

# Image Processing

## COMP3072/COMPGV12

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Reader

Geometric Modeling and Computer Graphics

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# Co-Instructor



Dan Stoyanov

# Class Timings



- Monday: 16:00-17:00, MPEB 1:03
- Wednesday: 9:00-11:00, Roberts 309
- Monday: 11:00-13:00, MPEB 1:05
- Monday: 17:00-18:00, MPEB 4.06

# Motivation



Before



After



[online sources]

# Image Restoration



[[http://photo-restoration.jaincotech.com/gallery\\_light\\_restoration.htm](http://photo-restoration.jaincotech.com/gallery_light_restoration.htm)]

# Image Clutter



# Seeing the Unseen



# Challenges?



# Challenges?



- Segmentation

# Challenges?



- Segmentation
- Missing depth

# Challenges?



- Segmentation
- Missing depth
- Missing data (occlusion)

# Challenges?

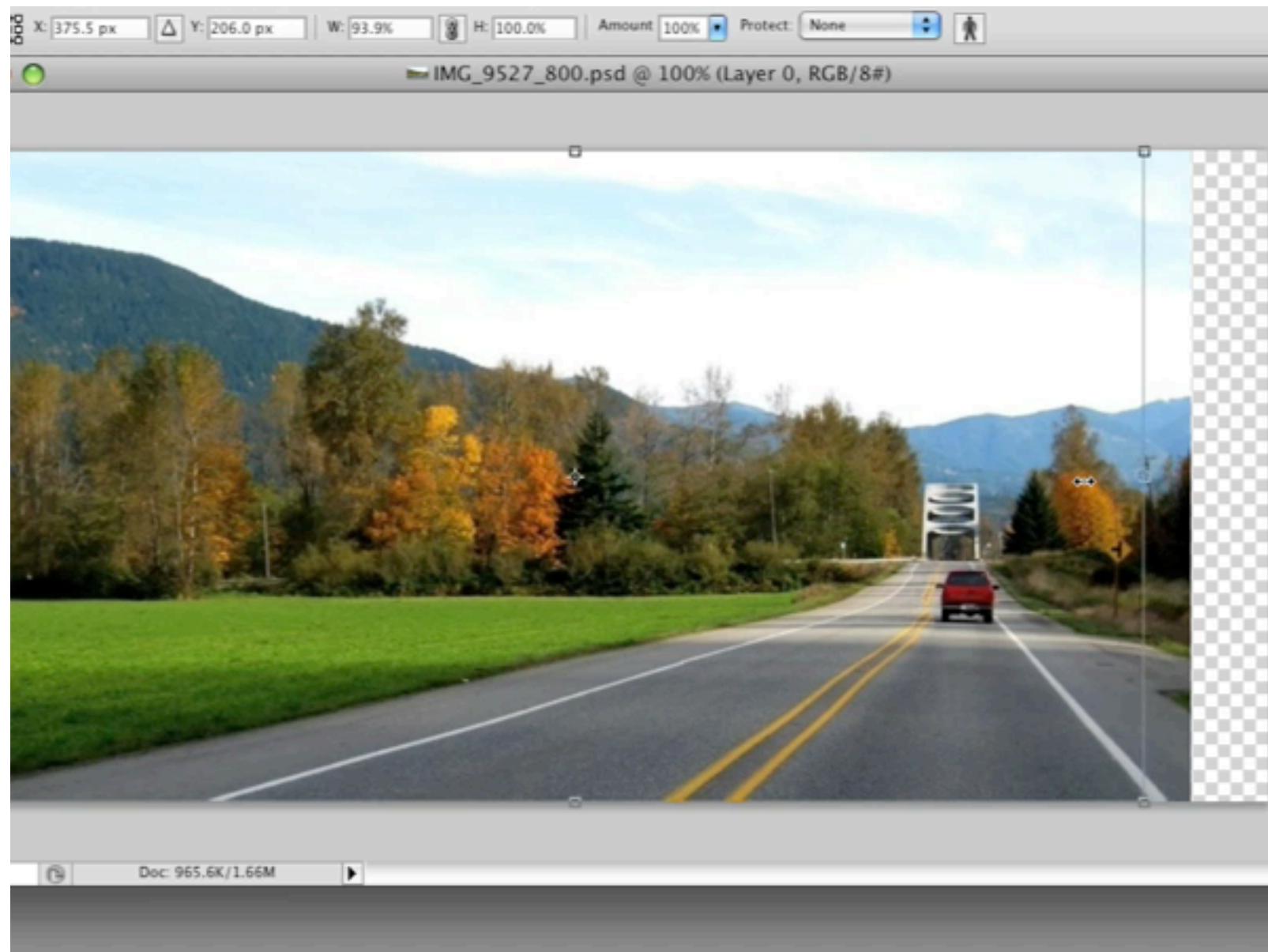


- Segmentation
- Missing depth
- Missing data (occlusion)
- Appearance effects, shadows, etc.

