

Image Processing

Gabriel Brostow & Simon Prince



Motivation and Goals

- Grounding in image processing techniques
- Concentrate on algorithms used in machine vision, graphics, medical imaging
- Best sensors ever!

Motivation and Goals

- Grounding in image processing techniques
- Concentrate on algorithms used in machine vision, graphics, medical imaging
- Best sensors ever! With a few problems...

Transmission interference



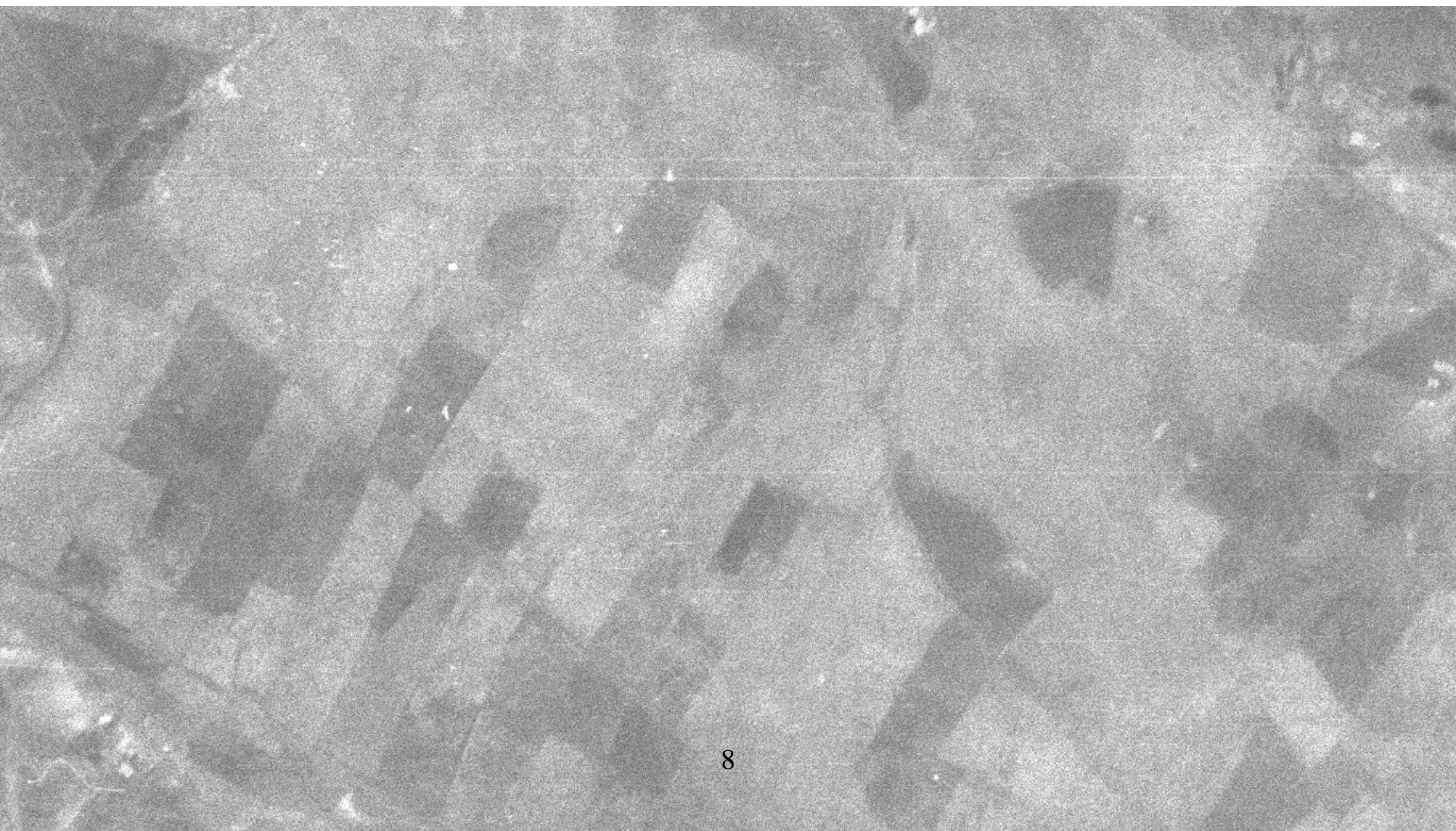
Compression artefacts



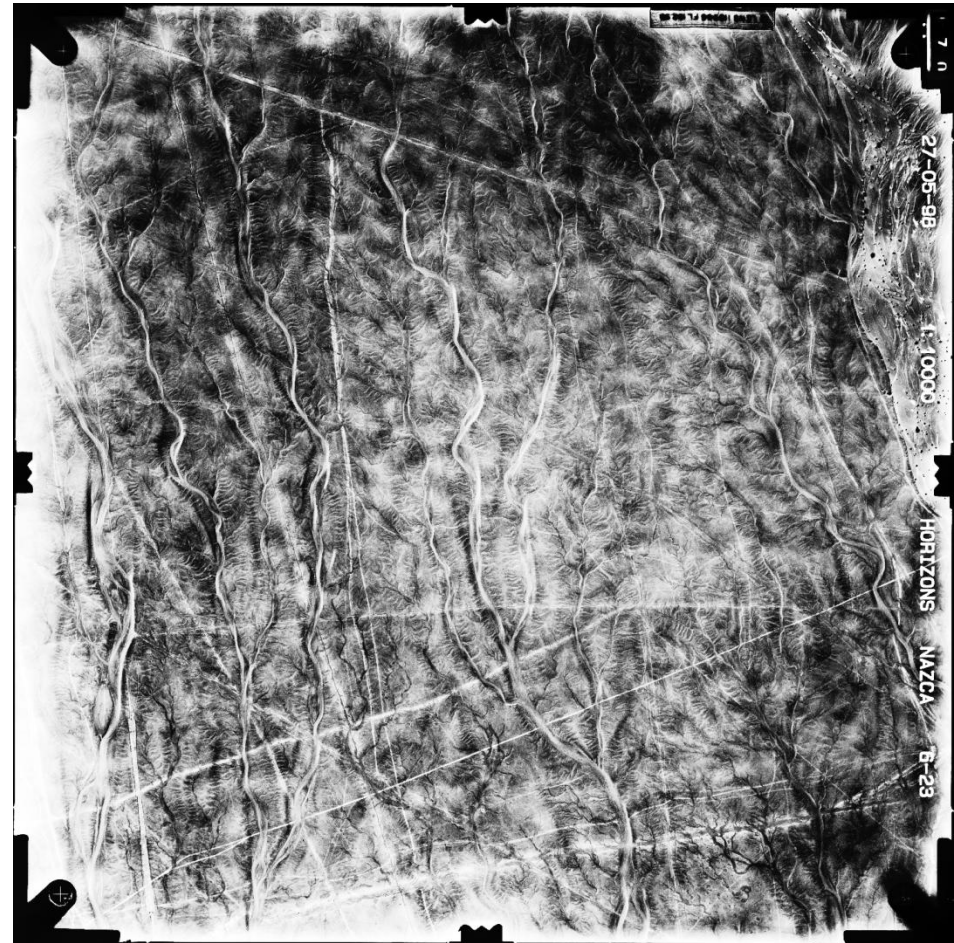
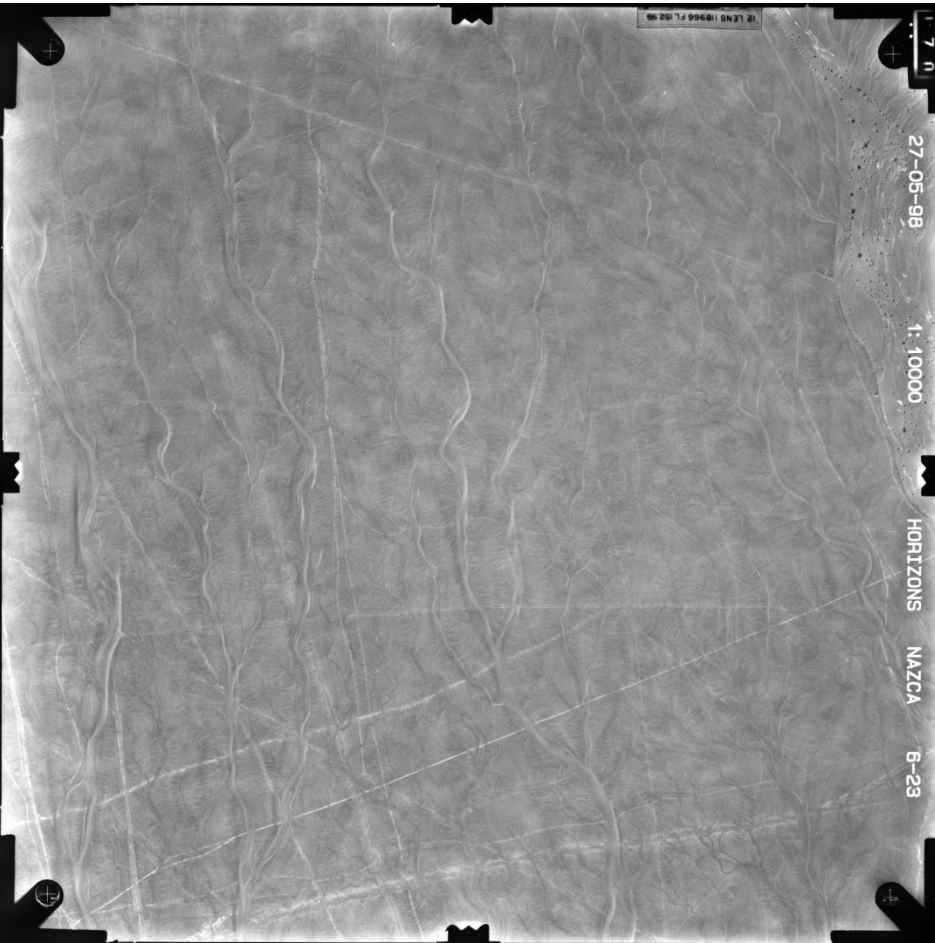
Spilling



