

# PROTOTYPE OF A 3D-MODEL OF THE EARTH GLOBE USING PHOTOMODELER SOFTWARE

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**KEY WORDS:** Close – Range Photogrammetry, PhotoModeler, Earth Globe, Animation, Didactic Project, co-ordinates transformation.

## Abstract

As a part of the project "Initiation to Research", students and their teachers produced a prototype of a spatial model of the Earth Globe. The model used has 30,56 cm of diameter, having, therefore, an approximate scale of 1: 41.745.000.

The prototype was built from digital pictures taken from the distance of 1 meter, denominated photographic matrix of the globe model.

The equipment used was:

- Digital Camera SONY DSC P-71
- PhotoModeler Software version 4.0d
- 3D Studio Max 5 Software
- Software Windows Movie Maker

First, it was decided to take 24 pictures, 12 of both hemispheres, having, then, 30° between each of them. The camera was placed facing the latitudes 45° N and 45° S, orthogonal to the object surface. Care was taken to avoid the light reflex on the object surface because it was too shiny.

The 3D modelling of the globe was made by the PhotoModeler Software. In order to reference points accurately and quickly, it was decided to mark them on the cross of the parallels and meridians.

The Cartesian co-ordinates X, Y and Z of 12 important points in latitude and longitude were calculated and inserted into the modelling process.

The model was exported on VRML format to the 3DS MAX 5 Software to make an animation in the .avi format.

These procedures could be used for the real Earth Globe, with satellite images showing the whole globe surface.

## 1. INTRODUCTION

As a part of the project "Initiation to Research" second year students of the **Instituto Militar de Engenharia - IME** and their tutors produced a prototype of a spatial model of the Earth Globe built up from digital images from a school globe. This has a diameter of 30,56 cm which corresponds to an approximate scale of 1 : 41 745 000.

The equipment used was:

- Digital camera SONY DSC – P 71
- Software PhotoModeler, version 4.0 d
- Software 3D Studio Max 5
- Software Windows Movie Maker

The images were taken by the digital camera and then processed by the (above) mentioned software. The purpose of this didactic project was to orient the students to experiment theory and practise of terrestrial photogrammetry. The project has the additional purpose of preparing an analogue procedure of modelling the real Earth Planet by use of satellite images.

## 2. PROJECT PLANNING

In the initial stage of the project the Digital Camera SONY DSC – P 71 with the following characteristics was available:

- nominal focal distance : 8 mm
- nominal format : 5,9 mm x 4,5 mm

At first it was necessary to improvise a support, which permitted taking all the images of the rotated globe with the same geometrical and photographically quality.

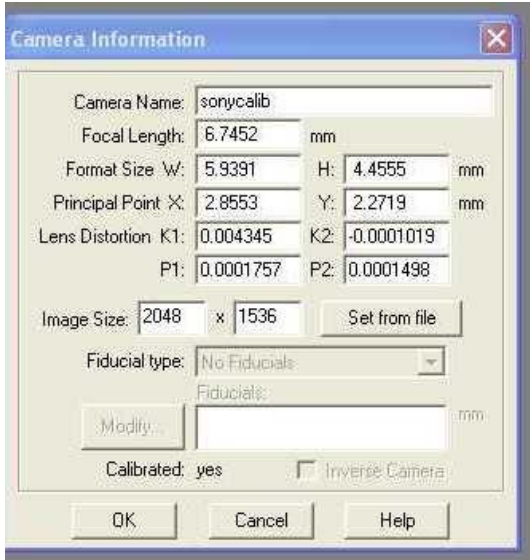
Also It was necessary to shade the intensity of the light in order to avoid white spots on the images of the globe.

### 2.1 Camera calibration

After establishing the sufficient conditions for correct illumination the camera had to be calibrated according to the instructions of the PhotoModeler user manual. The following results were obtained :

- focal distance : 6,745 mm
- more details can be found at table 1

Table 1 – Camera calibration

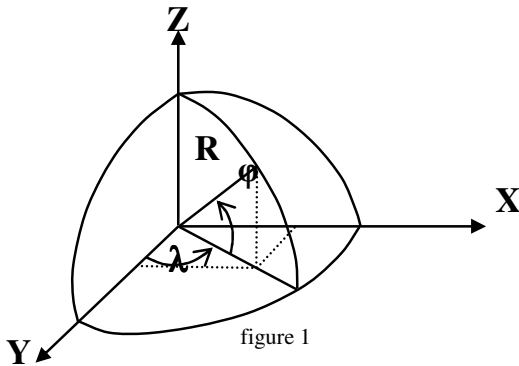


### 3. CONTROL POINTS

For processing the absolute orientation in the PhotoModeler Program distinctive control points were selected: The intersections of meridians of  $15^{\circ}$  amplitude with parallels of  $10^{\circ}$  of amplitude, and also the two poles of the Earth.