# Content Aware Resizing



# Patch Match



# 'Interactive' Images



Edit session

# Motivation and Goals



# Motivation and Goals



- Grounding in image processing techniques

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- Concentrate on ***algorithms*** useful for machine vision

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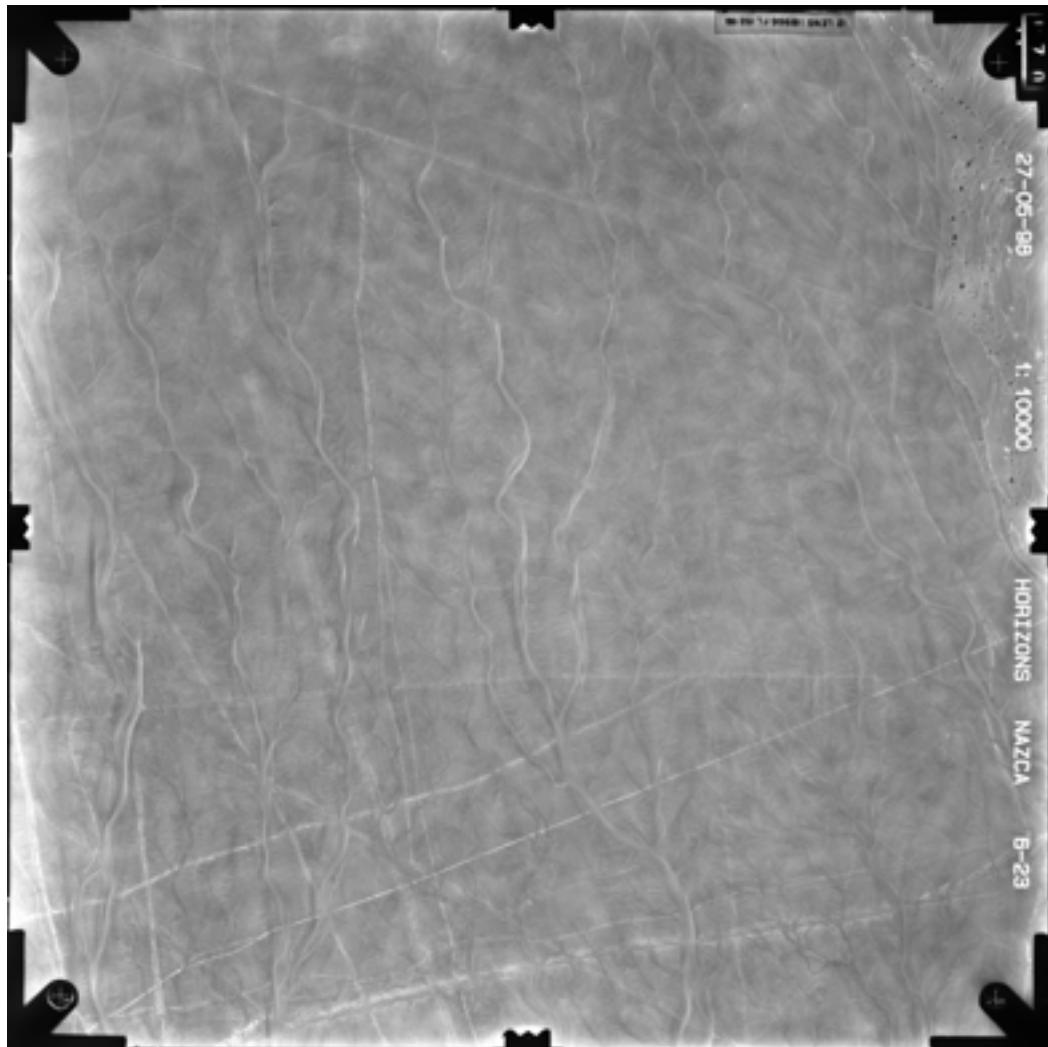
- Grounding in image processing techniques
- Concentrate on ***algorithms*** useful for machine vision
- Best sensors ever!

