



UNIVERSITY OF
SOUTH CAROLINA

CSCE 590 INTRODUCTION TO IMAGE PROCESSING

Introduction

Why Image Processing?

- Who here has a camera?
- How many cameras do you have
- Point where computers fast/cheap
- Cameras become omnipresent
- Deep Learning...



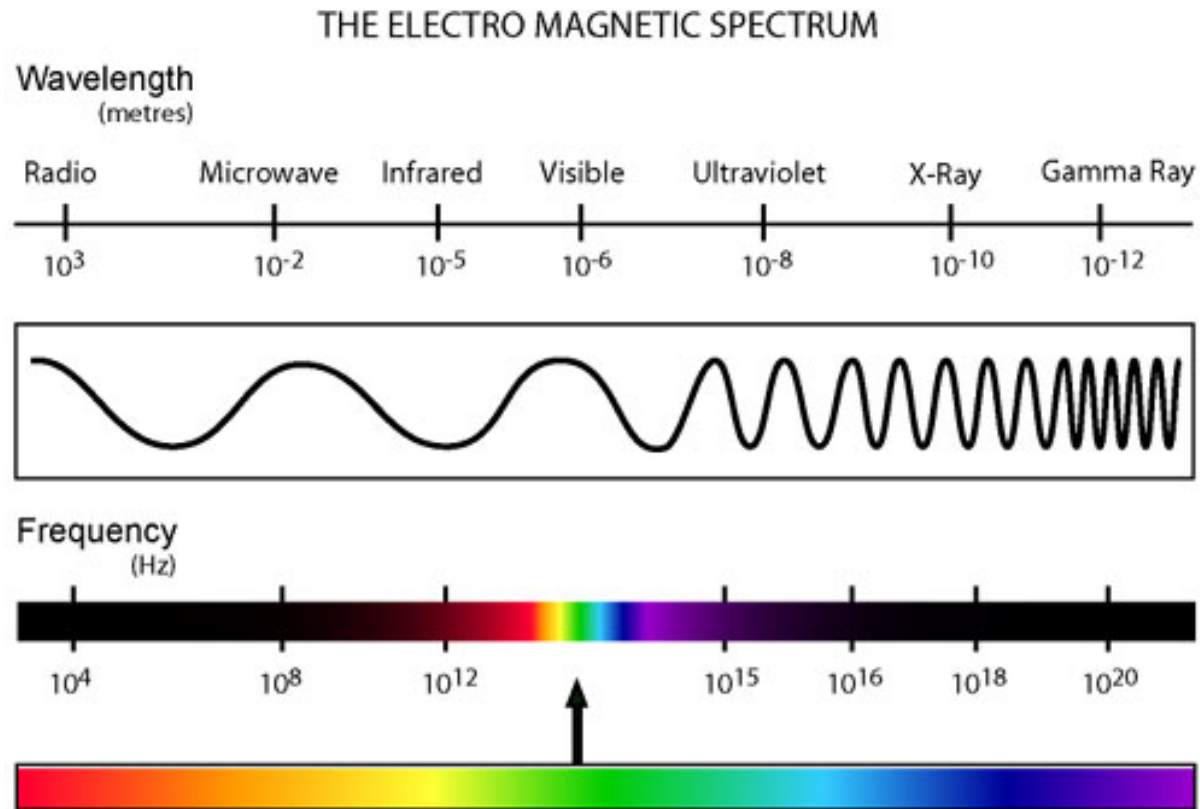
Major Topics Covered in Class

- image acquisition
- digital image representation
- Image enhancement
- Image restoration
- Color image processing
- Image compression
- Image segmentation
- Morphological image processing