Scratches, Sensor noise



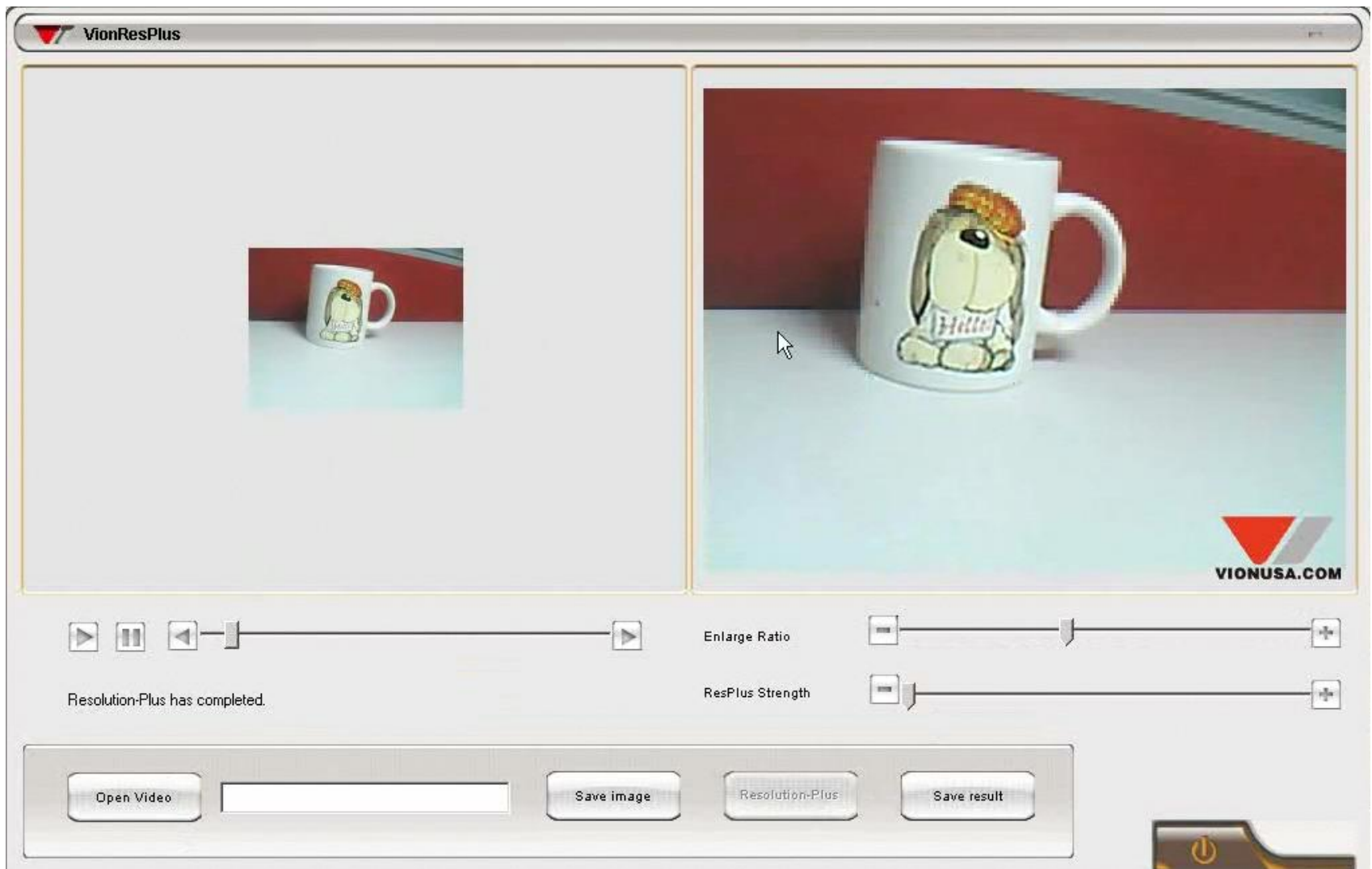
Bad contrast



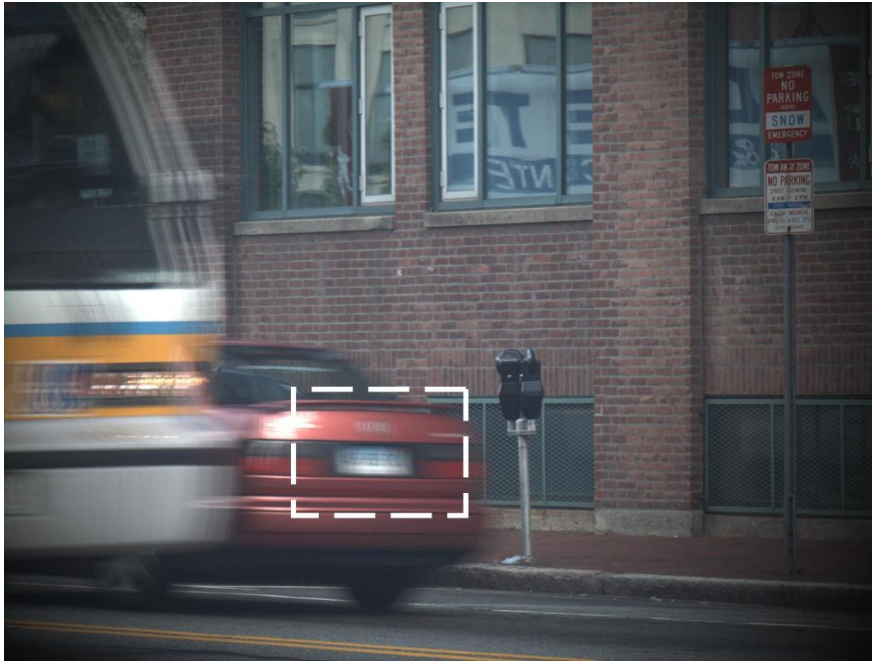
Resolution → Super resolution?



Super resolution



Removing motion blur



Original image



Cropped subwindow



After motion blur removal

Removing motion blur

Coded Exposure Photography: Assisting Motion Deblurring using Fluttered Shutter

Raskar, Agrawal, Tumblin (Siggraph2006)

