CSE107
Fall 2022

Lecture 27

Assignments/Announcements

- HW 04 due Monday, Dec. 12 at 11:59pm.
  - NO LATE ASSIGNMENTS FOR HW 04 ACCEPTED.
  - NOT EVEN FOR 10% OFF.
  - If you submit HW 04 after 11:59pm on Monday, Dec. 12, you will get a score of zero.
- TAs will be in lab sections this week for first ~30-60 minutes to:
  - Answer questions about HW 04.
  - For you to pick up uncollected midterm exams.
- Final exam:
  - Wednesday, December 14 from 6:30-9:30pm
  - More details in next slides

Final Exam

- Final exam: Wednesday, Dec. 14, 6:30-9:30 pm in this room (SSB 160)
- The final exam will cover:
  - Material since the midterm exam (more on next slides) and histogram equalization.
  - Otherwise not comprehensive.
- The exam will be printed. You don't need to bring paper. Bring something to write with.
- You will have the full 3 hours but shouldn't need all of it.

Final Exam

- Open book and open notes.
- You can use your device (laptop, tablet) to view course material in electronic form:
  - PDF of the text.
  - Lecture slides and notes.
  - Your electronic notes.
  - Homeworks and their solutions.
- Similar format to midterm
  - T/F
  - Multiple choice
  - HW like questions

Midterm

- The midterm will cover histogram equalization and the material after midterm.
- Lectures 15-27
- HW 3-4
  - HW 3-4 solutions will be available at CatCourses: Files->Homeworks
- Text:
  - Third edition:
    - Chapter 3: sections 3.3 through 3.6
    - Chapter 10: except section 10.6
    - Chapter 6: through section 6.2
  - Third edition:
    - Chapter 3: sections 3.3 through 3.76
    - Chapter 10: except sections 10.5, 10.6, and 10.8
    - Chapter 7: through section 7.2

Final Exam

- Before midterm: histogram equalization (section 3.3 both textbook editions)
- Since midterm:
  - Spatial filtering (section 3.4 both editions)
  - Smoothing spatial filters (section 3.5 both editions)
    - Linear
    - Non-linear (ex: median)
  - Sharpening spatial filters (section 3.6 both editions)
    - Laplacian
    - Gradient

Final Exam

- Since midterm:
  - Edge detection (section 10.2 both editions)
    - Thresholding the gradient magnitude
    - Canny edge detector
    - Hough transform
  - Region-based segmentation (section 10.4 both editions)
    - Region splitting and merging
  - Segmentation using morphological watersheds (section 10.5 in 3rd edition and section 10.7 in 4th edition)

Final Exam

- Since midterm:
  - Color Image Processing:
    - Material covered in lectures 26 and 27.
    - Final exam questions will be T/F or multiple choice only for this material.

Questions?

Today

- Chap. 6/7: Color Image Processing

Pseudocolor Image Processing

- Pseudocolor image processing consists of assigning colors to gray values based on a specified criterion.
- Also referred to as *false color* images.
- Typically used to facilitate visualization.

Pseudocolor Image Processing

- Intensity slicing:
  - Image considered as 3-D function.
  - Place planes parallel to coordinate plane of image.
  - These planes slices the 3-D function and different colors are assigned to each side of the planes.

