

## THE PHOTOGRAMMETRIC CONTRIBUTION TO ARCHAEOLOGICAL DOCUMENTATION OF PREHISTORY

**Klaus Hanke**

CIPA - The ICOMOS / ISPRS Committee for Documentation of Cultural Heritage  
Institute of Geodesy, University of Innsbruck  
Technikerstrasse 13, A-6020 Innsbruck, Austria  
Phone: +43-512-5076752, E-mail: Klaus.Hanke@uibk.ac.at

Working Group V/5

**KEY WORDS:** archaeology, CAD, close-range photogrammetry, documentation

### ABSTRACT

During the last decade there was a big archaeological sensation finding a 5000 year old mummy called "Ötzi", the man from Hauslabjoch on a glacier in the Alps. Our institute had overtaken the task to document the mummy itself and the connected surrounding. The photogrammetric data was captured using a Linhof metrica semi-metric camera with a 4" x 5" format. The photos have been scanned using KODAK PhotoCD Pro in high resolution of 4096 x 6144 pixels. The restitution of the mummy's surface proves to be very ambitious and is still going on to visualize at least parts of the body.

Close to the place where the mummy has been found, a very typical piece of rock was found and excavated. Archaeologists regard it to be a hiding place or shelter for prehistoric shepherds. This rock has also been documented photogrammetrically using digital techniques. The created virtual 3D-modell was the basis for a real model in scale 1:20, which has been built by the archaeologists for a demonstration and for further scientific investigations.

The background and working flow of both outstanding photogrammetric documentations will be shown.

### 1 PHOTOGRAMMETRIC DOCUMENTATION OF "HOHLER STEIN"

In course of archaeological surveys the oldest human traces of the Ötztal-valley were found. Under the so-called "Hohler Stein" (i.e. "hollow rock"), a big rock shelter near Vent (municipality of Sölden, the Tyrol, Austria) was discovered at a height of 2050 meters above the sea level and not more than 10 km from the famous Iceman's place of discovery, a respective camp with fire places and stone tools. It seems to date from the 6th / 5th millenium B. C. This is an evidence for the fact that the main chain of the Alps was explored by hunters, gatherers and herdsmen already at such an archaic time.



Fig. 1: Archaeological site "Hohler Stein"

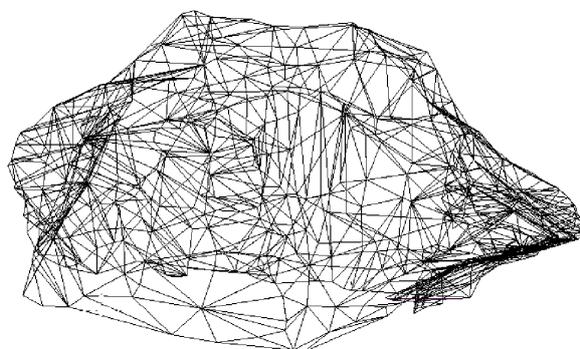


Fig. 2: Wireframe model of the object

In summer 1997 we have been asked by the Institute for Prehistory and Protohistory at the University of Innsbruck to try a surveying and representation of this rock shelter for documentation and further creation of a solid model 1:10 for an exhibition of the archaeological site.

The photogrammetric data acquisition was done using a calibrated small format camera as a light weight equipment, because the archaeological site is situated 2050 m above sea level and can only be reached on foot. The rock is about 4 m high and lies on an area of about 8 x 7 meters. A number of 22 photos was needed to cover the object from all sides (figure 1). A bundle adjustment was calculated and overall 576 3D-points have been measured to represent the rock's surface. A 3D- wireframe model was built (see figure 2) and faces defined between the points of the surface. This surface proved to be very complex and so it was difficult to derive a contour representation of the rock. This was needed to later building a real solid model which should be shown in an exhibition of the archaeological site. Any automatic contour generation brought no satisfying results (see figure 3a and b)). So the only way was to generate explicitly the intersection curves of the 3D-model with horizontal planes (figure 3c). This procedure was done with the rendering software Autodesk 3D-Studio and led to the further used contours with an interval of 20 cm.