Short Exposure

Traditional

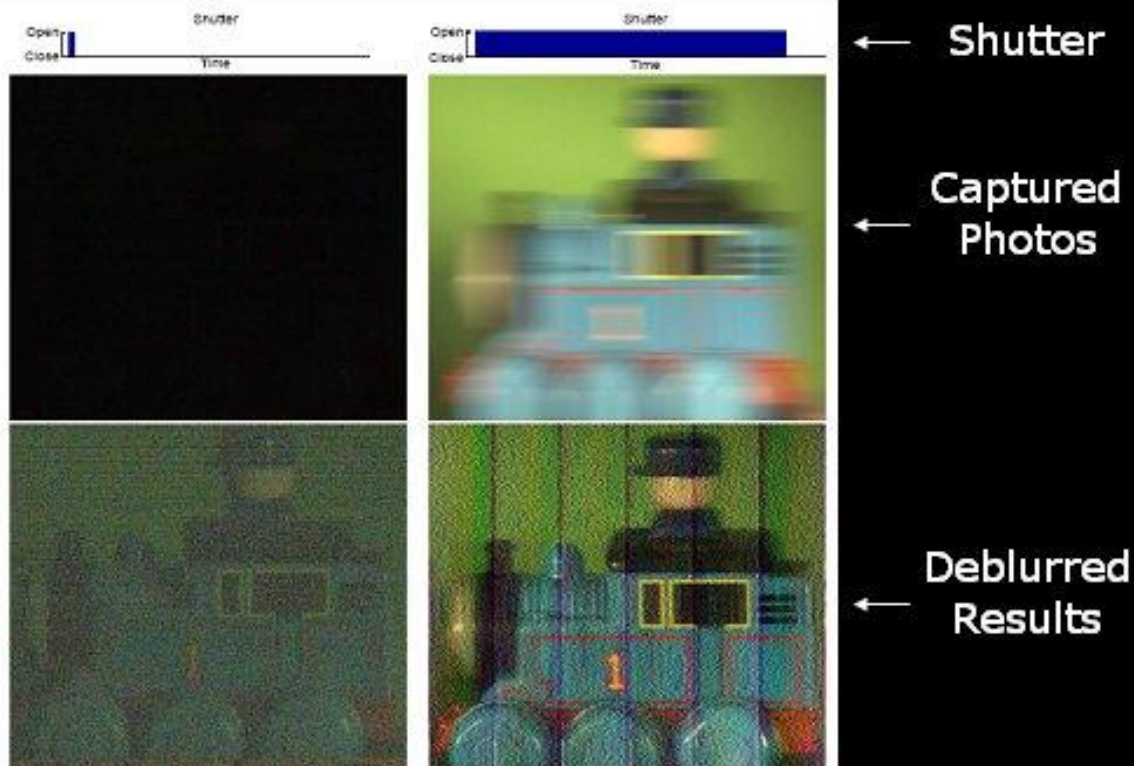


Image is dark
and noisy

Result has Banding
Artifacts and some spatial
frequencies are lost

Fluttered Shutter Camera

Raskar, Agrawal, Tumblin Siggraph2006



Ferroelectric shutter in front of the lens is turned opaque or transparent in a rapid binary sequence

Removing motion blur

Coded Exposure Photography: Assisting Motion Deblurring using Fluttered Shutter

Raskar, Agrawal, Tumblin (Siggraph2006)