Pseudocolor Image Processing

- Intensity slicing: geometric interpretation

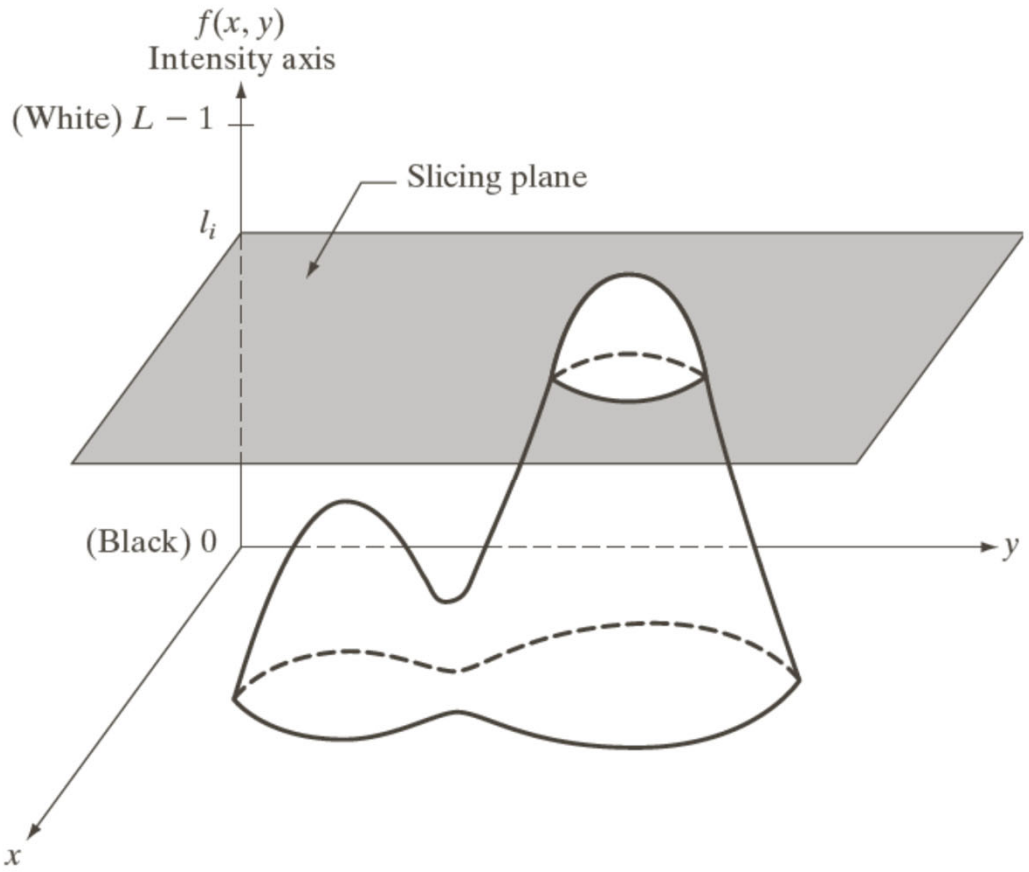
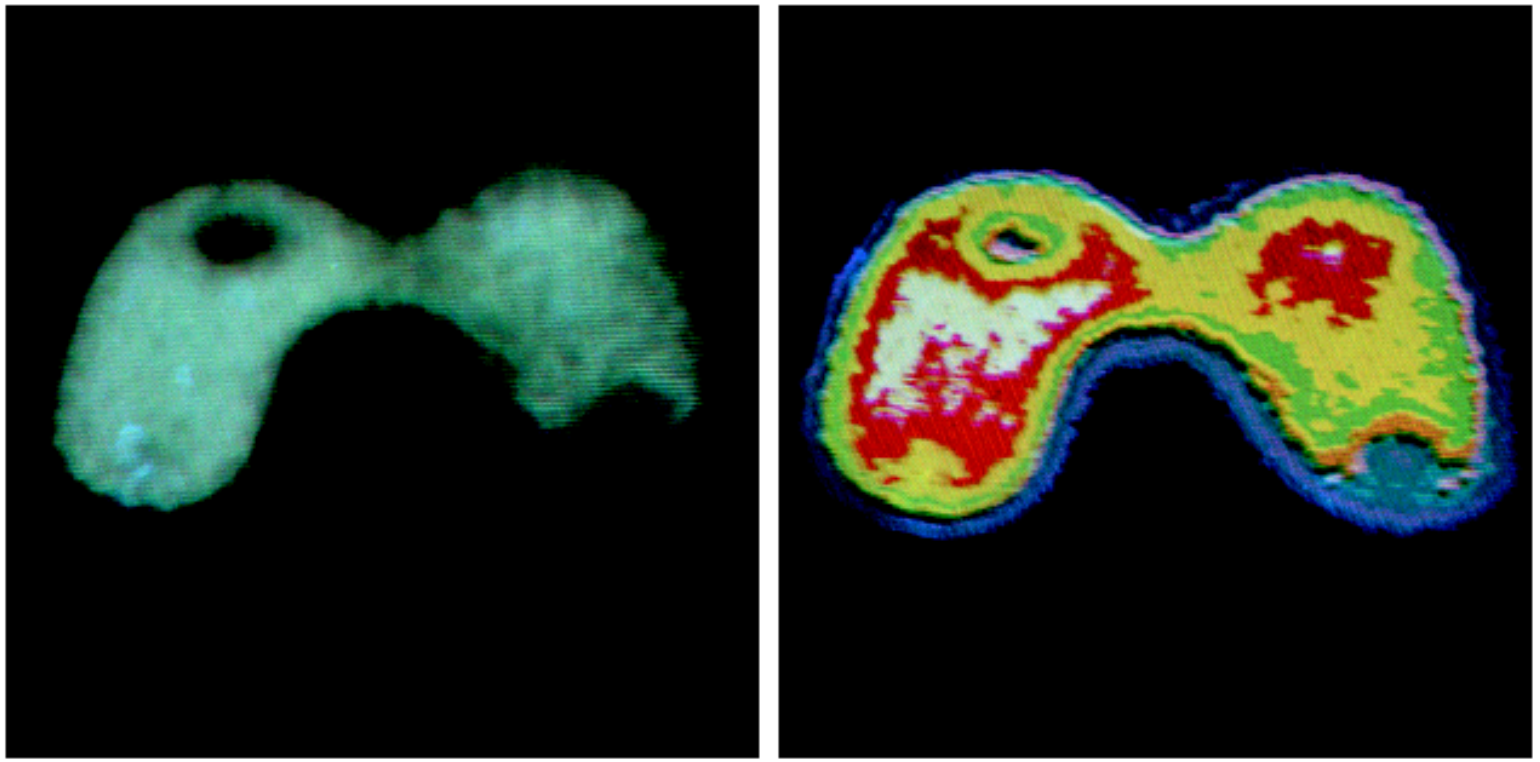


