6.3 Pseudocolour image processing

Assign colours to gray values based on specified criterion
Use: human visualization / interpretation of gray-scale events

6.3.1 Intensity Slicing

View image as 3D function and place planes parallel to coordinate plane; each plane slices the function in area of intersection
E.g., plane at $f(x,y) = l_i \Rightarrow$ 2 levels $\Rightarrow$ 2 different colours

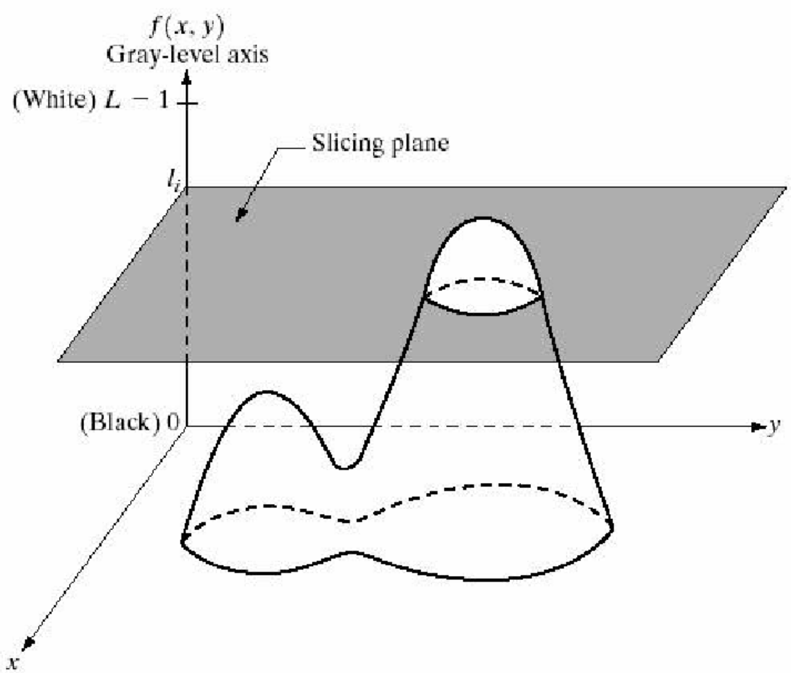


FIGURE 6.18 Geometric interpretation of the intensity-slicing technique.

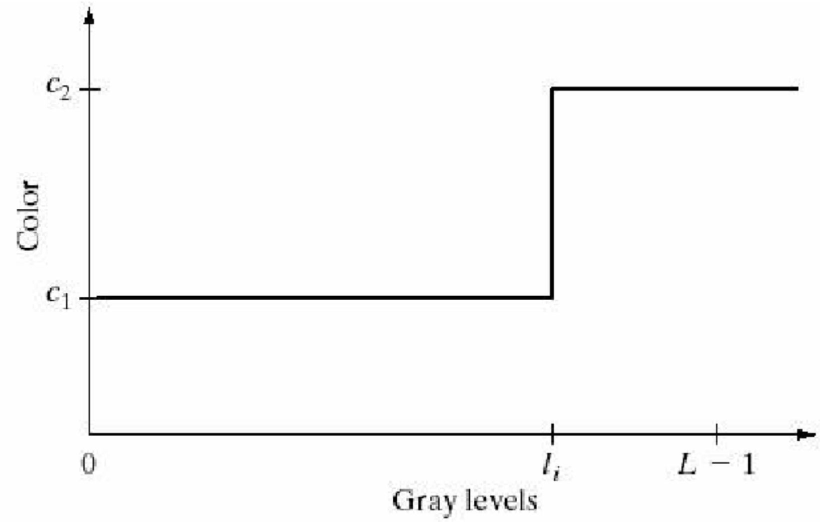


FIGURE 6.19 An alternative representation of the intensity-slicing technique.

