A New Moon: Improved Lunar Orbiter Mosaics. Charles J. Byrne, Image Again, Middletown, New Jersey; cjbyrne@monmouth.com.

Introduction: Photographs of the five Lunar Orbiter missions in 1965 and 1966 provide comprehensive coverage of the moon at resolutions in the range of about 1 meter to 300 meters. With a few exceptions, they are taken at a moderately low sun angle to clearly show the topography. These photos, especially the set edited by Bowker and Hughes [1], are still in active use in books, papers, and slide presentations and they are likely to be used in planning the missions of future lunar spacecraft. Scanning artifacts (sometimes called the “venetian blind effect”) detract from the visual quality of the photographs, particularly when they are printed at high contrast to show albedo variations such as rays or subtle topology features such as the margins of lava flows. The author has written a program [2] to estimate and remove the artifacts from the pictures, greatly improving their cosmetic quality. The program detects lines between framelets of a mosaic, removes the lines caused by light leaking between framelets, estimates the systematic streaks caused by cathode ray tube scanning in the spacecraft and the Ground Reconstruction Equipment, and compensates for these streaks. Non-linearity introduced by contrast enhancement in the production of the input photos is considered in the compensation process. A comparison of a mosaic before and after processing is shown in Figure 1. Further information on the process is provided in Reference [2].

Figure 1: Lunar Orbiter subframe LO4-140H3 before and after processing.

Status of Processing: Currently, the photos being processed are selected from those of Bowker and Hughes [1]. The photos were digitized by staff of the Lunar and Planetary Institute with consultation and further processing by Jeff Gillis [3]. The processed photos from Lunar Orbiter missions 1, 2, 3, and 5 have been provided to LPI for use in an annotated atlas, for release on electronic media. In the majority of cases, the images are strongly improved by processing.

Process Improvements: Experience in processing the pictures has led to improvements in the program and its operation. Some of these improvements increase the likelihood of successfully finding framelet edges, while others compensate for secondary artifacts; those that are only seen clearly after the primary artifacts are removed. For example, a feature has been added to compensate for an alternating pattern of darker and lighter framelets in some of the images. A spectral analysis program has been written to compare the spectra of the input and output images to provide a quantitative measure of improvement. Figure 2 shows the fine-scale normalized vertical spectral density of LO4-140H3 before and after processing.

Figure 2: Spectral density of LO4-140H3 for periods near the framelet width (about 40 Pixels).

Future Plans: The author plans to complete the processing of digitized Lunar Orbiter 4 photographs. These photos form an extensive and orderly survey, primarily of the near side of the moon. Initial experiments indicate that the relative uniformity of the processed images can be used to produce larger mosaics of good quality.