# Motivation and Goals

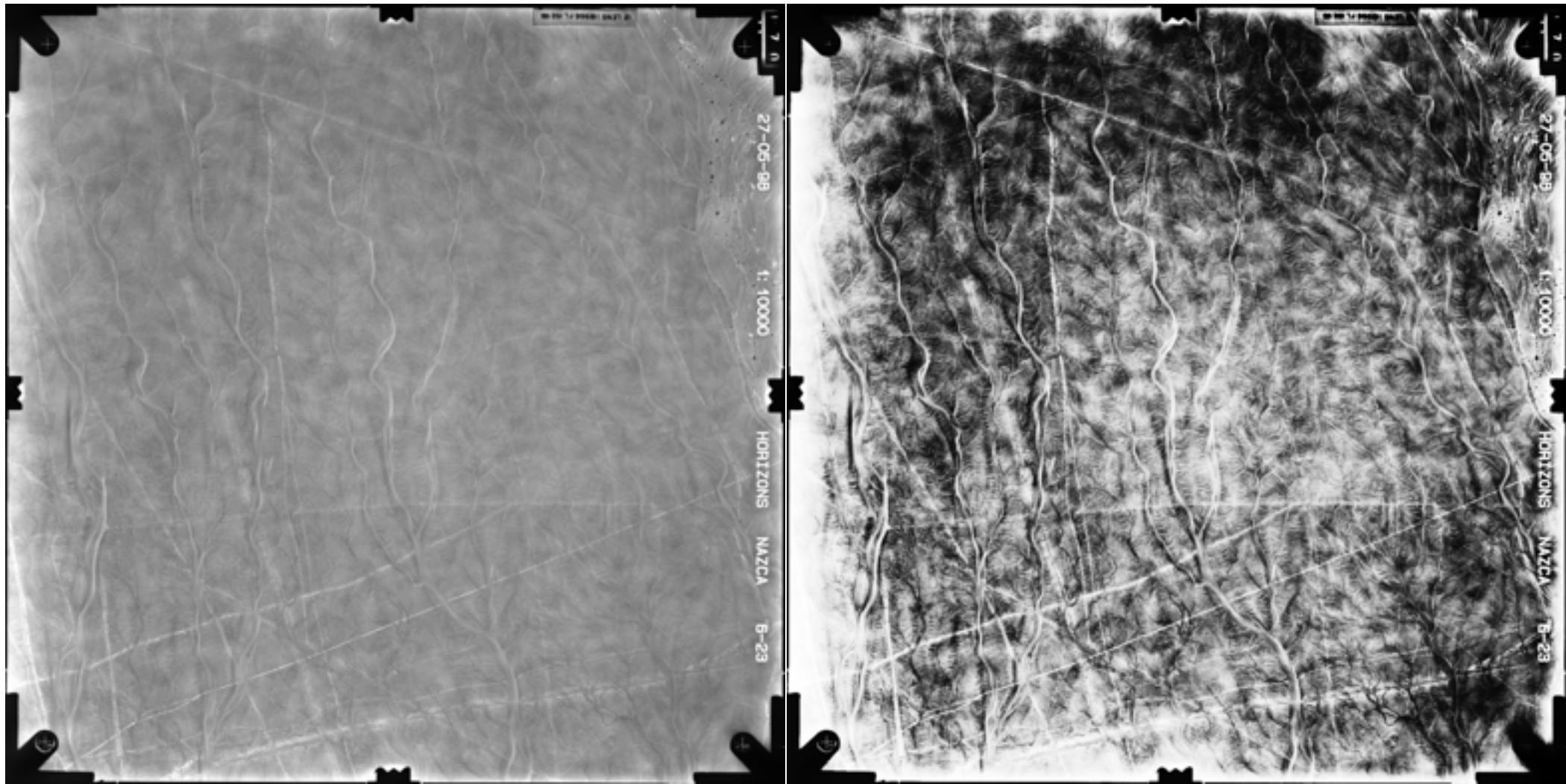


- Grounding in image processing techniques
- Concentrate on ***algorithms*** useful for machine vision
- Best sensors ever! *with a few problems...*