FIGURE 6.18
Geometric interpretation of the intensity-slicing technique.

Pseudocolor Image Processing

- Intensity slicing: example

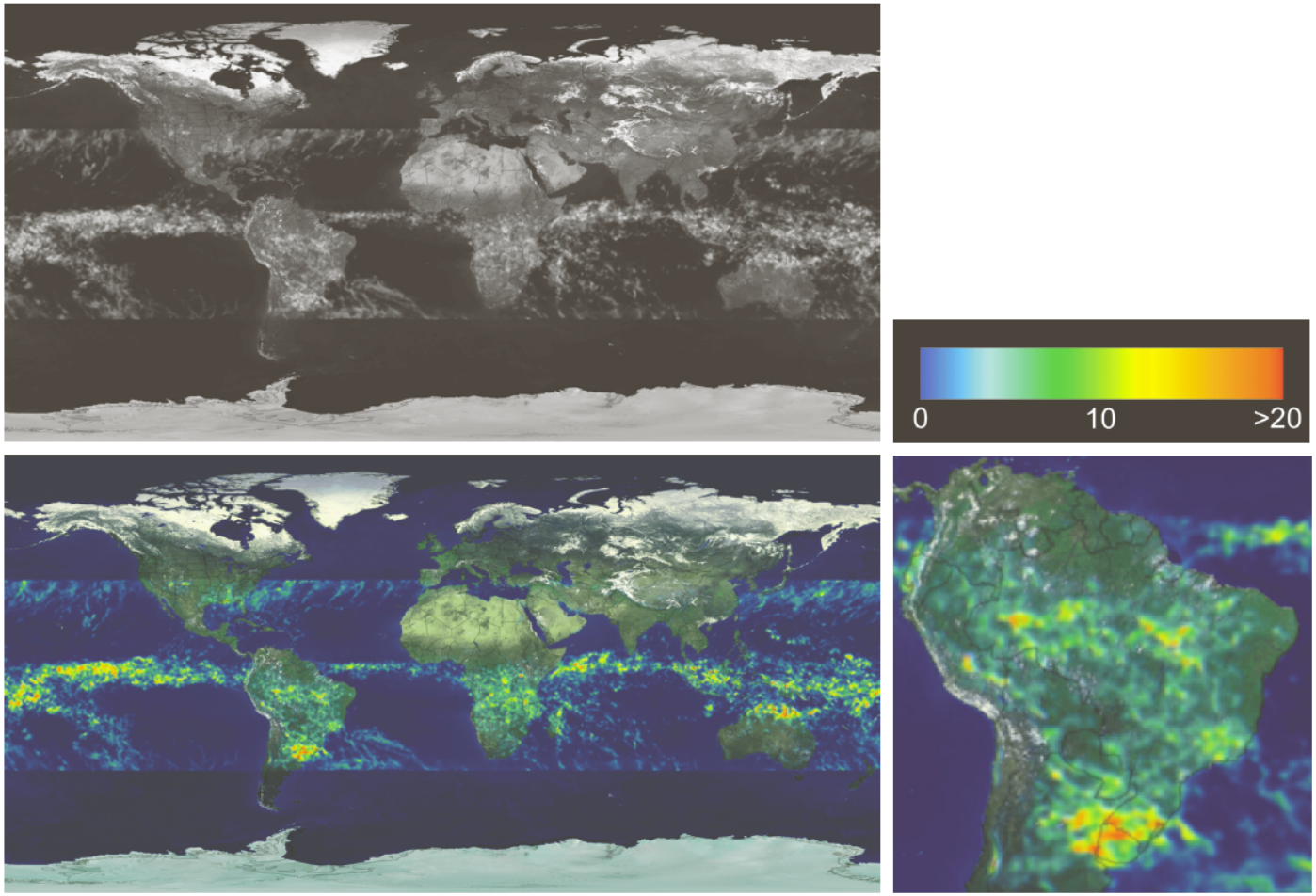


a b

FIGURE 6.20 (a) Monochrome image of the Picker Thyroid Phantom. (b) Result of density slicing into eight colors. (Courtesy of Dr. J. L. Blankenship, Instrumentation and Controls Division, Oak Ridge National Laboratory.)

Pseudocolor Image Processing

- Intensity slicing: example



a b
c d

FIGURE 6.22 (a) Gray-scale image in which intensity (in the lighter horizontal band shown) corresponds to average monthly rainfall. (b) Colors assigned to intensity values. (c) Color-coded image. (d) Zoom of the South American region. (Courtesy of NASA.)

Pseudocolor Image Processing

- Combining multiple single-channel (grayscale) images into a single color image for visualization:

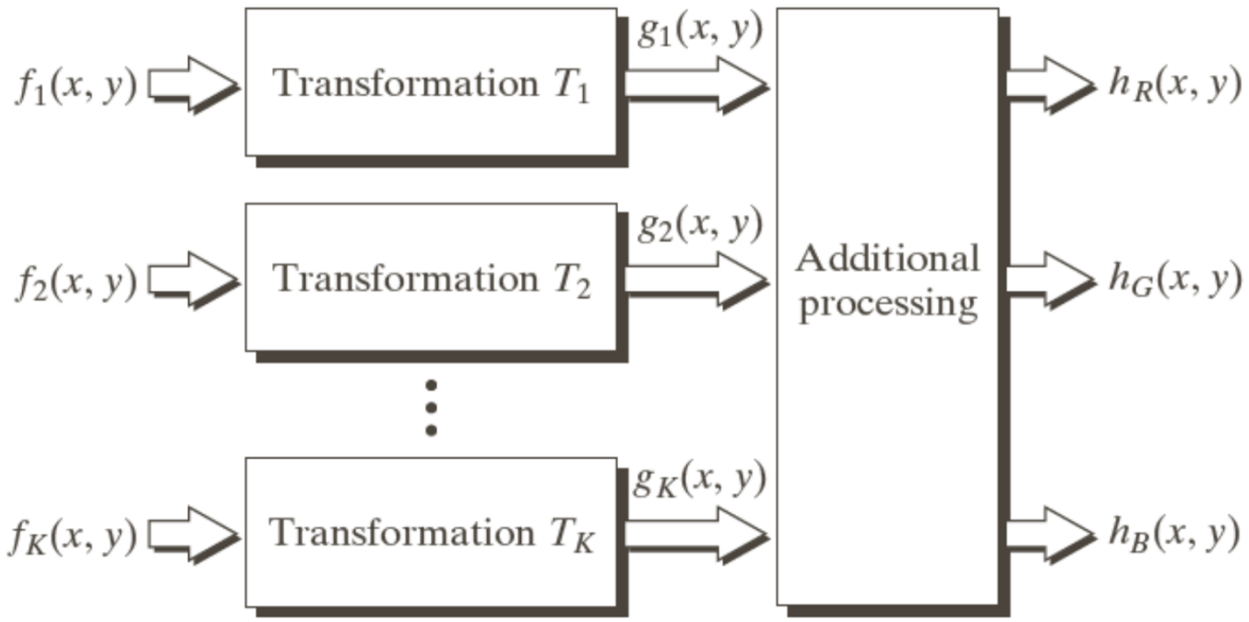


FIGURE 6.26 A pseudocolor coding approach used when several monochrome images are available.

Pseudocolor Image Processing

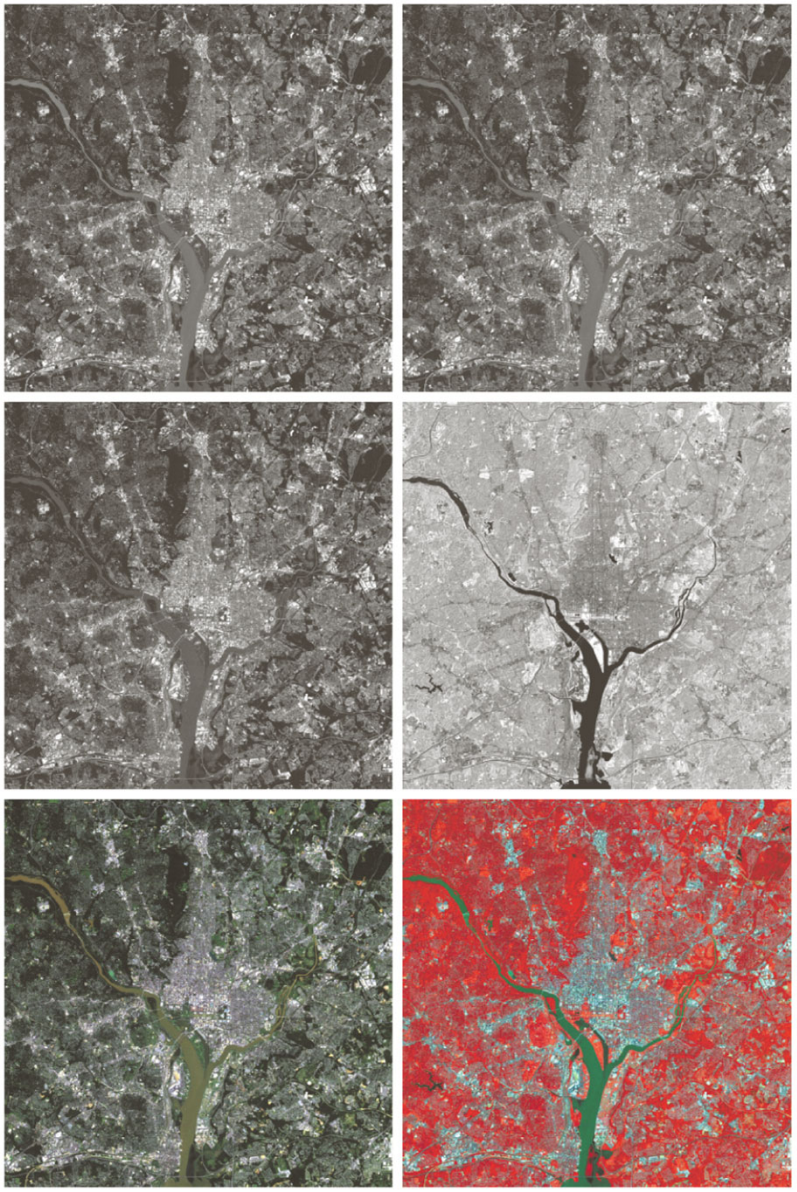
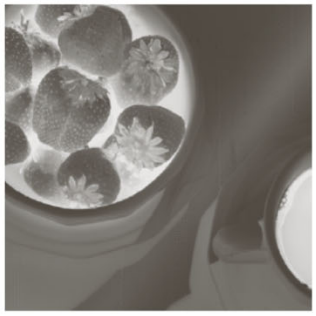