Human Perception VS Machine Vision

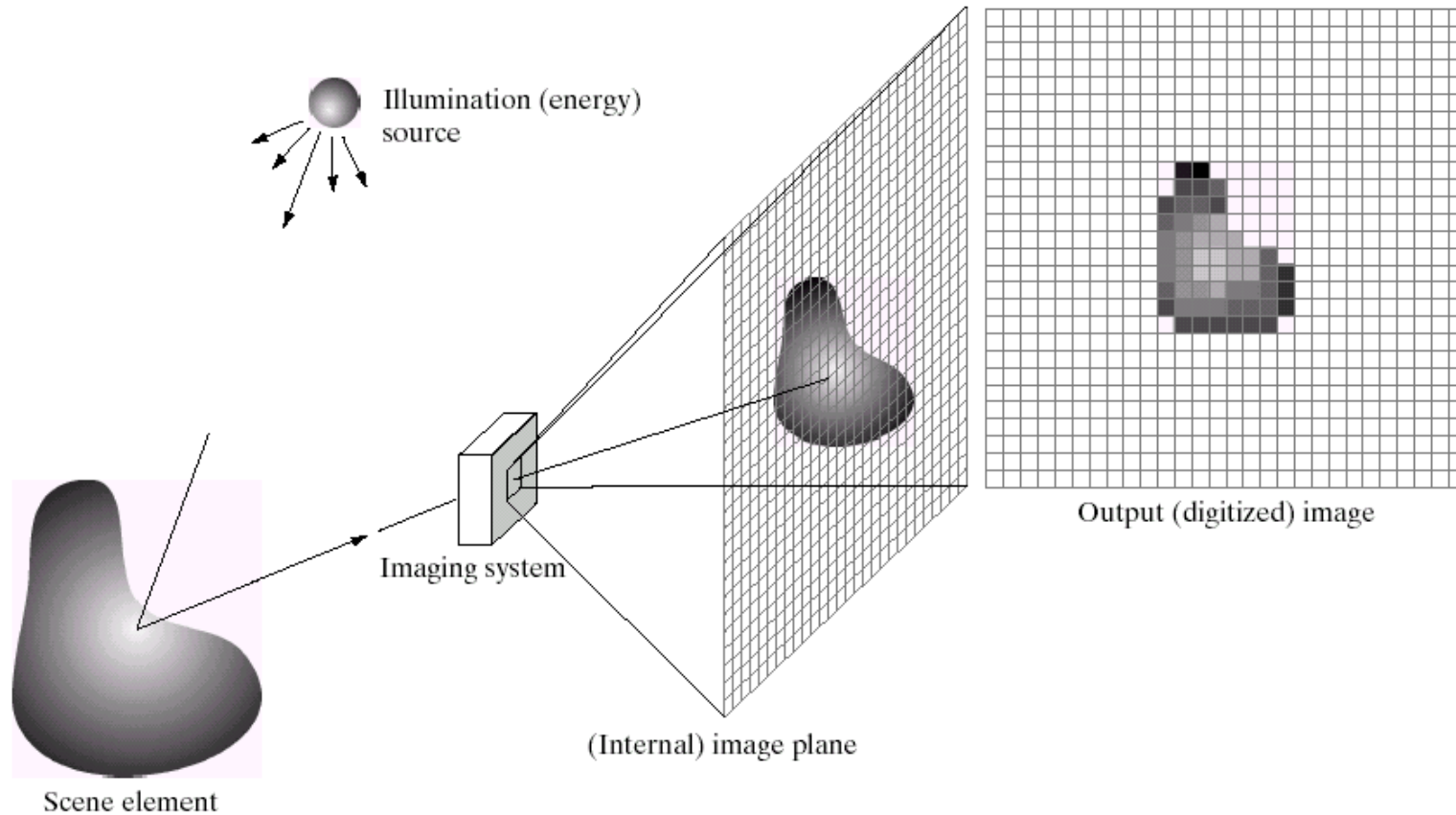
- **Limited vs entire EM spectrum**



<http://www.kollewin.com/blog/electromagnetic-spectrum/>



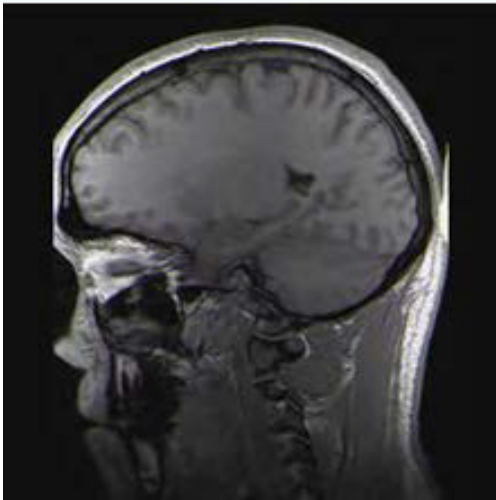
Image Acquisition and Representation



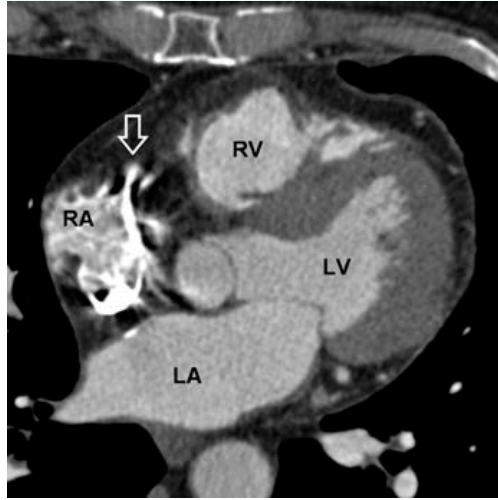
a b c d e

FIGURE 2.15 An example of the digital image acquisition process. (a) Energy (“illumination”) source. (b) An element of a scene. (c) Imaging