# Poor Contrast



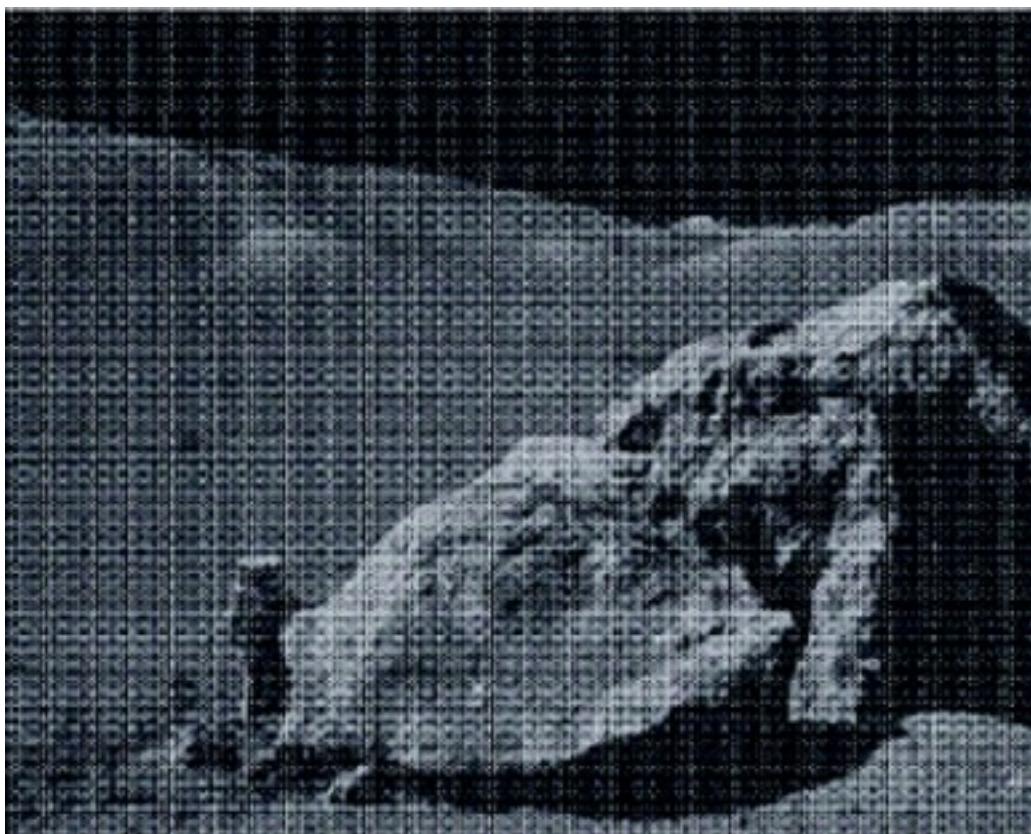
# Poor Contrast



# Low Light



# Transmission Interference



# Transmission Interference



# Compression Artefact



# Compression Artefact



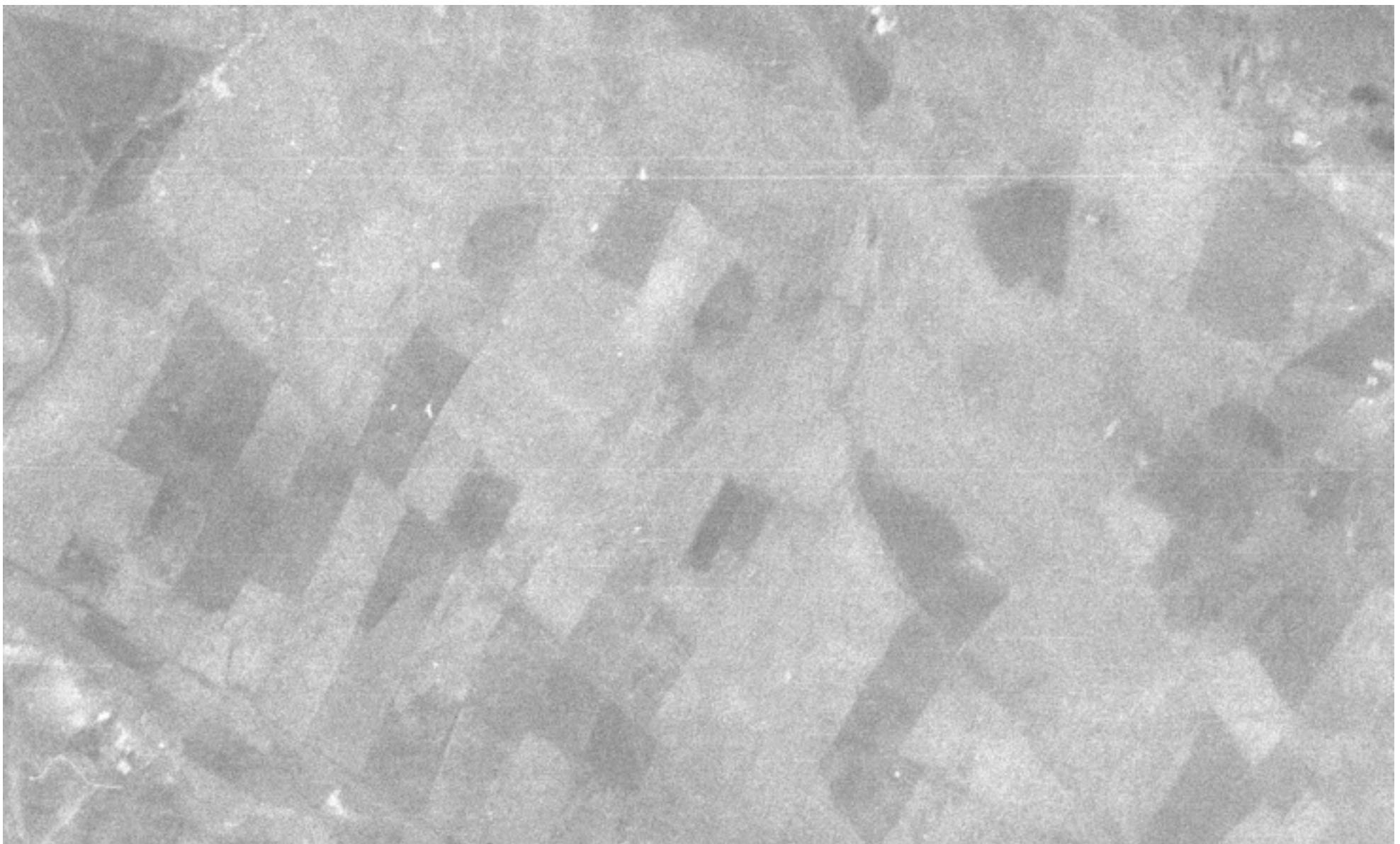