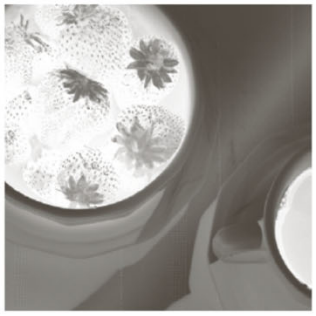
FIGURE 6.27 (a)–(d) Images in bands 1–4 in Fig. 1.10 (see Table 1.1). (e) Color composite image obtained by treating (a), (b), and (c) as the red, green, blue components of an RGB image. (f) Image obtained in the same manner, but using in the red channel the near-infrared image in (d). (Original multispectral images courtesy of NASA.)

a b
c d
e f

Full color

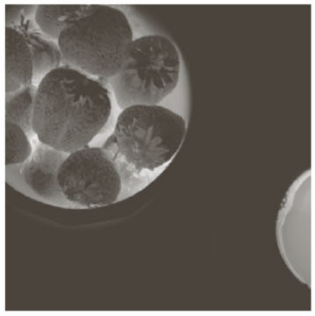


Cyan



Magenta

Yellow



Black

Red

Green

Blue

Hue

Saturation

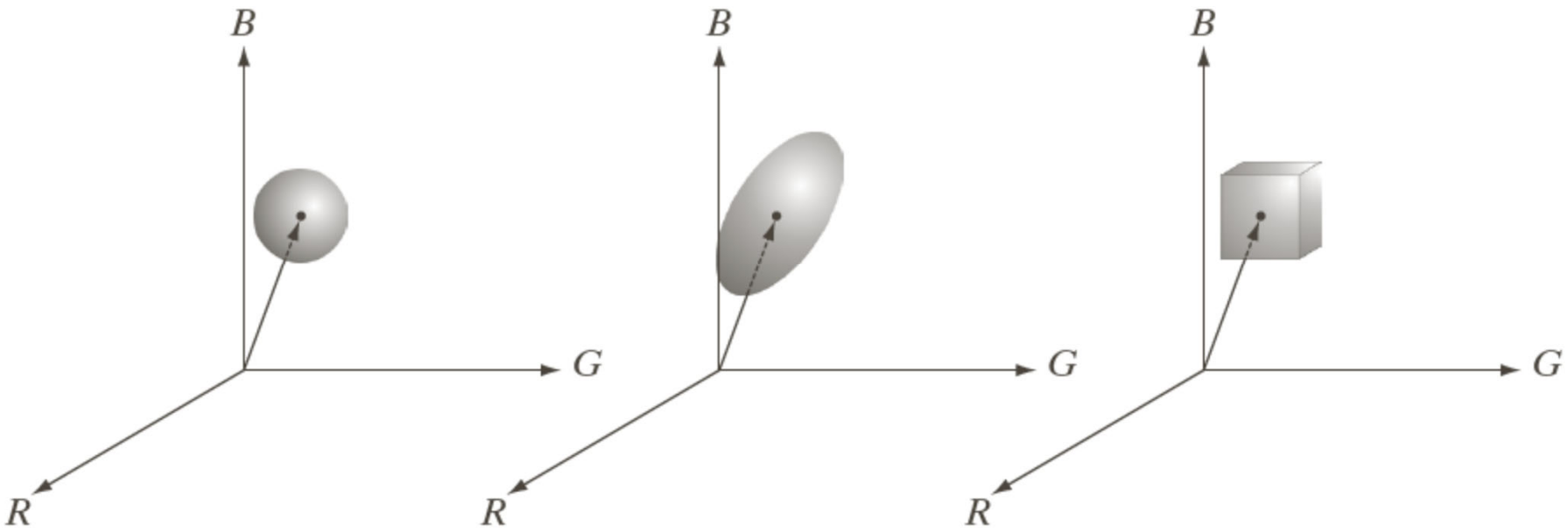
Intensity

FIGURE 6.30 A full-color image and its various color-space components.