In general:

Gray scale: $[0, L-1]$

Black $[f(x,y)=0]$**: level** l_0**; White** $[f(x,y)=L-1]$**:** l_{L-1}

Suppose P **planes perp. to intensity axis: levels** $l_1, l_2, \ldots, l_P$

Planes partition gray scale into $P+1$ **intervals** $V_1, V_2, \ldots, V_{P+1}$

Colour assignment: $f(x,y) = c_k$ **if** $f(x,y) \in V_k$

Example 6.3: Intensity slicing (human chest)

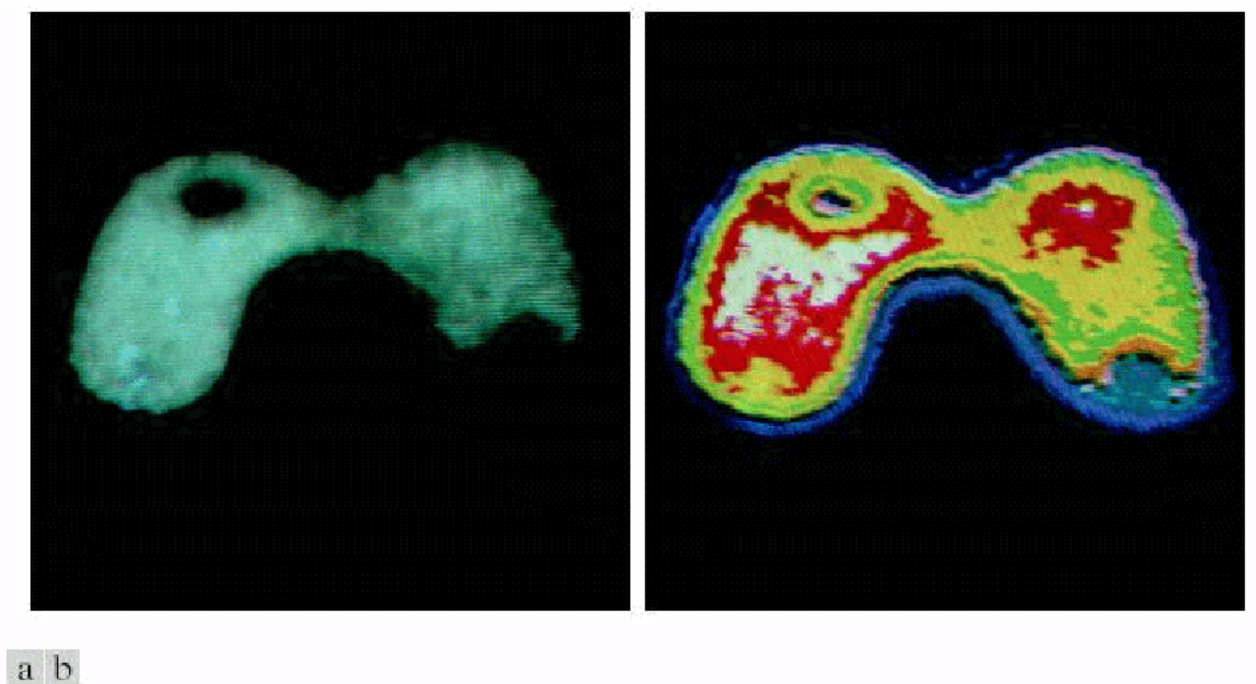
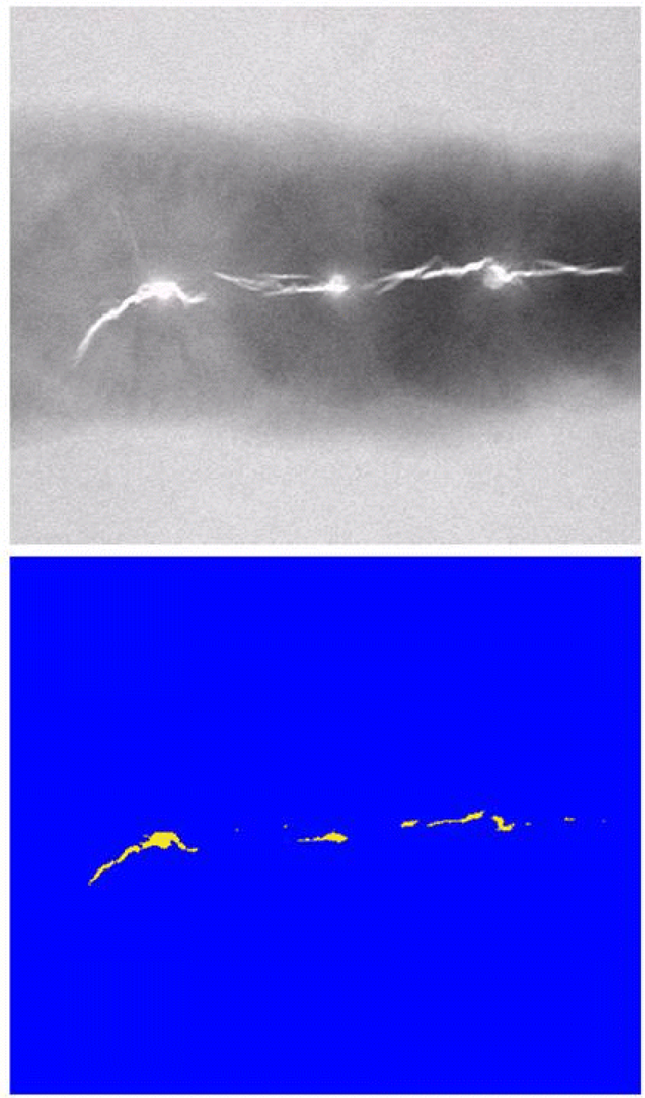


