SPARC Project Report

Project Name: Modeling Long-Term Water Management Strategies on the Irrigated Plain of Miān-āb, in the Khuzistan Province of Iran.

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I.   Summary of work undertaken in collaboration with SPARC

Since the second half of the twentieth century, air and space-born stereo imaging has been systematically used for the creation of the topographic maps. Originally, stereo images were processed by human and the maps were created manually. Nowadays, modern photogrammetric software imitate this process and create high resolution 3D models of the terrain. Photogrammetric software may also be used to create 3D models from historic stereo images. The advantages of the historic imagery in preserving evidence of a landscape that, in most cases, is destroyed or dramatically altered was discussed. The result is called a historic DEM, meaning that the terrain model corresponds to the landscape at the time of the imaging.

My SPARC project was part of my dissertation research that aims at understanding the long-term history of water management on the irrigated landscape of Miāynāb, in the Khuzistan province of Iran. The is home to the remains of a complicated irrigation system, which includes canals, dams, weirs, bridges, subterranean channels, etc.; some of these structures were nominated a World Heritage Site in 2009. The project relies heavily on historical aerial photographs and declassified Corona imagery for documentation and modeling of canal evolution on the plain. It was conceivable that a historic DEM that corresponds to the topography of the documented irrigated landscape will significantly enhance my ability to generate and test hypotheses about the function of several hydraulic features, and about the evolution of the canal systems on the plain.

Casana and Cothren (2008) have used CORONA satellite imagery to create historic DEMs. Despite promising results, the resolution of historic DEM is still low. These scholars demonstrated that the use of CORONA images for DEM generation is most relevant for the sub-images where the distortion of the imagery is minimal. Carefully curated and digitized datasets of historic imagery from the United States have been utilized for the creation of historic DEMs of great resolution and accuracy. In the Middle East, these datasets are not easily available for public use. However, Iran National Cartographic Center has provided commercial access to these datasets. I decided to test the possibility of using high-resolution historic aerial photos which I had acquired for my dissertation research in order to create a historic DEM. For this purpose, two datasets of the imagery which were acquired in 1956 and 1975 were used. Through the funding provided by SPARC, I purchased additional rows of the imagery in order to have the full stereo coverage. The early dataset provided satisfying results with great resolution and accuracy while the test with the second dataset was unsuccessful. The results is further discussed below.

II.   Summary of Results

Photogrammetric modeling was undertaken at CAST using Agistoft PhotoScan 1.1.0. Unlike the aerial photos that are provided by USGS in digitized format, the metadata of aerial photos of Miyānāb are not completely known. This proved to be a major problem in working with the data. From the imaging parameters, only the focal length of the camera was visible in the contact photo.

The 1956 dataset, composed of 35 photos, with a ground scale of c. 1:12500. All the images were previously scanned at New York University and University of Pennsylvania Digital Studio facilities. On these images, the fiducial marks were visible which helped with relatively accurate cropping and transformation of the digitized imagery. Photos were loaded in the PhotoScan software. For Camera Calibration, ground resolution (pix/m) and focal length were added manually. Other cameral parameters remained to be calculated by the software. Testing with several parameters in the course of the process, a very good model of high resolution (less than one meter) was created. See the appendix.

The 1975 dataset composed of c. 200 photos, and various subgroups of this dataset were selected and tested. Unfortunately, most photos in the 1975 dataset missed all or some of the fiducial marks. This seemed to be one of the other reasons contributing to the lack of success with this dataset. Despite repeating the steps that were successfully used for the 1956 dataset, as well as testing of new strategies, the software fail to create an accurate topographic model. In addition to the lack of camera parameters, it was decided that effect of variation in the scanning process might have contributed to the lack of success with the large dataset.

The successful 1956 model provided valuable information about the historic topography of the plain and its hydraulic infrastructure. This information has been incorporated into the analytical section of my dissertation research on the water history of the Miyānāb. In addition to the value of the project for my personal research, the SPARC project proved that the idea of creating historic DEM from aerial photos can yield very successful results. It is possible that with better software, more datasets can be used successfully. However, at this stage, it was decided that re-scanning of the photos of the 1975 dataset under consistent and controlled condition might yield better results. This possibility will be tested in future.

III. Presentations and Publications Completed

Soroush, M. (2014, November). *Evolution of the Sasanian Monumental Canal Projects: the Case of Gargar Canal*. Presented at the American School of Oriental Research Annual Meeting, San Diego, CA.
Soroush, M. (2016). *Irrigated Landscapes Beyond Political Dynamics: Long Term Water Management Strategies on the Miyanab Plain of Khuzistan (Iran).* New York University.

IV. Presentations and Publications In Press / Planned

Soroush, Mehrnoush. (In progress) "Irrigated Landscapes Beyond Political Dynamics: Long Term Patterns of Water Management on the Miyānāb plain of the Khuzistan province of Iran." New York University.