system. (d) Projection of the scene onto the image plane. (e) Digitized image.

Examples



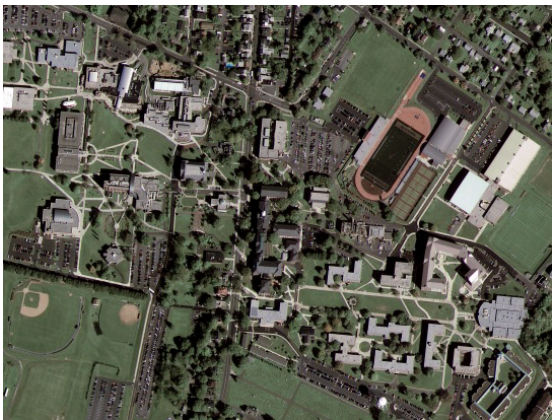
1. Brain MRI



2. Cardiac CT



3. Fetus Ultrasound



4. Satellite image



5. IR image

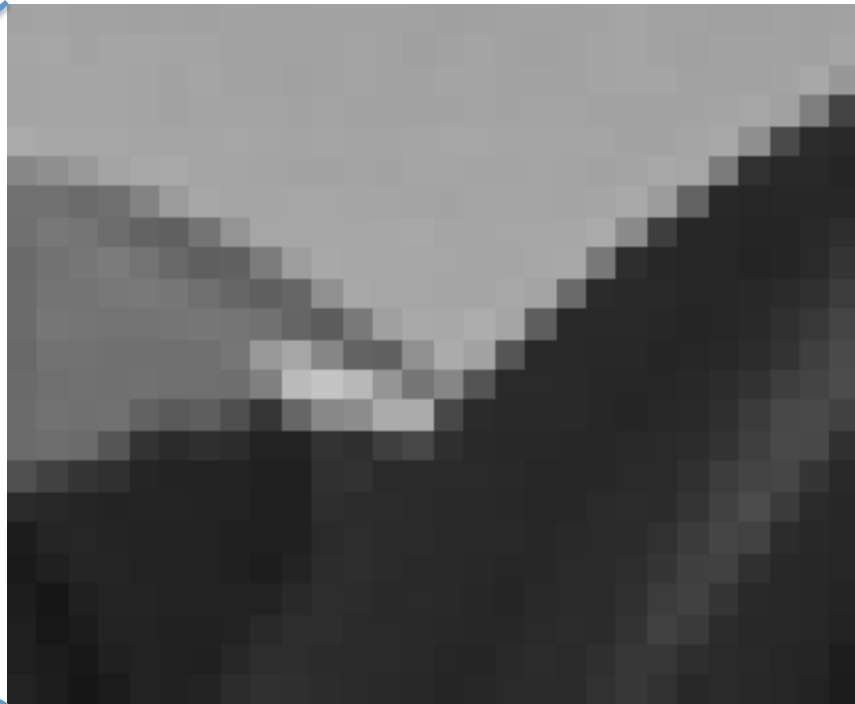
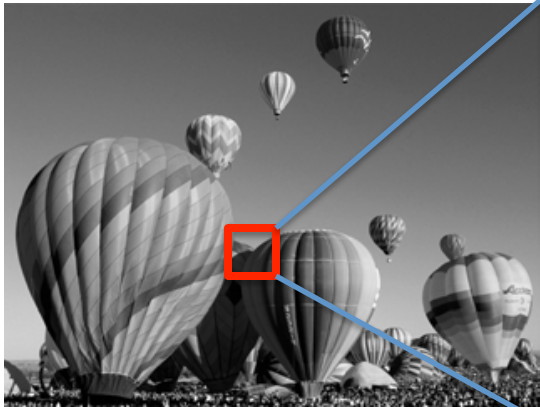
- 1 and 3. <http://en.wikipedia.org>
2. <http://radiology.rsna.org>
4. <http://emap-int.com>
5. <http://www.imaging1.com>