FIGURE 6.20 (a) Monochrome image of the Picker Thyroid Phantom. (b) Result of density slicing into eight colors. (Courtesy of Dr. J. L. Blankenship, Instrumentation and Controls Division, Oak Ridge National Laboratory.)

Regions that appear of constant intensity in the monochrome image are actually quite variable!

Here the gray scale was divided into intervals, without regard of the meaning of the gray levels

Another example: X-ray image of weld



a
b

FIGURE 6.21 (a) Monochrome X-ray image of a weld. (b) Result of color coding. (Original image courtesy of X-TEK Systems, Ltd.)

Example 6.4: Use of colour to highlight rainfall levels

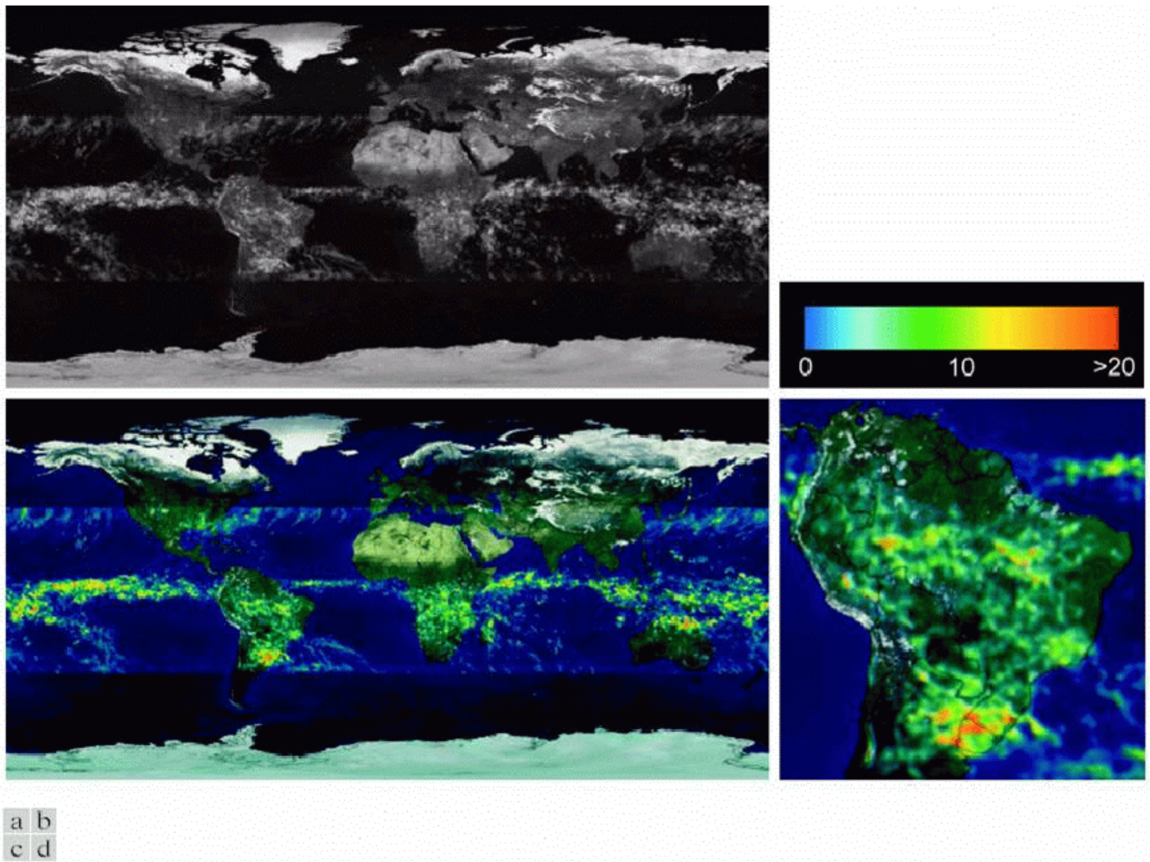


FIGURE 6.22 (a) Gray-scale image in which intensity (in the lighter horizontal band shown) corresponds to average monthly