#### 3.1 Geographical and Cartesian Co-ordinates.

The geographical co-ordinates of the control points were transformed into Cartesian co-ordinates by use of the following formulas:



$$\left\{ \begin{array}{l} Y = R \cos \varphi \cos \lambda \\ X = R \cos \varphi \sin \lambda \\ Z = R \sin \varphi \end{array} \right\}$$

where

$$\left\{ \begin{array}{l} \lambda : \text{Longitude} \\ \varphi : \text{Latitude} \\ R : \text{Radius of globe} \end{array} \right\}$$

### 4. TAKING IMAGES AND PROCESSING WITH PHOTOMODELER

#### 4.1 Taking Images

After all the necessary preparations had been made, one had only to pay attention to the exact rotation of the globe of  $30^{\circ}$  between the subsequent images and to the fact that the camera had to be pointed perpendicularly to the face of the globe at latitudes  $45^{\circ}$  N and  $45^{\circ}$  S.

24 photographs of the globe were taken, 12 of them in each hemisphere.

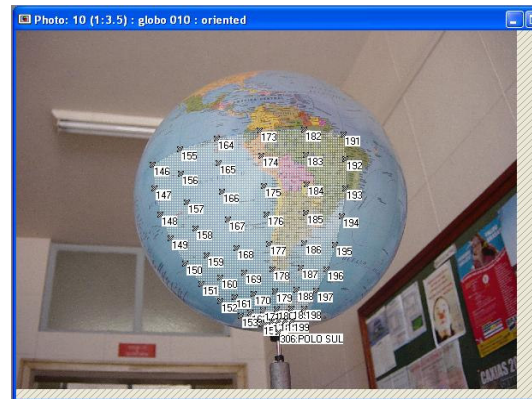
At a later stage, images of both polar regions were taken.

#### 4.2 Processing

Before starting the processing it was necessary to invert the Y-axis of the Cartesian co-ordinate system shown in figure, because in the PhotoModeler software the values of Y increase in the direction of the rear of the globe.

At first the above mentioned distinctive points at the intersection of meridians with parallels were marked in each of the matrixes and referenced at least in 3 or more of them.

After processing of each section the residuals were analysed and the measurements, when necessary, corrected in order to avoid deformations of the model of the globe.

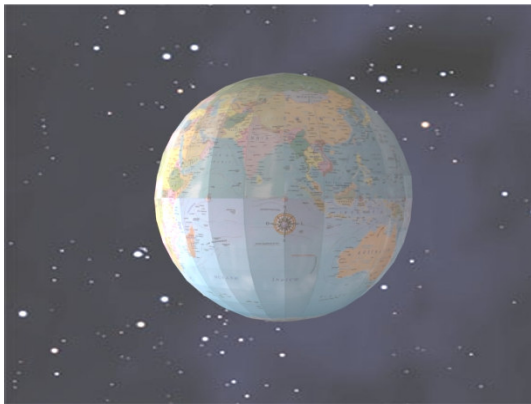
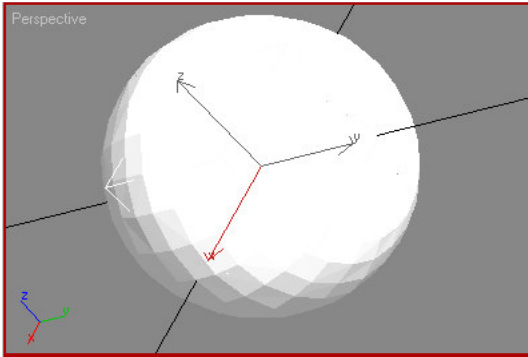


In the following stage the texture of the sections was selected. Due to some imperfections in the polar regions of the globe some measured points had to be touched up, however without affecting the quality of the final result.

### 5. SETTING UP THE VIDEO

The model created in the PhotoModeler software was exported into the 3D Studio Max 5 software in the format VRML 2.0.

After the transfer, videos and snapshots with 2 cameras (one fixed and one movable) around the globe were created. Then the videos ( in .avi format ) and the photographs ( in .jpg format ) were rendered and edited by use of the software Windows Movie Maker. As a final result the video in the format Windows Media Video ( .wmv ) has a presentation time of 45 seconds.



## 6. CONCLUSIONS

On finishing the project the efficiency of the PhotoModeler software in making the prototype was evident as well as the utility of the 3 DS Max 5 software for virtual simulations of the natural orbit, as was the case in this project. Furthermore it can be concluded that this prototype could be expanded for satellite images of the real Earth Planet; as mentioned before.

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## VIDEO

Cliglobo.wmv