Short Exposure

Traditional

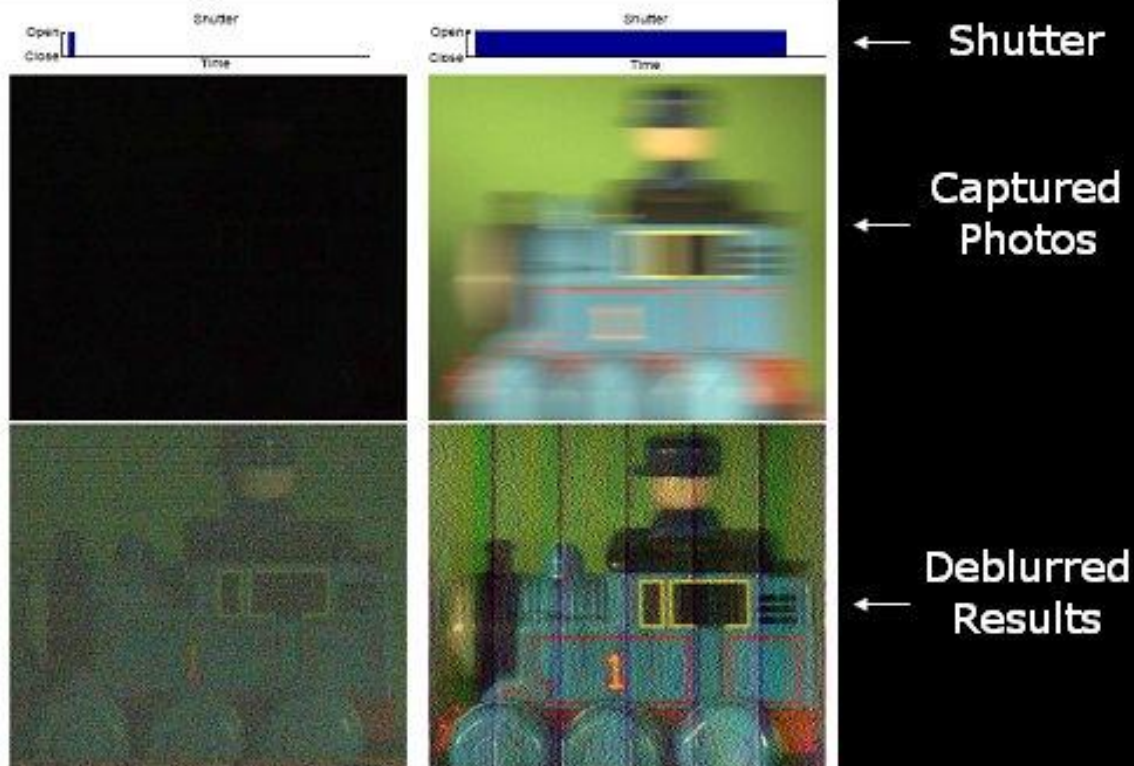


Image is dark
and noisy

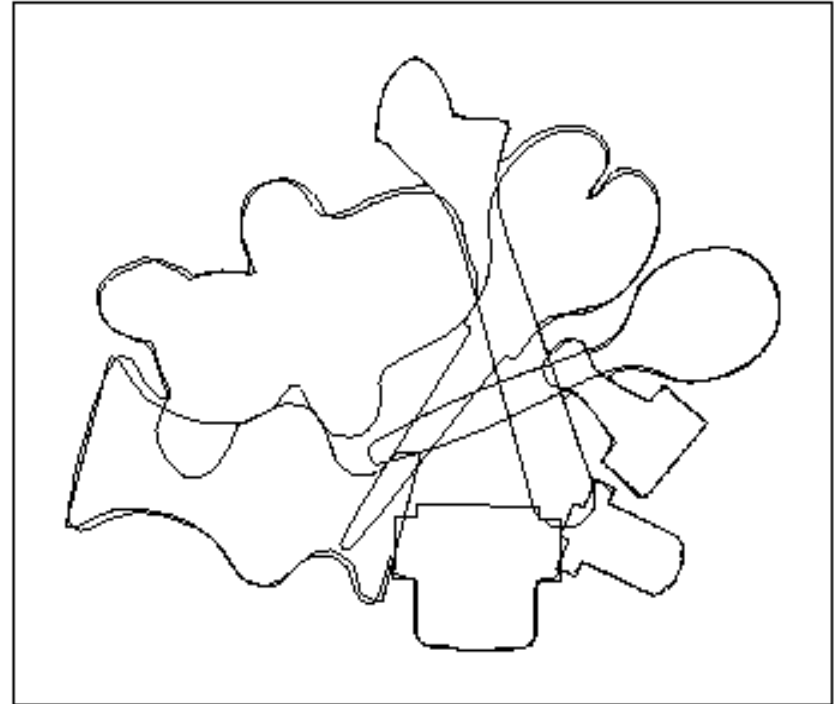
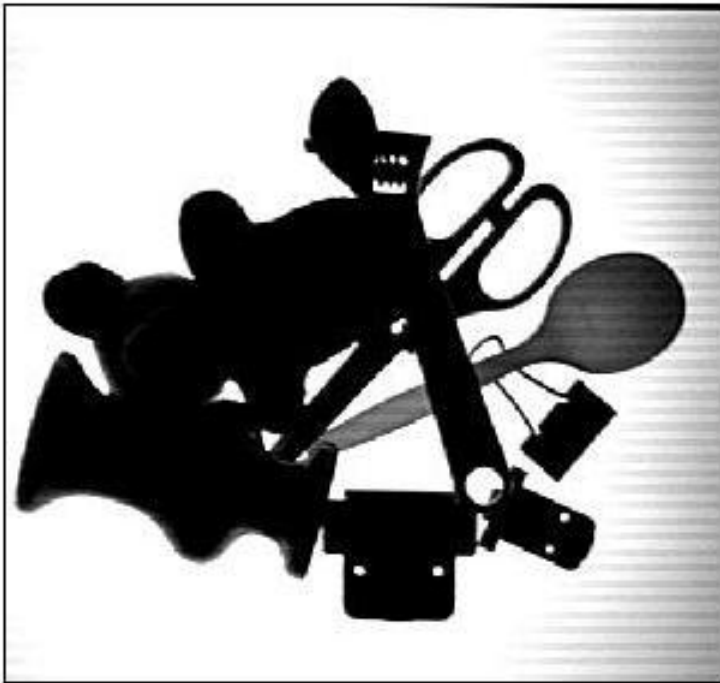
Result has Banding
Artifacts and some spatial
frequencies are lost

Syllabus

1. The digital image
2. Image segmentation*
3. Image transformations
4. Morphological operations*
5. Feature characterization

*= Homework will be assigned

Features and Object Recognition



Syllabus (GV12/3072)

- 6. Image Filtering
- 7. Edge detection*
- 8. Corner detection
- 9. Color images*
- 10. Template matching

*= Homework will be assigned

Why Now?