# Spilling



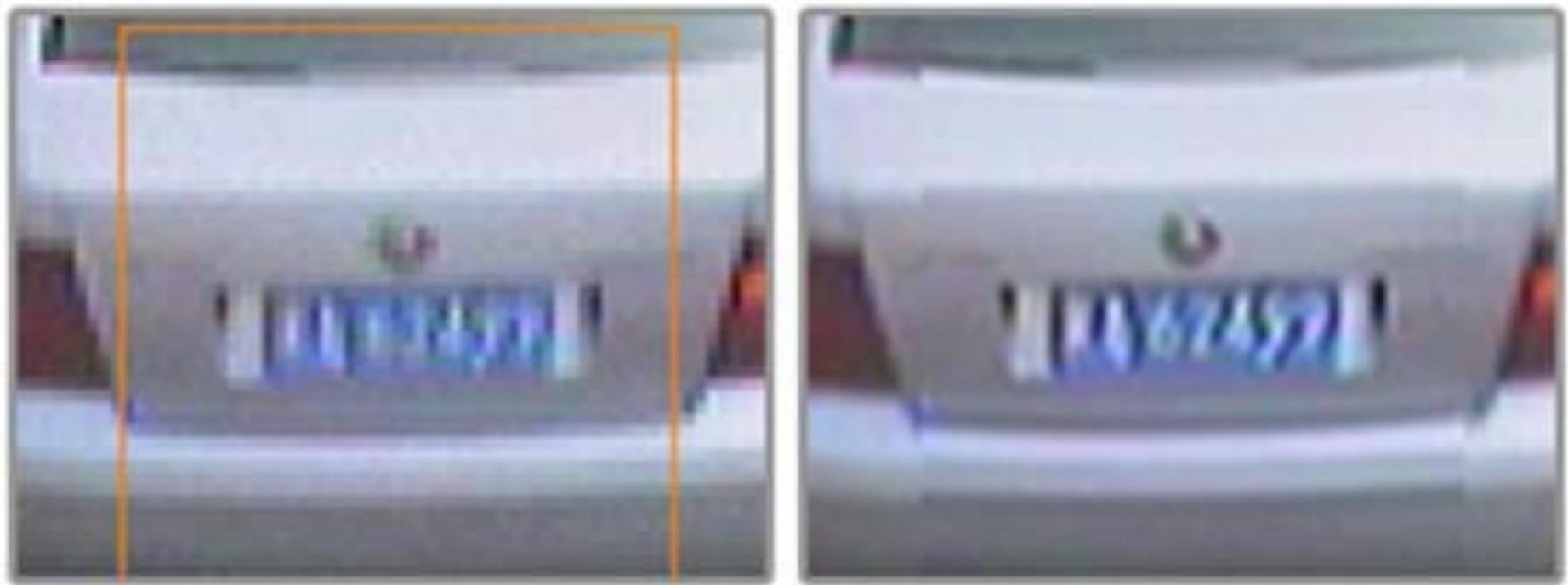
# Spilling



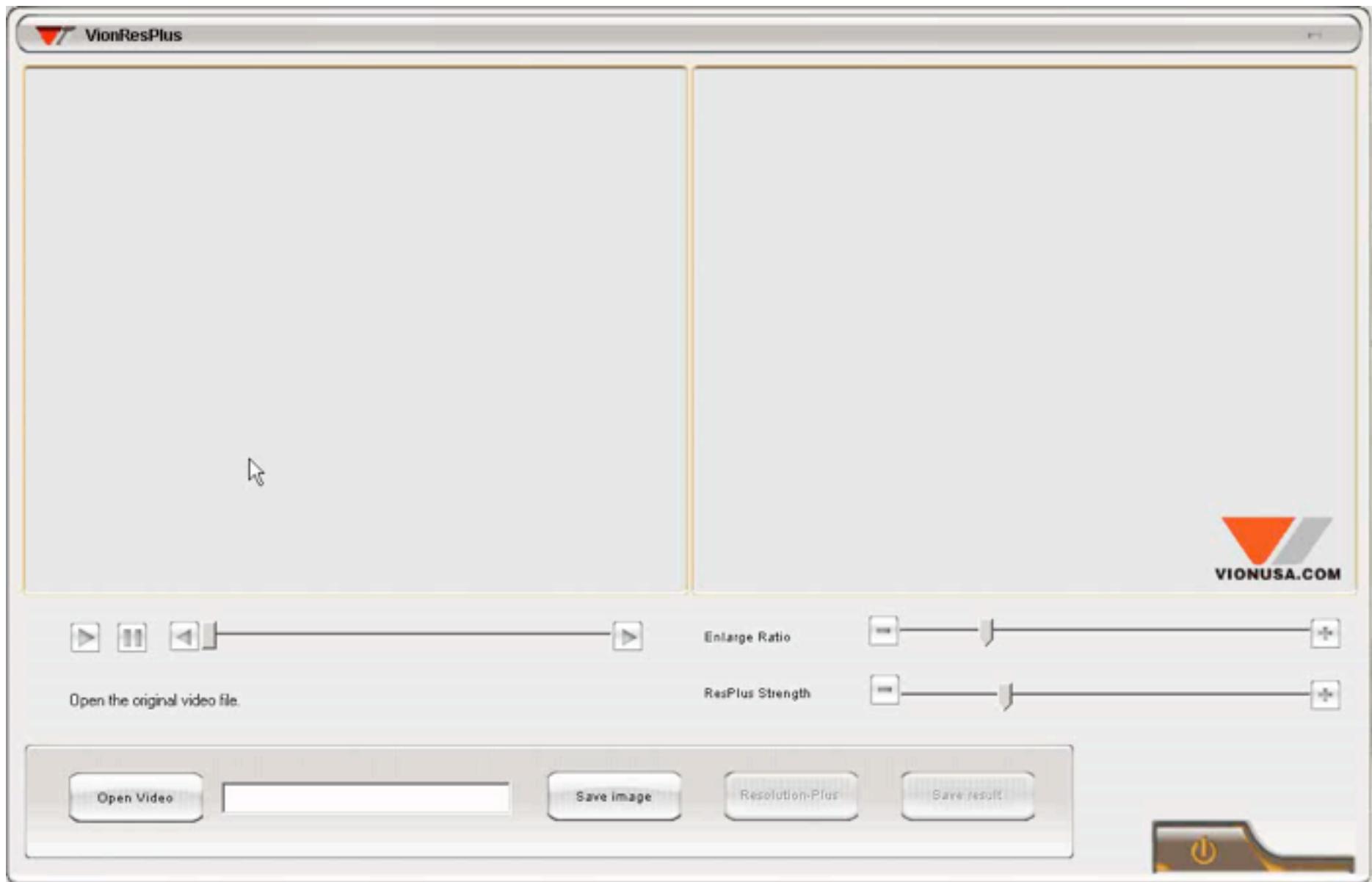
# Scratches, Sensor Noise



# Super Resolution



# Super Resolution



# Removing Motion Blur



Original image



Cropped subwindow

[Images from Amit Agrawal]

