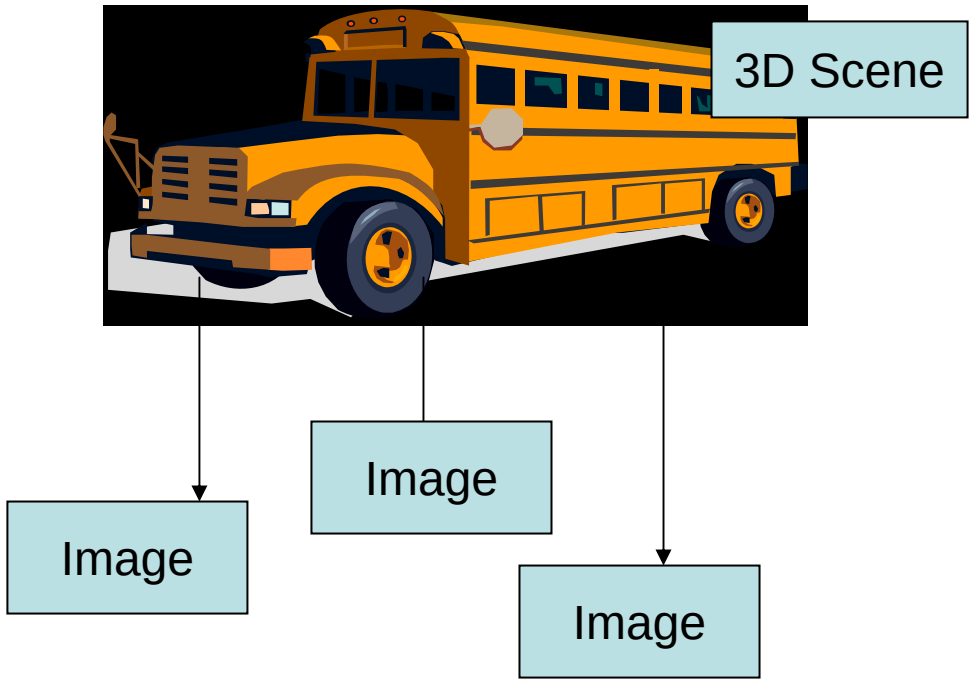
Introduction

EE 520: Image Analysis & Computer Vision

General Stuff

- Class time - MW 10-2, Tu-Th 10-2?
- Office hours – by appointment for this week
- Web: http://www.ece.iastate.edu/~namrata/EE520/
- Evaluation
  - 40% midterm, 30% each for 2 projects
  - Project: report + 30 min presentation + code
  - Homework – not graded – simple MATLAB experiments of what is taught in class
- Your research areas?

Image Analysis/ Comp Vision?



One image - Segment, Recognition, Edge detect & get contour
Two images – Registration, Optical flow, Get 3D structure (stereo)
Time sequence - Structure from Motion, Tracking, Change Detection

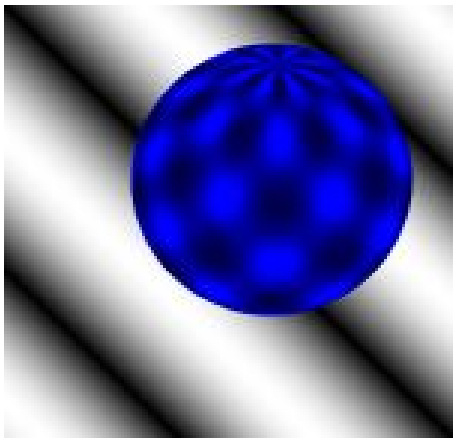
2D Image Analysis: Feature extraction

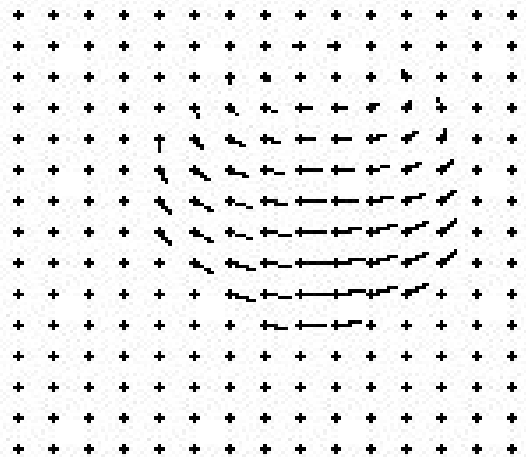
- Intensity
- Edges – threshold image derivative
- Texture – repeated basic “primitives” & spatial relation, view at different scales
- Motion – Threshold frame difference
- Motion – Optical flow (where did pixel *(i,j)* move)
- Shape, Local histogram, PCA, image transforms

