About the Cover

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Research in night sky luminosity is aimed at exploring the effect of scattered moonlight on faint objects such as might be recorded on an astronomer's film plates. The photograph on the cover, showing the moon above the Elsinore mountains in California, features pseudocolor bands representing contours of equal luminosity. Selected more for its dramatic—almost impressionistic—visual effect than for the technical virtuosity of the digital picture process whereby it was created, the image is the result of a simple assignment of color to specific digital values for the brightness.

Tri-X film processed to an ASA rating of 800 produced the required sky gradients with an exposure time of 120 seconds at f/5.6. The effective field of view was 46x65 degrees. Photographic images representing four lunar phases at several altitudes were evaluated by The Aerospace

Figure 1. Original black and white photo from which cover image was derived. Dotted lines delineate the actual portion of the scene shown on the cover.

Figure 2. The generation of digital images.

Figure 3. Binary image of sky luminosity in the vicinity of the moon. Numbered contours indicate the following brightness values (in footlamberts): (1) $4.53 \times 10^{-3}$, (2) $3.13 \times 10^{-3}$, (3) $2.38 \times 10^{-3}$, and (4) $1.80 \times 10^{-3}$. 
Corporation's Digital Image Processing Laboratory for determination of constant luminosity contours. Each image was scanned by a microdensitometer using a 50-micrometer-square aperture and converted into a digital 512x512 pixel format. Figure 1 shows the original black and white photo from which the cover was derived. The sky appeared clear when this photo was taken, but the long exposure recorded the considerable scatter of the moonlight from aerosols and the effect of an aircraft vapor trail about 1 hour old.

Digital images like those shown on the cover and on the color plates at right are produced by a series of steps (see Figure 2), each of which contributes uniquely to the end result: First of all the sky with its variations in radiance is recorded by the camera on film. The camera introduces its own effects on the quality of the quantified data. Some of these effects, such as lens transmission, off-axis fall-off, and flare, can be either measured or estimated with reasonable accuracy; others may be ignored. Finally, the film adds its unique characteristics to the overall data reduction process—definition, graininess, resolving power, and film speed. Fortunately, these parameters can be calibrated through the use of a reference image, such as grey-wedge—a strip of film on which a series of known light levels are recorded.

The microdensitometer introduces aperture effects and system anomalies, e.g., light source fluctuation, photomultiplier tube nonlinearity, and analog-to-digital converter nonlinearity. Every effort is made to operate the microdensitometer in its known linear region to reduce its effect on the overall data analysis. The output of the computer is a digital representation of each pixel corresponding to its density level on the original film. A given digital count may be displayed as a representative value of sky luminosity shaped into contours as shown in Figure 3.

Although by no means representing a sophisticated application of digital image processing, such experiments contribute significantly to the quality of astronomical data.

J. A. Rowe, a member of the technical staff of the Aerospace Optical Systems Department, Electronics and Optics Division, is particularly interested in finding new ways of using computer graphics to illustrate optical systems engineering studies. His activities have included research into the application of military systems to civilian needs and in the performance evaluation of a variety of optical systems.

Each illustration below and at right shows the effects of haze as seen by the camera, not the human eye, when the moon's phase, altitude, and camera exposure were maintained constant. The contours representing lines of equal luminosity usually expand outward in azimuth from the moon except when unusual aerosol conditions occur—at which time they can become intermingled. These photographs were produced by assigning colors to specific brightness levels, a process known as "pseudocolor."