

**SIMULATION MODEL OF AN AEROPHOTOGRAMMETRIC SURVEY  
DEDICATED TO THE COMPREHENSION OF THE METHODS USED IN THE  
CREATION OF MAPS FOR CHILDREN**

**Msc. Claudia Regina Grégio d'Arce Filetti<sup>1</sup>**

**Claudia Marina da Rocha<sup>2</sup>**

**Luciana do Nascimento<sup>2</sup>**

**Greicielle Furiel da Silva<sup>2</sup>**

**Suzy Mari Nakano<sup>2</sup>**

Universidade Estadual de Maringá

Department of Civil Engineering

Avenida Carlos Borges, 1114 -Sobrelaja - Maringá - PR

CEP: 87020-900

e-mail: [filetti@nobel.com.br](mailto:filetti@nobel.com.br)

**ABSTRACT**

The study of cartography since the beginning of school has more and more reaffirmed its importance, since students learn how to read and comprehend maps, becoming its users. It is also important to make the resources used in the confection of maps explicit to children, so that they get able to correspond the map to what it is representing. From the proceedings of surveys used for the map's elaboration, the one proceeding from the aerophotogrammetric survey most attracts children's attention, since the photography is a palpable, perceptible and very representative material. Nevertheless, children are not able to comprehend well the survey itself due to the difficulty to visualize how it is executed. This study is about the elaboration of a simulation model of an aerophotogrammetric survey, which matches a reduced model from an area of the *Universidade Estadual de Maringá* with a light projection model. This combination makes possible for children to comprehend how an aerophotogrammetric survey is elaborated, and also helps them to understand concepts like scale, altitude, vertical projection, oblique projection, contour line and datum plane, from others, in an attractive and entertaining way.

**INTRODUCTION**

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<sup>1</sup> Professor MSc. in the Department of Civil Engineering of the *Universidade Estadual de Maringá* (Maringá, State of Paraná, Brazil) and candidate for a doctor's degree in the *Universidade Estadual de São Paulo* (Presidente Prudente - São Paulo, Brazil).

<sup>2</sup> Academics oriented in a teach project of the *Universidade Estadual de Maringá* (Maringá, State of Paraná, Brazil).

The cartography is a knowledge which has been developed alongside of History and refers, in general, to the elaboration of maps those are graphic expressions represented by a speech that synthesizes information, expresses knowledge and studies situations, always involving the idea of space's production.

SIMIELLI (1999) presents a detailed construction of purpose for cartography teach for the elementary school and "medium school" (=high school). This purpose begins offering elements those make the comprehension of the proceedings necessary to elaborate graphic representations, especially the maps, to children from the first until the fourth year of the elementary school or from levels needing instructions for reading and writing cartography. The author affirms: "The idea is to educate the student for the cartographic view".

The same author uses children's natural interest for images to reach the objective mentioned above and suggests that many visual resources - drawings, photos, scale models, drafts, maps, satellite images, pictures, tables games and representations made by children - be offered, making the student to get used to the visual speech.

The reduced models bring to children the materialization of real spaces, propitiating concepts which children can usually not comprehend, since they still present an abstraction level still getting developed when they are in the first half of the medium school and so they need to visualize to comprehend. For example, the concept of Earth's rotation and translation, the lunar and solar eclipses, from others.

During a work executed with a group of students from the third year of the elementary school at *Notre Dame* – a school from *Maringá*, in the State of *Paraná*, Brazil – , I instructed them to make a reduced model of the Solar System. When the students started to paint the seas and continents on a polystyrene sphere to represent the Earth, of the children asked me how people could know that Brazil had that presented form.

The answer came from another student: "the contours are copied from photos taken from airplanes".

When I explained them, in a simple way, how the aerial photographs for topical surveys are made, I noticed that although children were interested and made an effort to comprehend how the flight proceeded, only with drawings and the pictures showed, they couldn't get it.

Then a simulation model of an aerophotogrammetric survey was elaborated. It matched a reduced model from an area of the *Universidade Estadual de Maringá* with a light projection model, intending to make possible for the children to comprehend how an aerophotogrammetric survey is made, and also to help in the understanding of concepts like scale, altitude, vertical projection, oblique projection, contour line and datum plane, from others.

