Photogrammetry Since many years photogrammetry has been used quite a lot for mapping, recording and documentation of archaeological monuments,

The Bamiyan Buddha before (left) and after (right) the destruction by Talibans

excavation findings and cultural heritage sites. Lately digital techniques for recording, processing and visualization have opened new possibilities for 3D modeling.

The Bamiyan Buddha The modeling of the cultural heritage area of Bamiyan, Afghanistan, is a good example showing the capabilities and achievements of the photogrammetric modeling techniques and combining large site landscape modeling with highly detailed modeling of local objects (statues). As it is well known, Afghani Talibans demolished the Buddha statues placed in Bamiyan in March 2001, notwithstanding the appeals from all over the world to save such ancient art masterpieces.

The distruction of the Bamiyan Buddha by Talibans

The demolition was carried on by means of explosives, guns, rockets and mortars in such an accurate way that no physical reconstruction is possible

Image based modeling is a breakthrough technology for the creation of 3D object and scene modeling. Only images are needed to produce the 3D models. No

expensive equipment or cumbersome calibration steps are necessary. The first phase consists of a set of consecutive, automatic steps that lead to the calibration and the pose of the camera for every image. A sparse set of feature points that describe the scene is reconstructed in 3D as well.

In a second phase a dense stereo matching algorithm is applied to the images. As a result dense depth maps are obtained for every image. From these data textured 3D models can be built.
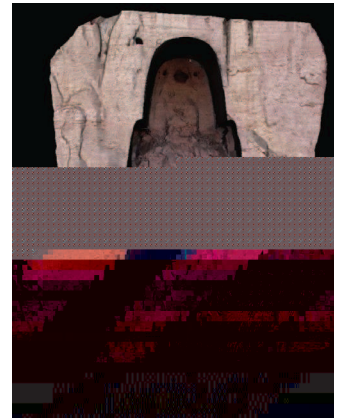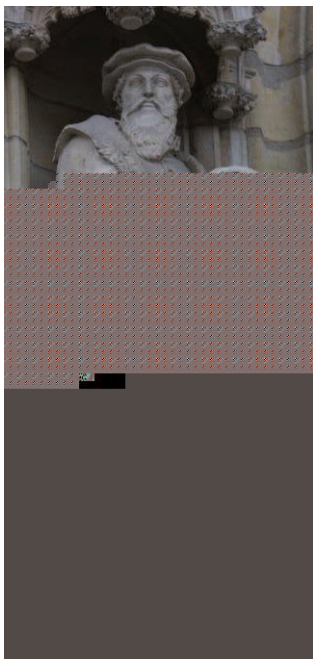
The digital models of the Bamiyan Buddha (left) and of its niche (right)

An important advantage of this approach is its ease-of-use. No heavy, complicated or fragile apparatus is involved. Taking images is part of regular, archaeological practice for
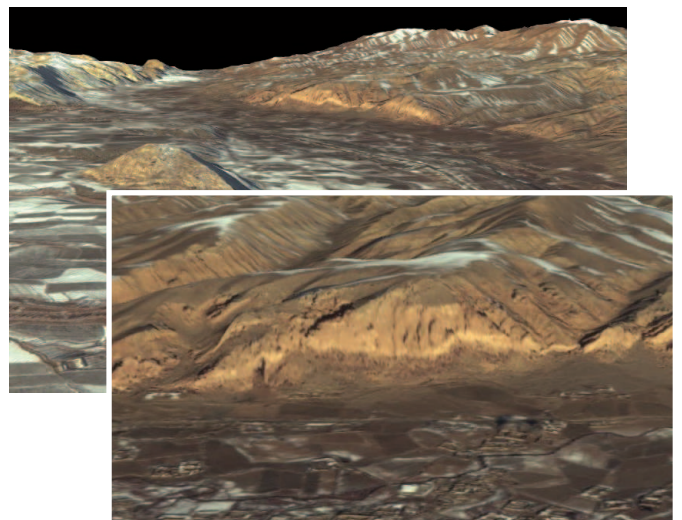
Digital terrain models of the Bamiyan site

instance. The ability to turn normal photographs into 3D models literally adds a new dimension. Compared to non-image based techniques there is the important advantage

tions. Both videos and photos can be used.

For the showcase, different types of images (terrestrial and satellite) have been used and a detailed terrain model (area of ca. 49x38 km) as well as the 3D models of the rock cliff (ca 1 km wide), the Great Buddha statue (53 m high) and its actual empty niche have been produced.

Another application: the statue of Mercator, original (left) and textured model (right)

that surface texture is directly extracted from the images. This adds to the realism and authenticity of the reconstruc-

Technical details   The image based modeling is based on (1) the calibration and orientation of the images, (2) the manual or automatic image matching for 3D point cloud and surface generation and (3) the texture mapping of the 3D model for photo-realistic visualization.

The 3D model of the Great Buddha and its empty niche have been reconstructed with a relative accuracy of ca 1-2 cm while the digital terrain model has an overall accuracy of ca 1.5 pixel (ca 3.5 m). The generated digital models are now used for the documentation and visualization of the destroyed monument, for virtual flights over the cultural heritage site, for animations as well as for the setup of a tourist information system.

The partners   The showcase Image-Based Modeling is being developed by the following EPOCH partners:

ETH Zürich, Switzerland
KU Leuven, Belgium

Interested?
Are you interested in this showcase? Do you think that this approach can help you in creating effective Cultural Heritage presentation projects or can be integrated in new research projects? Please contact Prof. Luc Van Gool (Luc.VanGool@esat.kuleuven.ac.be) of KU Leuven at +32 16 321705.