- Medicine

- Automatic or assisted diagnosis
- Image-guided surgery

- Agriculture

- Film and television

- Surveillance and police work

- Military

- <http://www.cs.ubc.ca/spider/lowe/vision.html>

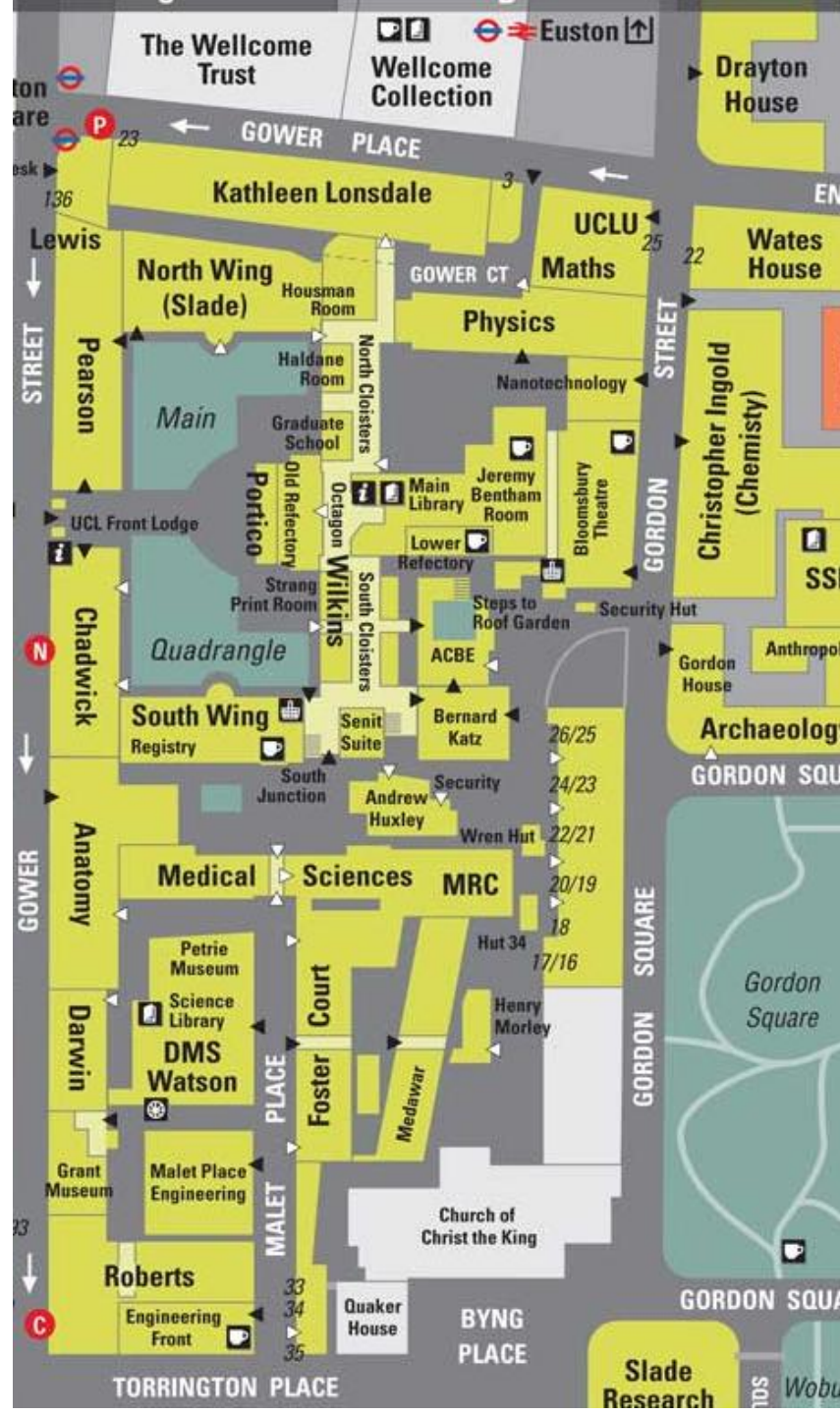
- Why are these sectors paying more attention?

Course content

- Lots of material!
- Some mathematics
 - Calculus (light)
 - Geometry and matrix algebra
 - Probability and statistics (light)
- Some programming – Matlab

Lectures and notes

- <http://www.cs.ucl.ac.uk/staff/G.Brostow/classes/IP2009/>
- Mon 16:00-17:00 (Drayton Ricardo LT)
- Wed 09:00-11:00 (Roberts G08, Sir David Davies LT)
- Lab sessions
 - Monday 11-12 (Malet Place Eng 4.06)
 - Monday 12-13 (Malet Place Eng 4.06)
 - Monday 17-18 (Malet Place Eng 4.06)
- subject: “join” to gv12-request@cs.ucl.ac.uk