rainfall. (b) Colors assigned to intensity values. (c) Color-coded image. (d) Zoom of the South America region. (Courtesy of NASA.)

Tropical rainfall measuring mission (TRMM): a satellite uses a precipitation radar, a microwave imager, and a visible and infrared scanner to detect rain (also over ocean)

6.3.2 Gray level to colour transformations

Perform three independent transformations on gray level of input pixel

Three results are fed separately into R, G and B channels of colour TV monitor $\Rightarrow$ composite image whose colour content is modulated by nature of transformation functions

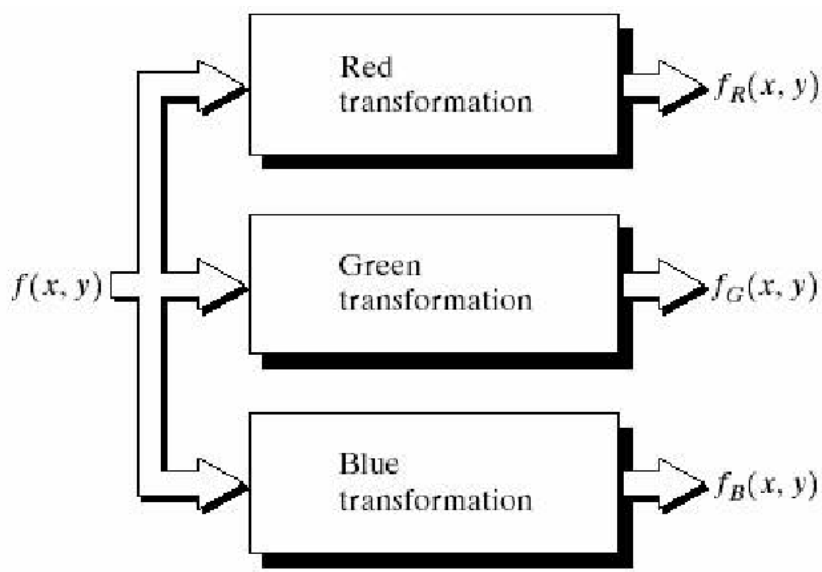


FIGURE 6.23 Functional block diagram for pseudocolor image processing. f_R, f_G, and f_B are fed into the corresponding red, green, and blue inputs of an RGB color monitor.

