REMOTE SENSING ARCHAEOLOGY USING HISTORICAL AERIAL PHOTOGRAPHS

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China, with a vast territory, is the only ancient civilized country of the world with a continuous history of over 5000 years. It has many cultural heritages. According to the latest statistics, there are 2351 cultural heritages approved as "the Key National Relics-preservation Unit" by the State Council, and over 9300 cultural heritages as "the Key Provincial Relics-preservation Unit" by provincial governments. In all it has over 400 000 immovable cultural relics (including ancient tombs, ancient architectural structures, cave temples, stone carvings and murals as well as important modern and contemporary historical sites and typical buildings).However, with the rapid social development, ever-worsening environment status, and the vast demand of land resources of the huge population and the booming industry, many cultural heritages are on the edge of extinction, and some of them are being threatened by the surrounding environmental change. In order to find better ways to protect these cultural heritages, understanding the past and present situation is very important and can help us forecast there prospective situation if no protective measures are taken.

Aerial photogrammetry is the technique that uses photographs for mapping and surveying. Although aerial photogrammetry was used primarily for military purposes until the end of World War II, thereafter peacetime uses expanded enormously. Since 1950s, China has conducted photogrammetry in a total area of 1026 square kilometers and acquired as many as 1820000 scenes of precious aerial photographs, with some key regions covered more than once. These aerial photographs objectively recorded the earth's surface configuration, vegetation coverage, landscapes and environment situation. By comparison of these old aerial photographs taken in different time, we could understand the change rate, change range and change rules of the land cover. In this sense, the photographs taken decades ago can help us understand the past situation of the cultural heritages. These plenty of old photographs are great treasure for remote sensing archaeology. In our work, we first conducted extensive literature research and fixed the target heritage sites. Then according to the target heritage sites we collected as many as 12000 scenes of old photographs. Quite many are taken in 1930-40s during the World War II for military use at that time. Aerial photogrammetry is different with remote sensing, especially the optical remote sensing in that the platform aircraft is not as stable as satellite and the aircraft flies much lower than the satellite. These two differences make the aerial photographs be more geometrically distorted. So in our work, the geometrical correction and registration are necessary. We geometrically corrected the old aerial photographs and sampled the old photographs to make sure the photographs and the images have the same pixel size. After the geometrical correction and sampling, we registered the old photographs with the satellites images for image interpretation and analysis. Because the swath of the old photographs is much smaller than the satellites images, so the spatially adjacent photographs have to be mosaicked before registration. Some photographs, especially the military ones are very inconsistent in brightness, so in the process of mosaicking the histogram match was also performed. Then after all the pre-processing procedures, by comparing the old aerial photographs with the recent satellite images such as SPOT, LANDSAT and RADARSAT, we extracted the information on what influencing the cultural heritages and how it influencing the cultural heritages in our target sites. By the spatial and temporal analysis of the target sites, we obtained the changing pattern of the sites and based on it we forecast the future change of the target sites. By a comprehensive analysis of the driving factors that contributing to status of the cultural heritages concerned, some protective measures were recommended, which could be the reference for the decision-makers.