# Removing Motion Blur



Original image



Cropped subwindow

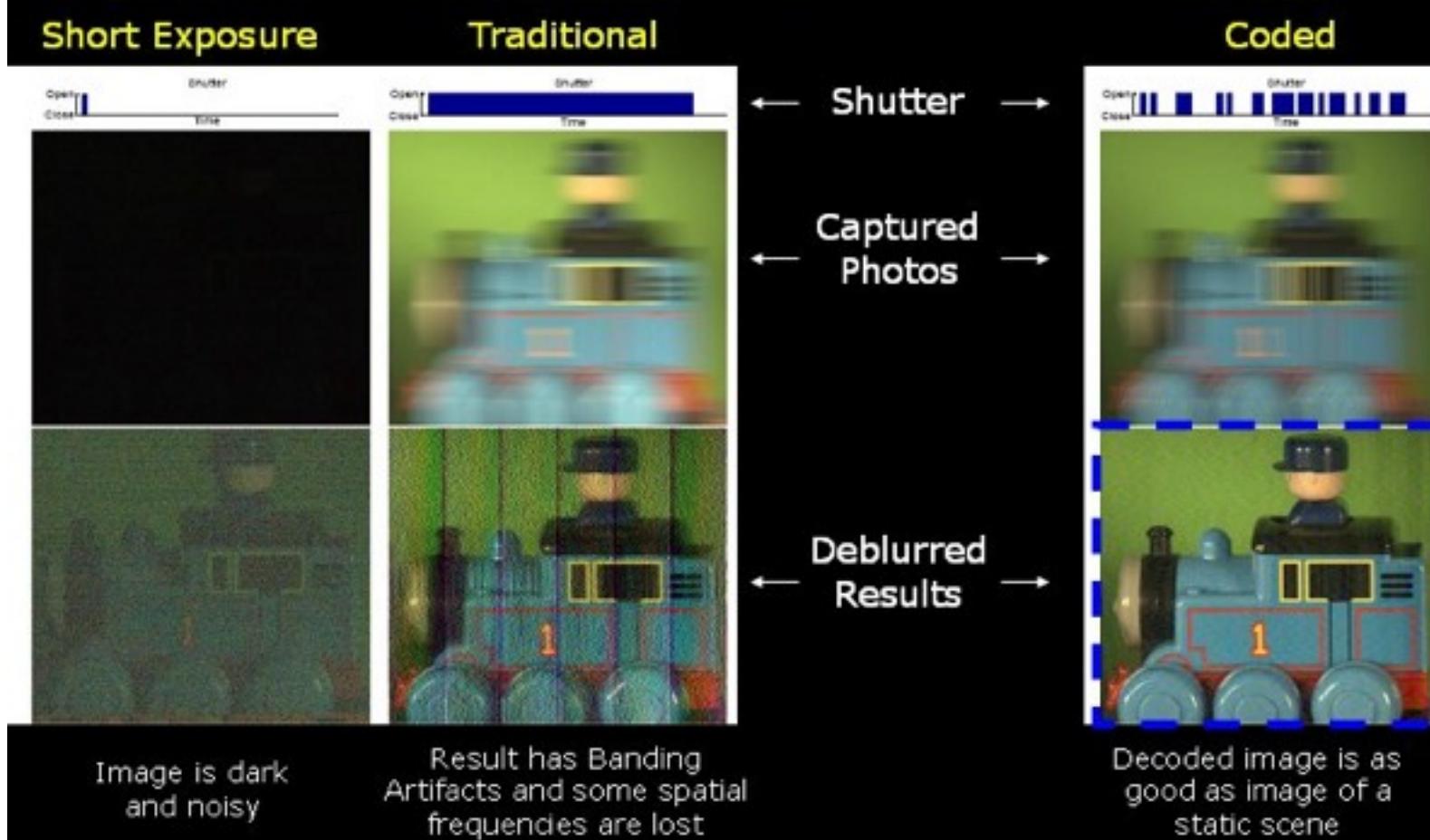


After motion blur removal

[Images from Amit Agrawal]

# Removing Motion Blur

Coded Exposure Photography:  
Assisting Motion Deblurring using Fluttered Shutter  
Raskar, Agrawal, Tumblin (Siggraph2006)



# Syllabus



# Syllabus



## 1. The digital image (introduction/characteristics)

# Syllabus



1. The digital image (introduction/characteristics)
2. Image segmentation

# Syllabus



1. The digital image (introduction/characteristics)
2. Image segmentation
3. Image transformations

# Syllabus



1. The digital image (introduction/characteristics)
2. Image segmentation
3. Image transformations
4. Morphological operations

# Syllabus



1. The digital image (introduction/characteristics)
2. Image segmentation
3. Image transformations
4. Morphological operations
5. Image Filtering

# Syllabus



# Syllabus



## 6. Feature characterization

# Syllabus



6. Feature characterization
7. Edge and corner detection

# Syllabus



6. Feature characterization
7. Edge and corner detection
8. Color images

# Syllabus



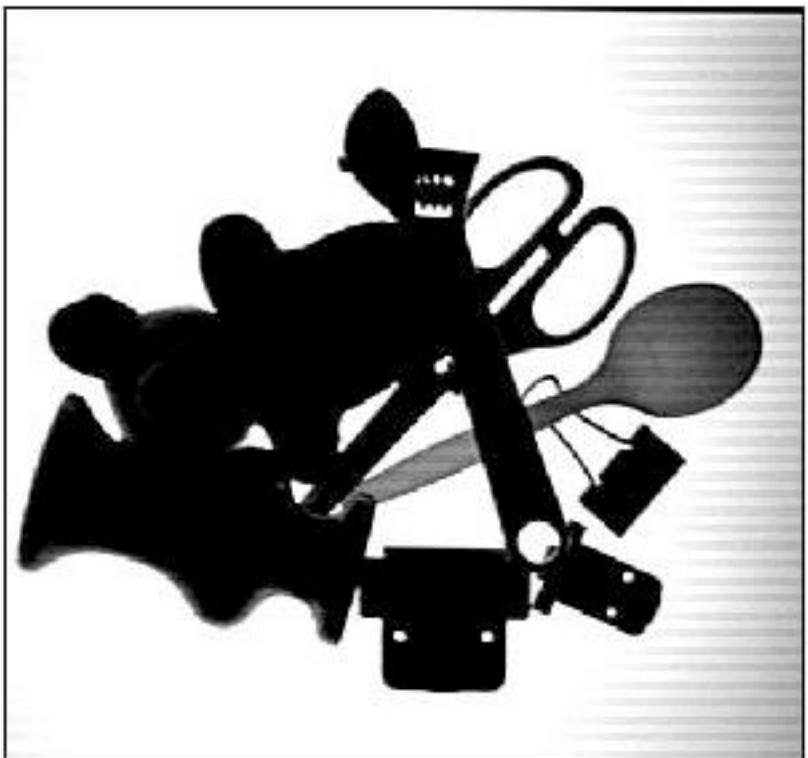
6. Feature characterization
7. Edge and corner detection
8. Color images
9. Template matching