Image Representation

- **Discrete representation of images**

- we'll carve up image into a rectangular grid of pixels $P[x,y]$
- • each pixel p will store an intensity value in $[0\ 1]$
- • $0 \rightarrow$ black; $1 \rightarrow$ white; in-between \rightarrow gray
- • Image size m by $n \rightarrow (mn)$ pixels



Applications of Digital Image Processing

- **Digital cameras, portable devices**
- **Photoshop**
- **Human computer interaction**
- **Medical imaging for diagnosis and treatment**
- **Surveillance**
- **Aerial Drones**
- **Autonomous Cars**
- **Convolutional Neural Networks**
- **Virtual/Augmented Reality**
- ...
- **Fast-growing market!**



Computer vision algorithms

- Image processing
- Geometric computer vision
- Semantic computer vision

- It is fundamental first to understand image formation



Difficult scenarios

- In certain settings, such as the underwater, robotic vision is particularly challenging
 - Different lighting conditions
 - Color loss
 - Hazing and blur
 - Texture loss



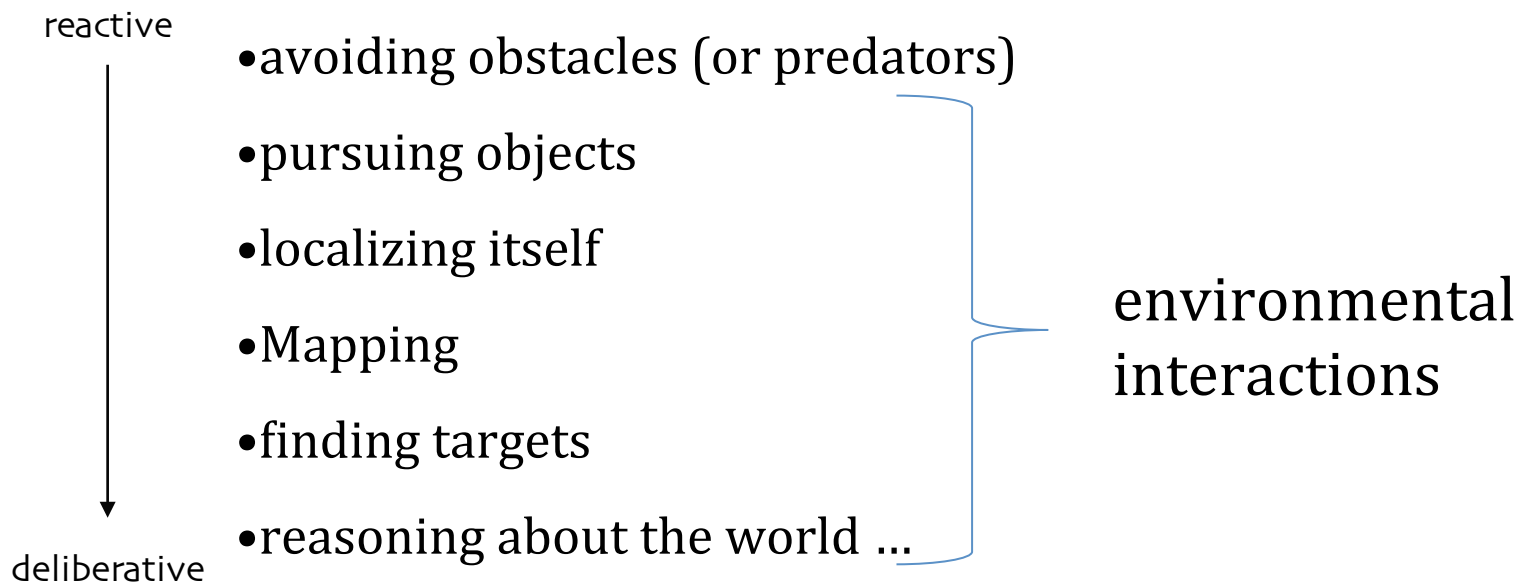
What does a robot need ?

doesn't need a full interpretation of available images

“This is Prof. X in his office offering me a cup of iced tea.”

does need information about what to do...