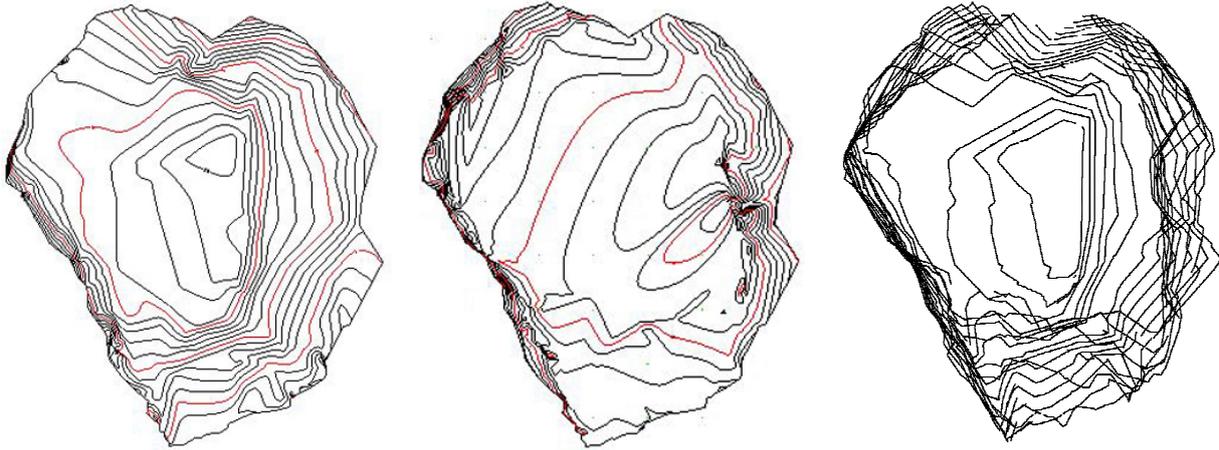


Fig. 3: Contour representation of the rock from interpolation a) upper b) lower part and c) from intersection procedures

The contours planes have then been cut out and mounted (see figure 4a) to give a realistic view of the rock shelter and its surrounding area. Smoothing and painting the model as well as adding small human figures and their equipment to the scene completed the representation of the site in a scale 1:10 (see figure 4b).

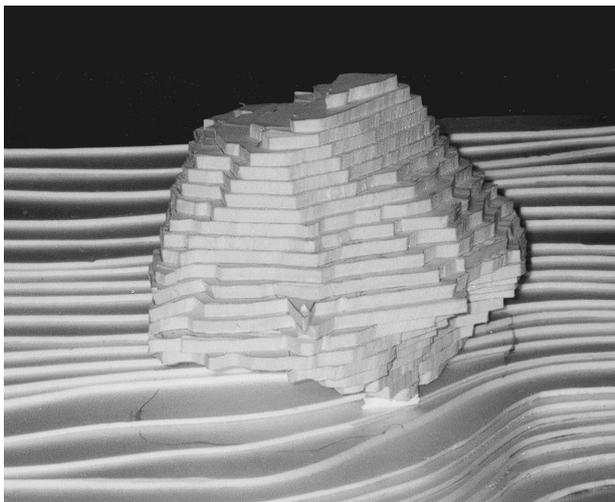


Fig. 4 a) mounted contour model



b) complete representation of the scene

## 2 DOCUMENTATION OF THE ICEMAN MUMMY "ÖTZI"

Ötzi is the oldest human mummy preserved by freezing. He is a Bronze Age man who died over 5,000 years ago when he was apparently caught in a snow storm during a hunting trip on a mountain between what is nowadays Austria and Italy. Together with the body were clothing, a bow and arrows, a bronze ax, and flint for making fire. It has been found by chance when a couple of mountaineers came across the site, when the snow on the glacier was low only for a couple of days. We have been asked by the Research Institute for Alpine Prehistory of Innsbruck University to do a photogrammetric documentation of the mummy "Ötzi" prior to further investigations and possible destroying or hurting of its corpus' surface.

