Photogrammetric Documentation and Visualization of Choli Minaret and Great Citadel in Erbil/Iraq

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Laboratory of Photogrammetry





- In 2006, two Czech expeditions were dispatched to Erbil with the aim of basic monument documentation, archaeological investigation and finding appropriate technology for the restoration of these structures.
- The first step was the photogrammetric and geodetic measurement of the Choli minaret and the Citadel in Erbil.









Al-Hassan bin Al –Haithm (965-1039)

First known description of photogrammetric principle 1032 *"camera obscura"* (banknote, Iraq)











Choli minaret: valuable historical monument; remnant of oldest Kurdish mosque from 14th century

Citadel: Kurdish symbol - partly destroyed by Saddam's regime; according to ICOMOS data, eight thousand years of inhabitation are proved in this unique urban concentration, making it the longest inhabited place on the Earth.



Field work



Geodetical measurement

Self reflecting total station Trimble 5000, distance measurement to 300m + small GPS







Photogrammetrical cameras



RolleiMetric réseau (film 6x6cm)

Canon digital calibrated camera





• Choli minaret, 2006





Photogrammetrical processing in Photomodeler software

Control and object point - geodetic measurement























Photo-plans of the lower part of the Choli minaret







Unwrapping of the upper part of the Choli minaret







Virtual modeling in AutoCAD







Animation





Animation























Citadel (Qala) in Erbil, 1947







Citadel (Qala) in Erbil, 2006



Big problem: no usable maps of Citadel, no photogrammetric images (Iraq – area without flights) only military flights (using is very problematic) and satellite images (resolution is not sufficient); geodetic measurement of all object is not possible (technical problems and structure of buildings – partly slum)

Geodetic and photogrammetric measurement:

- 16 control points
- 80 aerial images, about 200 terrestrial images
- 500 geodetically measured object points
- 800 object points from Photomodeler

Inside of Citadel

Inside of Citadel

Inside of Citadel

Inside of Citadel -water and electricity - only 1-2 hours daily

Surface canalisation

One of well-preserved palace

ART

Marking of control points

Geodetic measurement on the roof

Geodetic measurement

Photo flight with US helicopter

Photo flight - over the Citadel

Aerial photogrammetry by hand-held digital camera from US helicopter

Full resolution of aerial digital images

Terrestrial images taken by digital camera Canon 20D

Processing of all images in Photomodeler

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3D processing (points and vectors)

Scheme of camera-stations

Facades - Rendering

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Satellite Image: Citadel in Erbil (QuickBird, 2005)

QuickBird and Ikonos satellite data comparison

QuickBird: left Ikonos: right

Image satellite data filtering and enhancement

original 65cm pan-resolution

after processing 25cm resolution

Creating of base map of the Citadel

Satellite data pan-sharpening – adding of panchromatic channel into multispectral image

Measured points:

The final model of the Citadel is under construction, completing ~12/2007 Next year: creation of GIS for Citadel

Thank you for your attention

http://lfgm.fsv.cvut.cz