STATUS OF THE DIGITIZATION OF LUNAR ORBITER IMAGES FROM ORIGINAL MASTER TAPES. D. R. Wingo[1] and A. E. Epps[2], [1]Skycorp Incorporated P.O. Box 596, NASA Ames Research Park, Moffett Field, CA 94035 wingod@skycorpinc.com, [2]Ibid, Austin.epps@gmail.com

Introduction: The Lunar Orbiter Image Recovery Project (LOIRP), supported by the NASA Lunar Science Institute and funded by NASA headquarters, was founded in 2008 to attempt the recovery of images from the original magnetic tapes recorded during the five Lunar Orbiter missions in 1966-67.

The LOIRP project has successfully captured approximately 40% of the images from the five lunar orbiters with great improvements in the dynamic range of the images. Hundreds of images have now be reproduced and are being prepared for submittal to the Planetary Data System.

Background: In 1966 and 1967 NASA sent five Lunar Orbiters to the Moon to provide photo-reconissance of potential landing sites for the Apollo program. The first three lunar orbiters were dedicated to this task and produced images of approximately 1 meter for high resolution images (HR frames), and 5-8 meters for medium resolution (MR frames) for the near side equatorial regions of the Moon and 30-50 meters on the far side.[1]

The driving requirement was to determine the nature of the lunar surface at the meter scale in order to determine the suitability of a particular surface for the landing of the Apollo Lunar Module. Master video tapes were made of the images for the purpose of computer digitization and processing to determine the maximum hight of obstructions such as rocks and craters that fed into a risk analysis for site selection. The Lunar Orbiter images were used to select the landing sites for Apollo 11, 12, and 14.

In parallel with the video tape archive a 35 mm film record was made using Ground Reconstruction Equipment (GRE). The film of the individual framelets (a single strip of scanned film) was recorded from a high persistence video monitor. These framelets were assembled into groups, filmed again, and then used to make positive photographic prints. The archive at the Lunar Planetary Laboratory and at the U.S. Geological Service in Flagstaff are both based on these film records.

LOIRP Project: In 2007 former NASA JPL employee Nancy Evans donated Ampex FR-900 drives to Skycorp and Spaceref Interactive for the purpose of working to recover images from the 2" instrumentation video tapes used to record and archive the Lunar Orbiter images during the mission. There were three questions that had to be answered before NASA would fund the recovery effort.

(1) *Can a forty plus year old tape drive be reactivated?* With initial funding from NASA headquarters we were able to get two of the remaining four FR-900 tape drives operational.

(2) *Are the archived Lunar Orbiter Tapes viable*? We were able to digitize, restore, and validate that we could recover images (starting with LO-1-102H the "Earthrise" image and then proceeding with LO-II-162H "Image of the Century", the oblique view of Copernicus

(3) *Is the quality of the captured images superior to what is already available in the existing archives?* We have been able to show the projected 4x increase in dynamic range that the original 70 mm spacecraft film provided. The increase is due to the limitations of the film based system used to capture the images in parallel with the magnetic tape.

Status of Capture: Our focus has principally been on recovering images from LOII and LOIII as they have the highest resolution images in the near side equatorial regions and thus are most compatible scientifically with the current Lunar Reconissance Orbiter LROC camera images. This provides a direct 1 to 1 comparison in resolution and dynamic range for scientific studes for changes in the lunar surface since the Lunar Orbiter missions.

Our statistics as of this date are:

LOII		
Framelets Captured	Total	12,170
Madrid		1,050
Woomera		10,100
Goldstone		1,020
Total number of framelets needed to complete all frames		26,219
Total unique framelets captured		9,833
Percentage Captured		37.5%
LOIII		
Framelets Captured	Total	21,633
Madrid		9,390
Woomera		7,203
Goldstone		5,040
Total number of framelets needed to complete all frames		18,400
Total unique framelets captured		16,934
Percentage Captured		92.0%

We have also captured framelets from Lunar Orbiter's 1,IV, and V, but less than 10% from those missions.

We have recovered literally hundreds of historic images, including the landing sites of Apollo 11, 12, and 14 before the landing. Our increase in dynamic range is allowing for a detailed examination of the pre and post mission state of the sites. We have been able to match resolution and geographic coordinates to the latest LRO images for studies of cratering rates on the Moon in the intervening 46 years. We are preparing large format mosaics of the Copernicus crater, photographed at ~2 meter resolution over 65% of its area by Lunar Orbiter V.

Our work has shown the improvements that come with the ability to go back to the original pristine raw data sets, something that has been extremely difficult to do with other Apollo era data sets and shows the value of retaining raw data for future eras when processing methods and computer power availability can bring forth new science not thought of by original researchers.

[1] Hansen T.P. (1970) *Guide to Lunar Orbiter Photographs, NASA Langley Research Center*