The photogrammetric recording was done using a LINHOF Metrica semi-metric camera mounted on a 40 cm stereo-basis. There were a lot of difficulties to overcome. We had to work in a sterile environment, disguised like medical doctors during a surgery. The photographic acquisition had to be done when the room was cooled down, but even there the mummy could lie only for 30 minutes without thawing. The temperature of the surface must not exceed 18° Celsius and the humidity must be guaranteed to be above 70% at any time. So the iceman was bedded on ice-cubes to keep the temperature and humidity stable. For the documentation we planned 8 different positions for the mummy, which was lying in a sterile box to prevent any infection (both, in one or the other direction). The light had to be a cool one and to prevent any (re)activation of germs or fungi, no flash was allowed to be used.

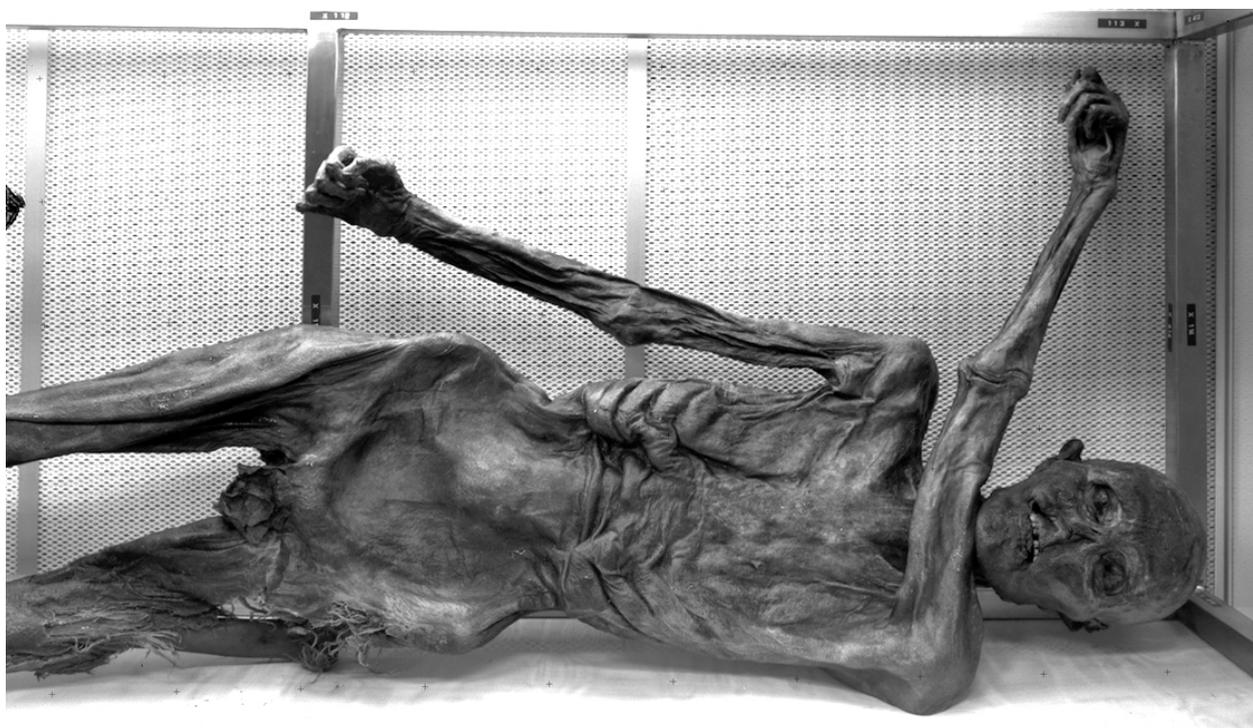


Fig. 5: One of the photos of the documentation of iceman mummy "Ötzi"

The Linhof Metrica that we used has a focal length of 90 mm for a film format of 4" x 5" (93 mm x 116 mm effective). The photos have been digitized and stored on a KODAK Photo CD pro at a resolution of 4096 x 6144 pixels for further digital processing. Figure 5 shows one of the original images. The restitution of the surface to create a 3D model is still going on and proves to be a very demanding task.

### ACKNOWLEDGEMENTS

I want to thank LINHOF Munich, Germany for giving away the camera and for their kind support and understanding of the difficulties during our work.