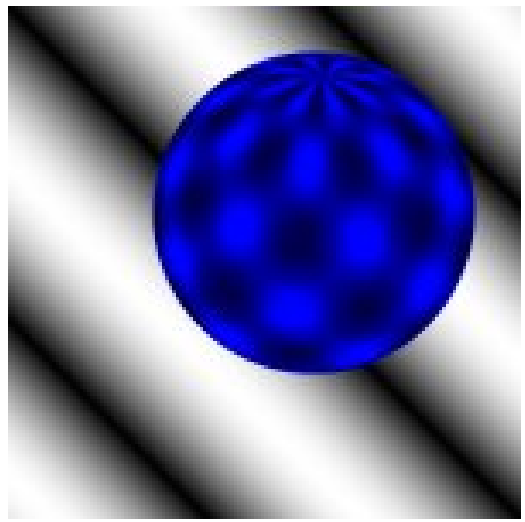
Coarse texture:
large size primitive,
small variance

Fine texture:
small size primitive,
large variance

Optical Flow







2D Image Analysis

- Segmentation – Estimate outer contour (boundary) of the object from the image

- Registration – Estimate a **global** transformation (Affine, Similarity, Euclidean) relating 2 images
  - taken from different views, different modalities or different times

2D Image Analysis

- Shape – geometric information after removing scale, translation, rotation

- Recognition / Classification / Detection
  - e.g. Faces, Objects, Vehicles, Activity (video)
  - Use intensity, shape, texture, motion,…

- Tracking – Estimate from a time seq. of images
  - Global motion **or**
  - Global motion & Local deformation (shape change)
  - Change detection – change in the system model

Recognition

- Faces: AT&T database

- Objects: COIL database

•Activity recognition, Abnormality detection

Representing Shape

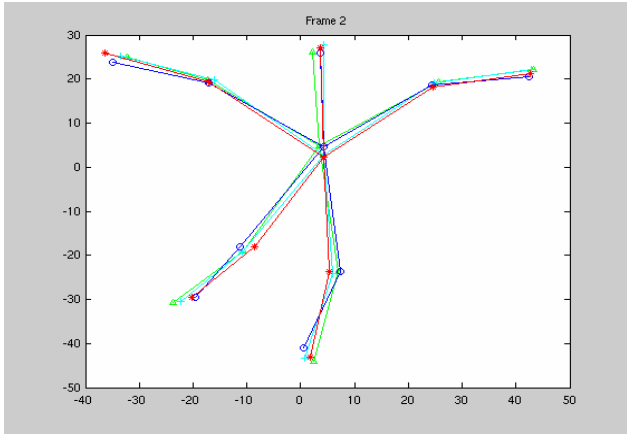
- Landmarks – points of high curvature or intensity or motion blobs or of “interest”
- Continuous curve – parametric finite dim. representation e.g. B-spline, angle repr.
- Continuous curve – infinite dim. representation – level set method

Tracking motion & deformation

- Fish :
  - “Feature”– Image intensity,
  - Shape repr.: Level set method
  - Initialiazation: Segmentation

- Group of People
  - “Feature” – Motion detection
  - Shape repr: Landmark shape
  - Also do change detection

- Human actions
  - “Feature”: local PCA
  - Shape: Landmark



- Leaf (CONDENSATION algorithm):
  - “Feature”: edges
  - Shape repr: B-spline

- Beating Heart: 3D image sequence

2D images → 3D structure

- Infer 3D scene structure from a set of 2D images
- “Structure”: X,Y,Z coordinates of object
- Inference based on a “Camera model”
- Structure from Stereo - 2 or more views of object
- Structure from Motion – moving object
  - Also implicitly tracks the 3D global motion

3D Images

- Get a 3D image at every time, e.g. MRI of different cross-sections of the brain
- Medical imagery (MRI, CT, ultrasound), Range images, ??
- Require representations of shape in 3D

Differences from 1D Signal Processing

- Take care of spatial relationships, e.g. spatial frequency, notion of shape
- Too much information – req. “feature” extraction
- Noise assumptions for 1D signals don’t always model image noise well
- **No standard statistical models to categorize images, every problem is different** ☹
- 3D scene → 2D images, can be occlusions, many problems are ill-posed