Example 6.5: Use of pseudocolour for highlighting explosives contained in luggage

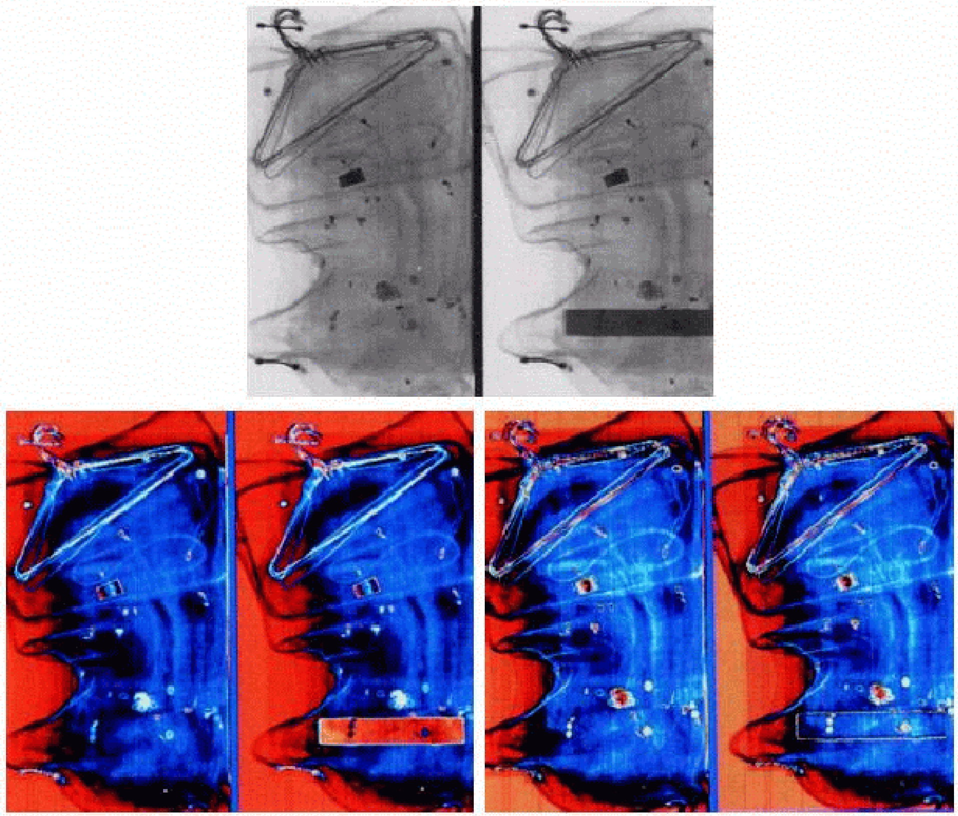


FIGURE 6.24 Pseudocolor enhancement by using the gray-level to color transformations in Fig. 6.25. (Original image courtesy of Dr. Mike Hurwitz, Westinghouse.)

Transformation functions for Example 6.5...