“Run Away!!”



Key problems

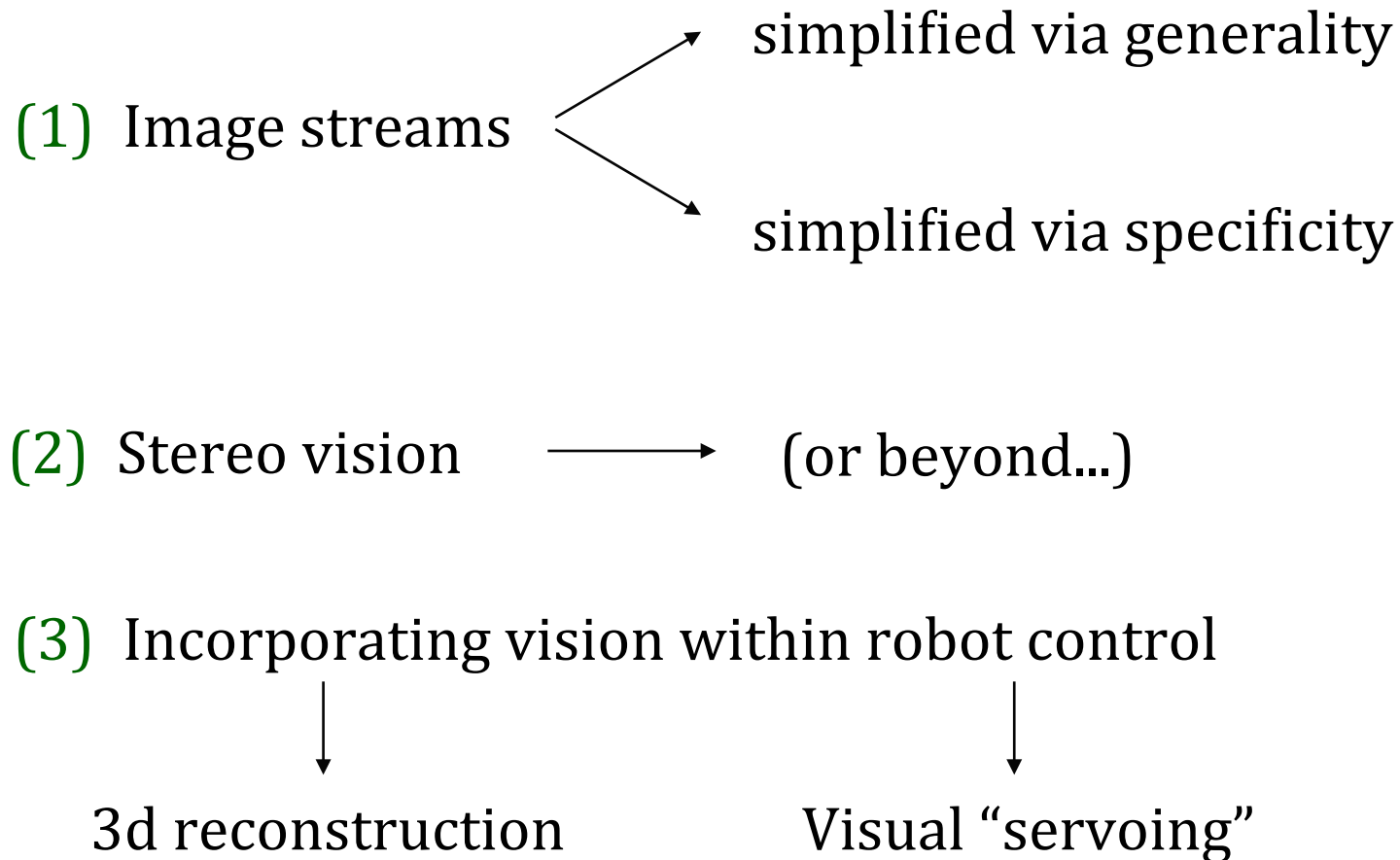
- Recognition:
 - What is that thing in the picture?
 - What are all the things in the image?
- Scene interpretation
 - Describe the image?
- Scene “reconstruction”:
 - What is the 3-dimensional layout of the scene?
 - What are the physical parameters that gave rise to the image?
 - What is a description of the scene?