# Syllabus

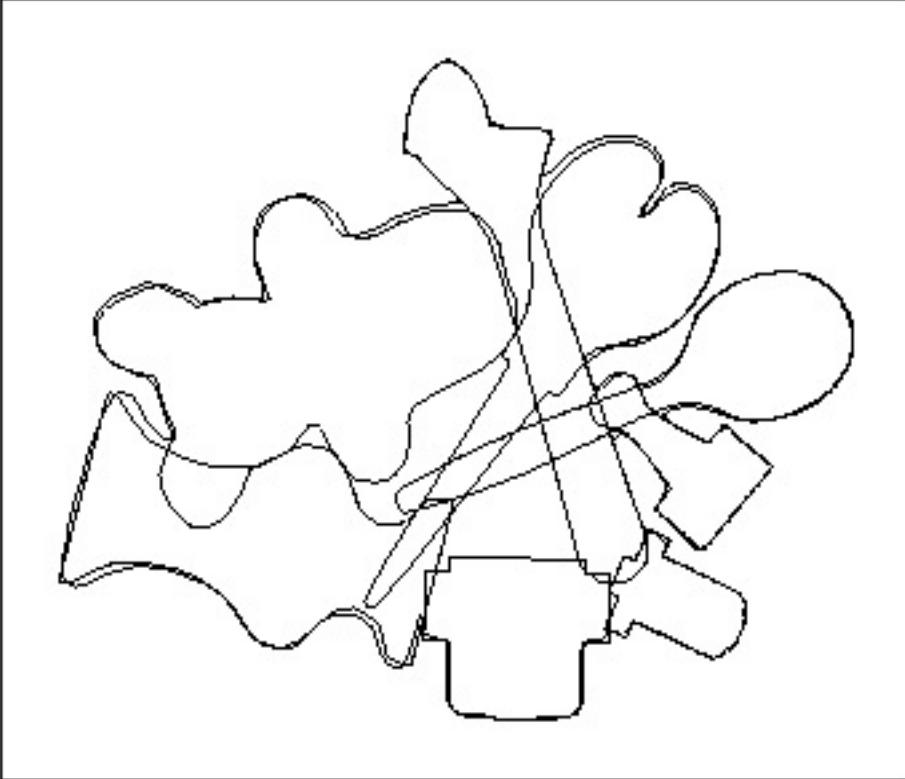
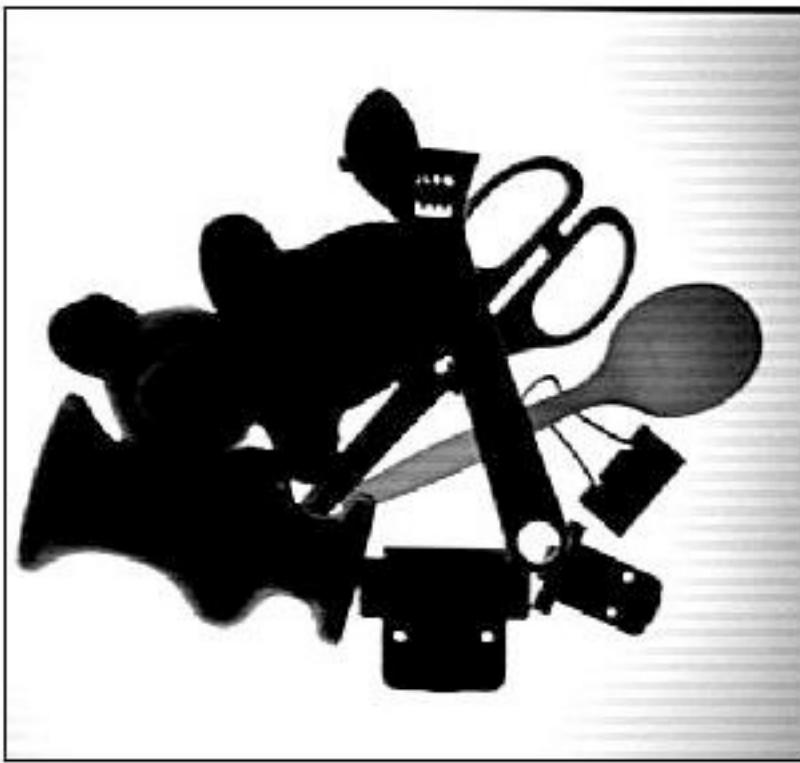