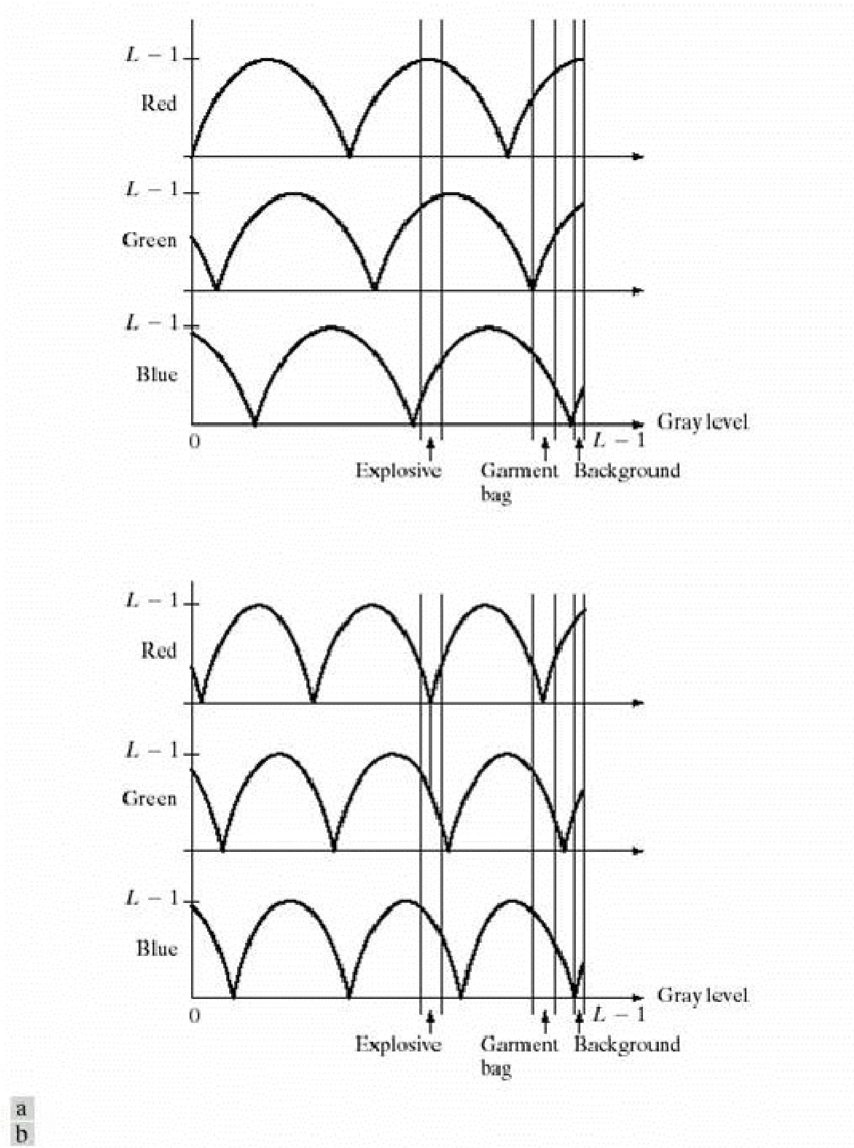
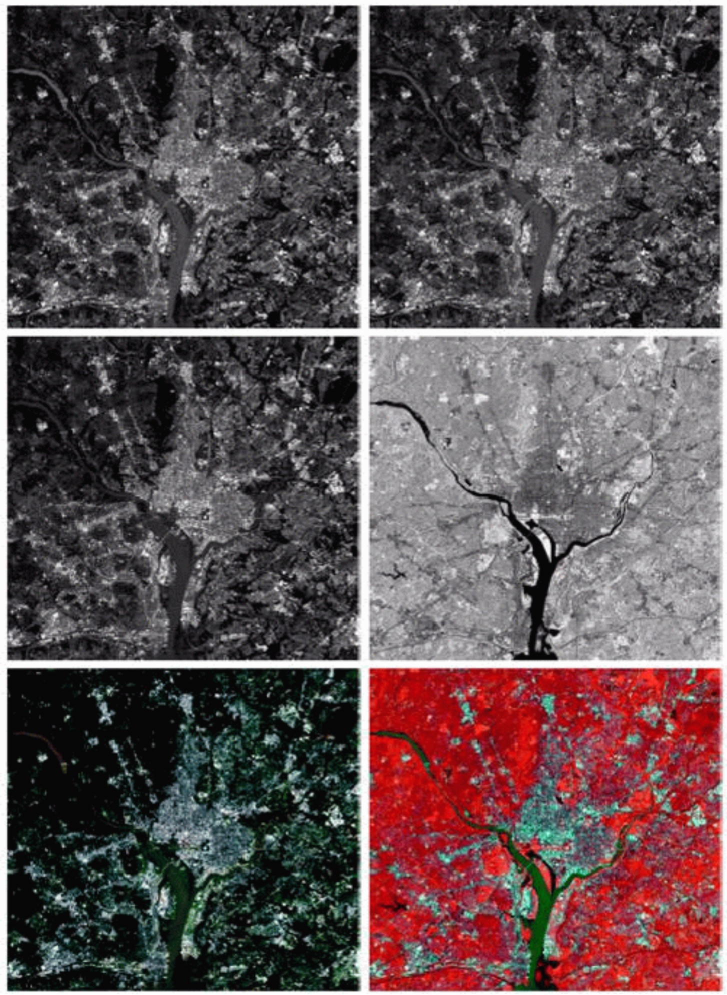