Notion of an “inverse problem.”



Robot vision sampler

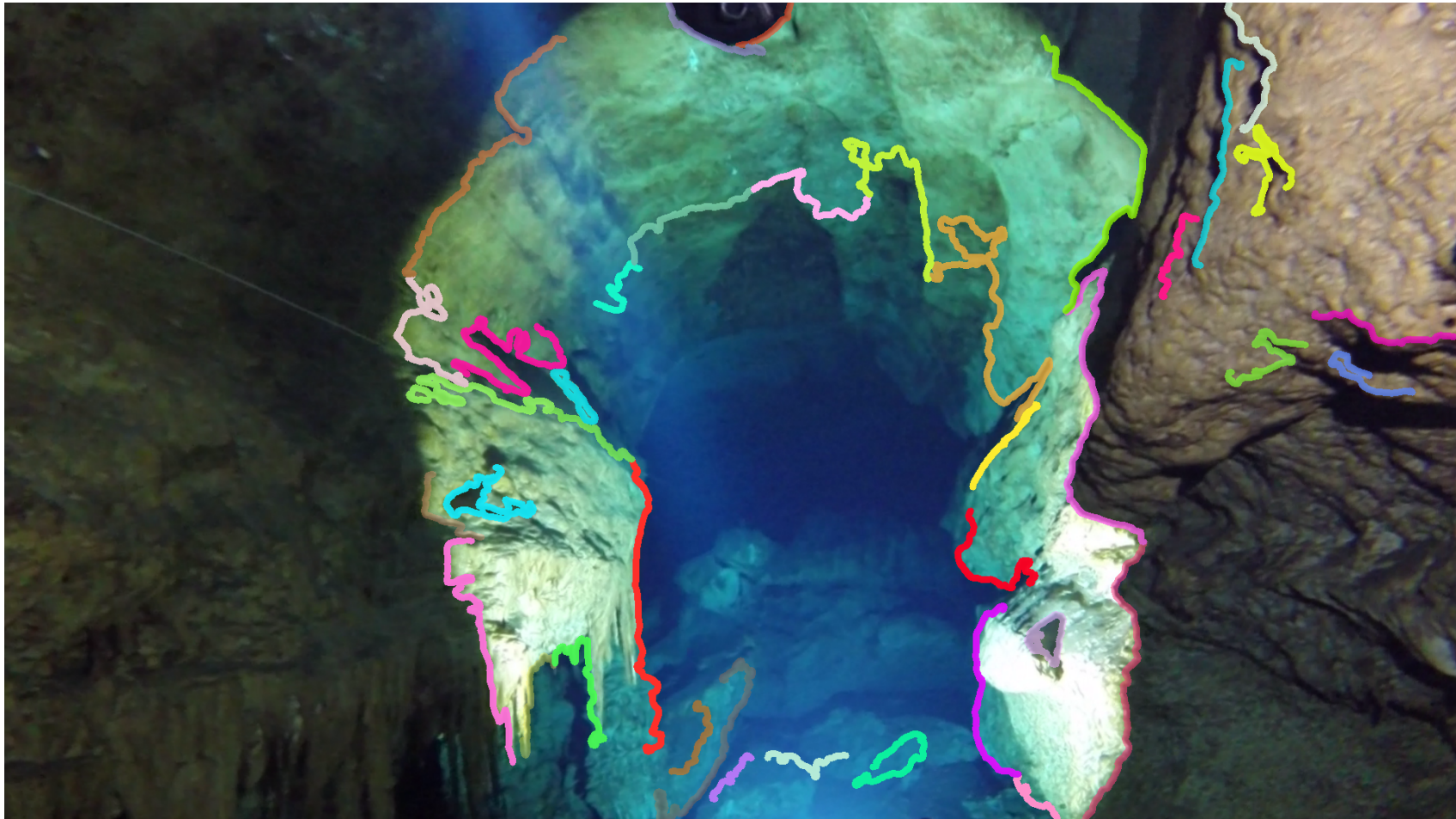
A brief overview of robotic vision processing...