6. Feature characterization
7. Edge and corner detection
8. Color images
9. Template matching
10. Advanced topics

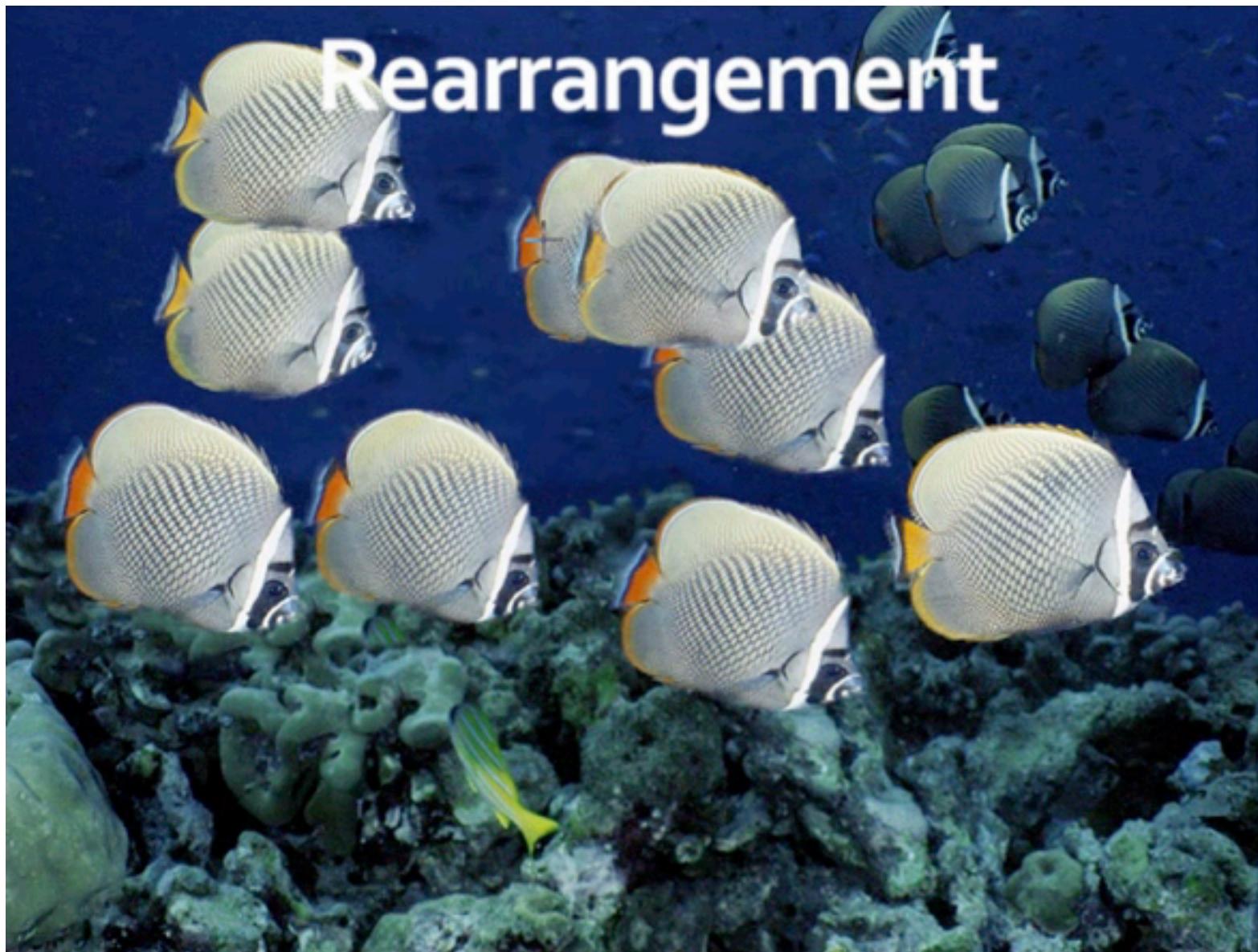
# Features and Object Recognition



# Features and Object Recognition



# Rep-Finder



# Why Now?



What are the sectors paying more attention?

# Course Content



- Lots of material!
- Expected background
  - Calculus
  - Geometry and matrix algebra
  - Probability and statistics
- Some programming – Matlab

# Assessment



- Four Assignments 20%.
  - Implement and test algorithms in Matlab
- Exam 80%
- Honor System

# Late Policy



Submissions after the deadline but **within 24 hours** of it will be **marked down to 90%** of the number of points achieved.

Submissions later than 24 hours, but **within 48 hours** from the deadline will be **marked down to 80%** of the number of points achieved.

Submissions **later than 48 hours** will receive **0%**.

# Logistics



- Monday 16:00-17:00 (MPEB 1.03)
- Wednesday 9:00-11:00 (Roberts 309)
- Lab sessions
  - Mon 11-12 (MPEB 1.05)
  - Mon 12-13 (MPEB 1.05)
  - Mon 17-18 (MPEB 4.06)
- Signup on Moodle

# Course TA



Melinos Averkiou



Aron Monszpart

# References



- Sonka, Hlavac and Boyle. “Image processing, Analysis, and Machine Vision.” Brooks/Cole publishing group, 1990.
- Efford. “Digital Image Processing: a practical introduction using Java.” Addison—Wesley, 2002.
- Watt and Policarpo. “The computer image.” Addison—Wesley, 2002.
- Gonzalez and Woods. “Digital image processing.” Prentice—Hall, 2002.
- Pratt. “Digital image processing.” Wiley, 2001.

# Unassessed CW Assignment



- Matlab introduction
- Start matlab:
  - matlab or
  - /opt/matlab7/bin/matlab
- Download any simple image
- Load it into matlab:

```
>> I = imread('foo.jpg');
```

# Unassessed CW Assignment



- Display the image in Matlab:

```
>> imshow(I);
```

- Print the image data array:

```
>> I
```

- Print the size of the image array and create a subimage:

```
>> size(I)
```

```
>> Isubwindow = I(72:92, 62:82);
```

```
>> imshow(Isubwindow);
```

# Unassessed CW Assignment



- Start the Matlab help tool (Help menu).
- In the “Contents” pane to the left of the window. Click on MATLAB.
- Go through the “Getting Started” section.
- Continue to the “Using MATLAB” section when you have time.