Assessment

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

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
```

(Ha! It's a trap! - use Ctrl-C to make it stop)

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

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

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

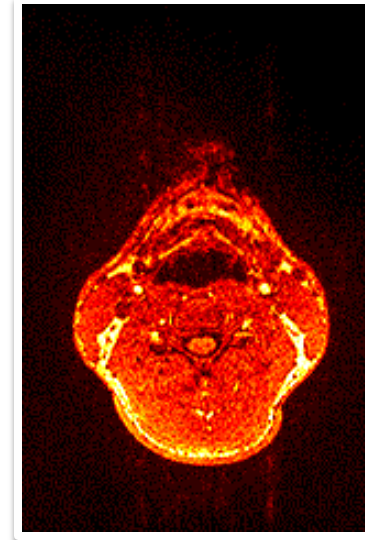
```
>> imshow(Isubwindow);
```

Unassessed CW Assignment

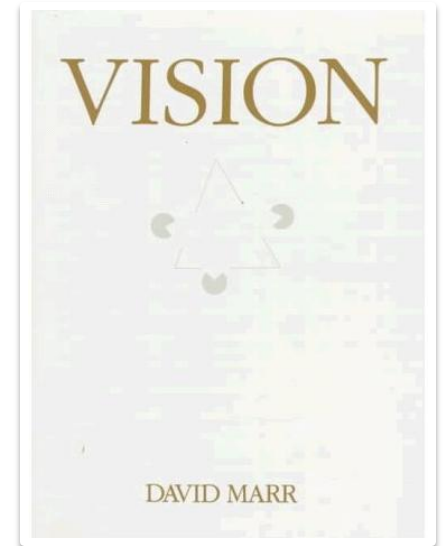
- Start the Matlab help tool (Help menu).
- In the “Contents” pane to the left of the window. Click on MATLAB.
- Go through the “Getting Started” section.
- Continue to the “Using MATLAB” section when you have time.

IP is Only Part of the Picture

- See Machine Vision (GI04) in MPEB 1.03 Tuesday at 10am



MRI of GJB



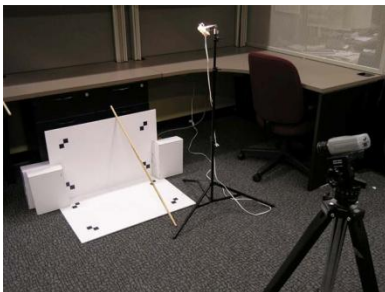
A Computational Investigation into the Human Representation and Processing of Visual Information

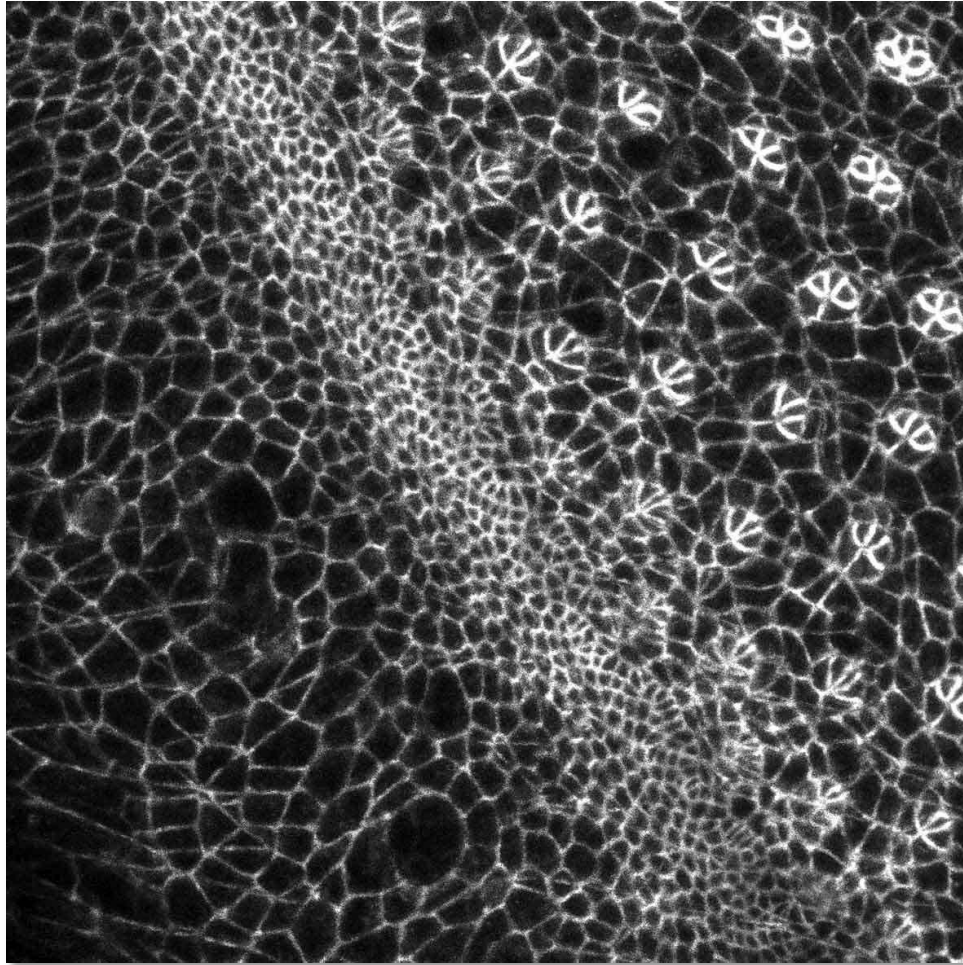
- Why?
 - To work on fun projects!

- 3D Gesture Interfaces (Xbox 360)



- Build Your Own 3D Scanner: Optical Triangulation for Beginners (Lanman + Taubin)





Developing *Drosophila* eye (30 hours)

With Franck Pichaud
Epithelial Morphogenesis &
Cell Polarity

Needed Innovations:

- Locate & track branching structures
- Propagate confidence to neighbors

Next Time: The Digital Image