Thresholded image



Edge detection



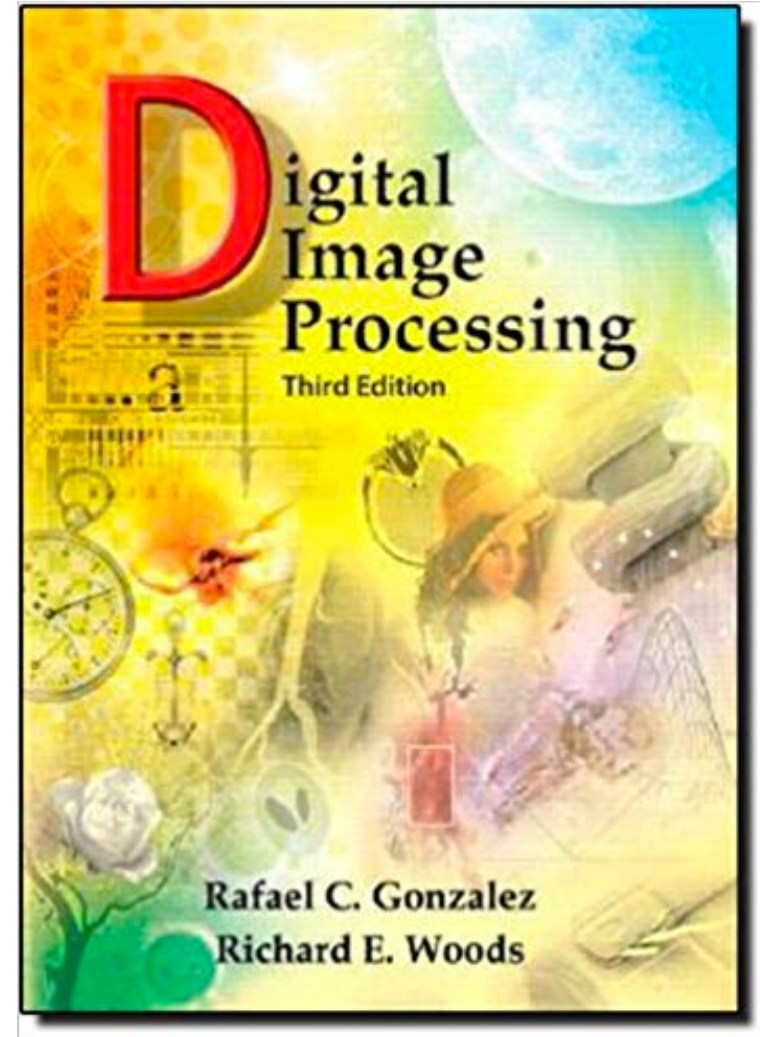
Tentative Schedule

	Monday	Tuesday	Wednesday	Thursday	Friday
Week 01	Introduction	Image Generation Perspective Transformation	Color Spaces	Image Formats, Compression	
Week 02	Statistics, Histogram, Thresholding	Single Image Operations	Holiday	Logical, Arithmetic Operations	A1
Week 03	Correlation	Segmentation	DeNoising	Review	
Week 04	Midterm	Convolution	Neurons and Convolutions	CNNs	A2
Week 05	Advanced Topics: Stereo	Advanced Topics: Flow	Advanced Topics: Motion	Advanced Topics: Shape from X	A3
Week 06	Features (Detection)	Features (Matching)	Open discussion	Review	A4



Textbook

Digital Image Processing
By R. C. Gonzalez and R. E. Woods
3rd edition



Evaluation

Schedule, deliverables, and evaluation:

<u>Component</u>	<u>Undergraduate</u>	<u>Graduate</u>
• Assignments (4)	12.5%	12.5%
• Graduate Assignments (4)	---	2.5%
• Midterm Exam	15%	10%
• Final Exam (standard time)	30%	25%
• <u>Class Participation</u>	<u>5%</u>	<u>5%</u>
• Total	100%	100%



Homeworks

- Using OpenCV
 - C++
 - Python
- Using MATLAB



Contact

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