Color Slicing

- Recall intensity level thresholding for grayscale images.
- What would equivalent transformation be in color images?

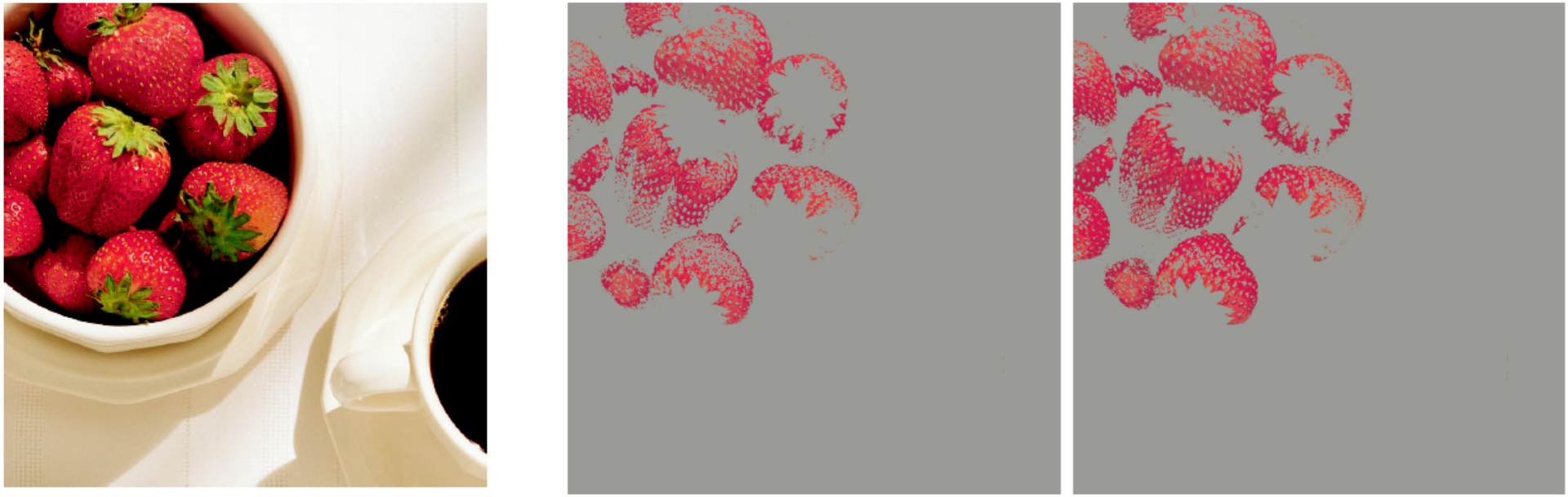
Image Segmentation Based on Color



a b c

FIGURE 6.43
Three approaches for enclosing data regions for RGB vector segmentation.

Color Slicing



a b

FIGURE 6.34 Color-slicing transformations that detect (a) reds within an RGB cube of width $W = 0.2549$ centered at (0.6863, 0.1608, 0.1922), and (b) reds within an RGB sphere of radius 0.1765 centered at the same point. Pixels outside the cube and sphere were replaced by color (0.5, 0.5, 0.5).