FIGURE 6.25 Transformation functions used to obtain the images in Fig. 6.24.

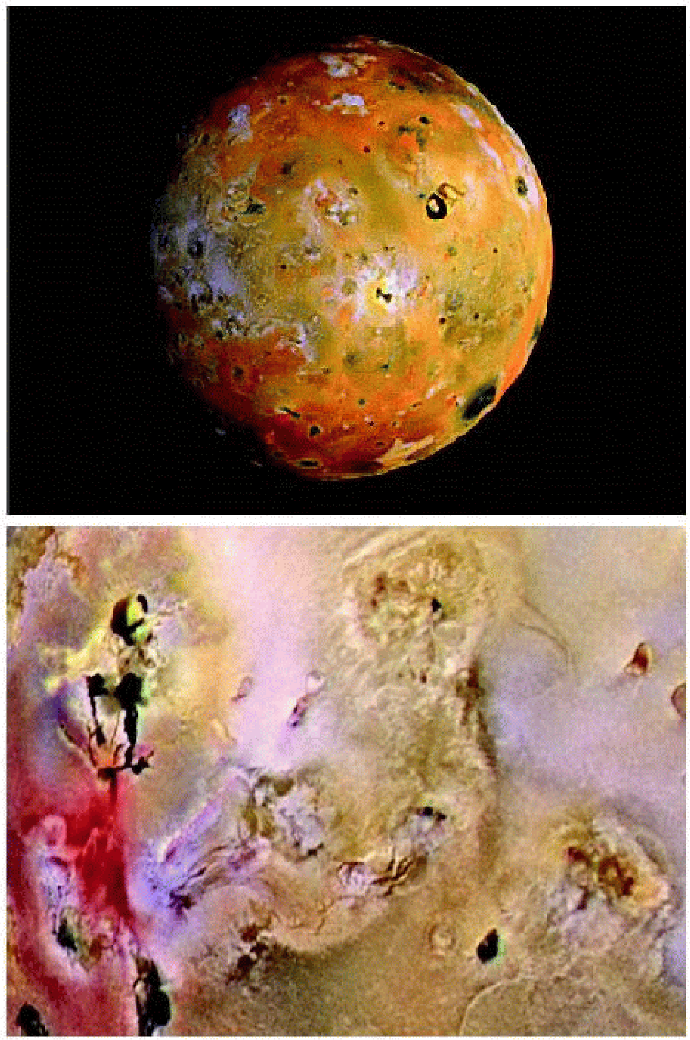
Example 6.6: Colour coding of multispectral images



a b
c d
e f

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.)

Example 6.6: Colour coding of multispectral images...



a
b

FIGURE 6.28 (a) Pseudocolor rendition of Jupiter Moon Io. (b) A close-up. (Courtesy of NASA.)

Several sensor images from the Galileo spacecraft (some in a spectral region not visible to human eye) were combined