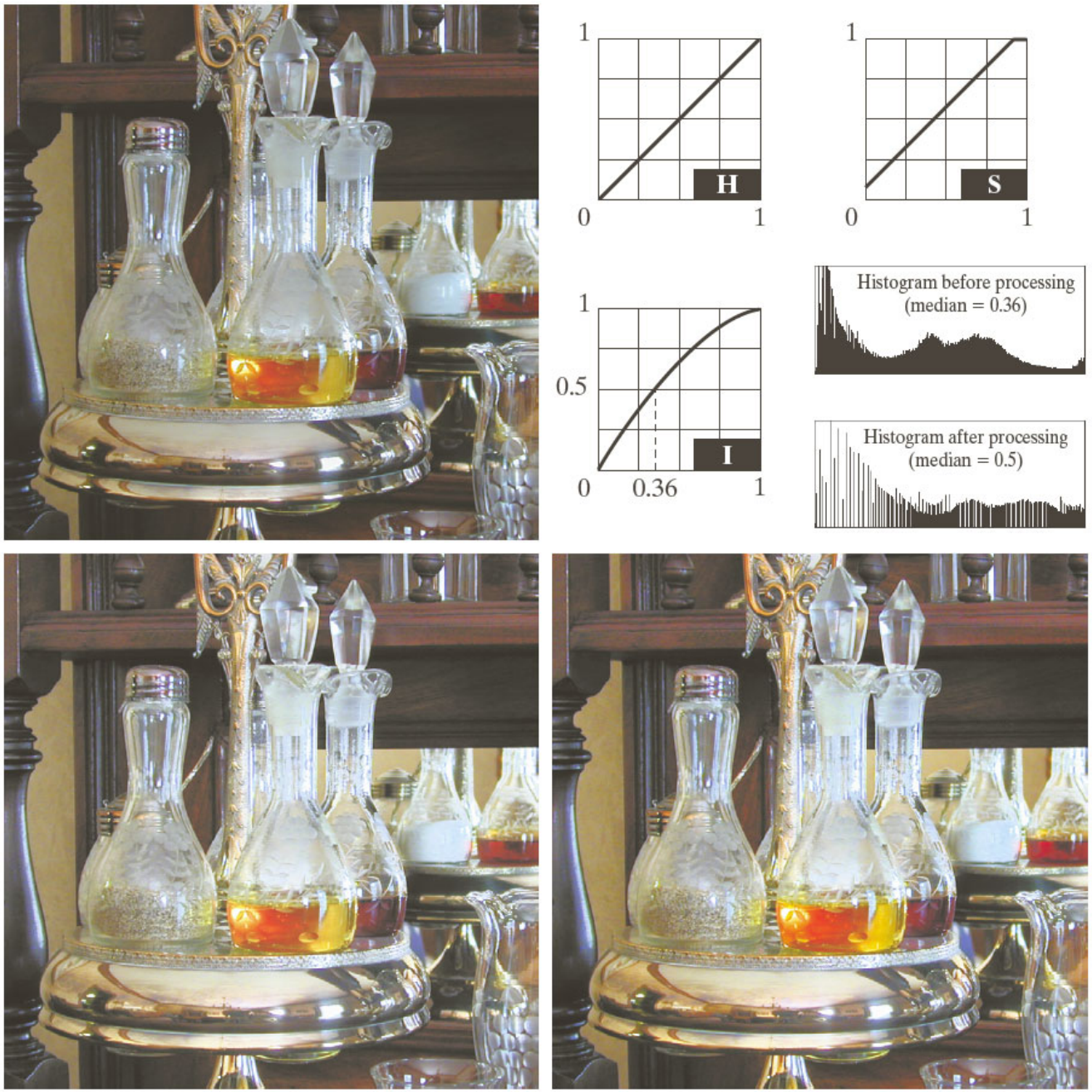
Histogram Equalization of Color Images

- Extending histogram equalization to color images:
  - Naïve approach: apply equalization to R,G,B channels independently.
  - Is this a reasonable approach?

Histogram Equalization of Color Images

- Extending histogram equalization to color images:
  - Better approach is to apply in HSI colorspace and then only to intensity (and possibly saturation).

Histogram Equalization of Color Images



a b
c d

FIGURE 6.37 Histogram equalization (followed by saturation adjustment) in the HSI color space.

Color Image Smoothing and Sharpening

- For similar reasons, typically better to apply image smoothing and sharpening in HSI colorspace to intensity image.

Color Image Smoothing and Sharpening

- Image smoothing in RGB vs. HSI colorspaces:

a b c

FIGURE 6.40 Image smoothing with a 5×5 averaging mask. (a) Result of processing each RGB component image. (b) Result of processing the intensity component of the HSI image and converting to RGB. (c) Difference between the two results.

Color Image Smoothing and Sharpening

- Image sharpening in RGB vs. HSI colorspaces:

a b c

FIGURE 6.41 Image sharpening with the Laplacian. (a) Result of processing each RGB channel. (b) Result of processing the HSI intensity component and converting to RGB. (c) Difference between the two results.