## DESCRIPTION OF THE MODEL

The simulation model of an aerophotogrammetric survey consists in the composition of a reduced model from an area of the *Universidade Estadual de Maringá* with a light projection model.

The reduced model was elaborated in horizontal scale 1:1000 and vertical scale 1:400. Its relief was reproduced in polystyrene using the draft of an area from the *Universidade Estadual de Maringá*. For that, the methodology presented by Simielli<sup>3</sup> was adopted. It's important to make clear that, on purpose, the effect of continuity of the relief was made, only in the half of the model; the other half was left in steps. This may facilitate the understanding of the concept of contour line.

Natural and artificial elements those belong to the studied area were reproduced over this relief. Miniatures of the buildings, vegetal coverage, isolated and agglomerate bush (forest), streets, gangways and electric net were elaborated.

The scale used (1:1000) permitted the main characteristics of each element to be represented, so that we could get as a final result a representation closed to the reality.

This reduced model constructed is situated on two polystyrene plates. The first, just under the reduced model, represents a datum plane of regional level, was painted in brown and is 40mm\* looser than the reduced model (\*with 20mm in each side in the gluing time). The second plate, under the first one, represents a datum plane of national level (medium level of the seas), was painted in blue and is 40mm looser than the first one, also distributed in 20mm of each side in the gluing time.

These two plates are helpful to comprehend the concepts: elevation of the relief and flight elevation.

The photo 1 shows de reduced model elaborated.



Photo 1: Reduced model from an area of the *Universidade Estadual de Maringá*.

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<sup>3</sup> Marina Elena Simielli. Do Plano ao Tridimensional: A Maquete como Recurso Didático. 1992.

The light projection model consists in a support formed by a rectangular base of plywood with 4mm of thickness and dimensions of 700mm x 450mm, set by its length end with two wood bases of 450mm length x 20mm width x 120mm height. Both wood bases have a crack with 350mm length x 10mm width x 60mm height. Four wood rods of 10mm width x 12mm length x 400mm height are mortised to these cracks (two in each base). The rods' mortise can change its position inside the cracks, keeping yet in pairs to make two alignments parallels to the direction of the length. Two hooks were added to these rods, one 10mm and the other 110mm far from their superior end, and in these hooks is set the track in which the system of light projection will move.

The system of light projection consists in four cubic polystyrene compartments, with dimensions: 40mm x 40mm x 40mm. One of its side is not closed with polystyrene, but in its overture was fixed a colourful filter (in respective, green, red, blue and yellow to each compartment). In the opposite side was fixed a hook to bind each compartment to the track. In their interior there is a lamp which projects, with the filter and the end, a colourful light beam with checkered form. The photo 2 shows the light projection model.



Photo 2: Light projection model.

Inserting the reduced model in the light projection model, we will get the model of simulation of an aerophotogrammetric survey, as the photo 3 shows.



Photo 3: Model of simulation of an aerophotogrammetric survey.

### **PERFORMANCE OF THE MODEL**

The model was idealized in the beginning only to demonstrate to children how the aerial photographs for topographical surveys proceed. Nevertheless, some details were added during its elaboration, intending to transmit some concepts those help in the future to comprehend the reading of maps.

The first detail, already mentioned, was the elaboration, side by side, of the half of the model's relief in steps (contour line) and the other half with an effect of continuity, in other words., each curve has the half of its representation in step and the other half with the assuaging of the step using mortar. This materialization of the contour line, like "cuts" in the relief (this is what the child imagines: in one side, the relief; in the other, the cuts made by it), helps to comprehend the meaning of the concept of contour line, its characteristics and also to visualize these representations on the maps.

Another detail, also already mentioned, was to fix the reduced model over two polystyrene plates those correspond to the plan of regional reference and to the medium level of the seas, in respective. The materialization of these plans helps to comprehend the concepts of elevation of the relief, and flight elevation.

Nevertheless, the model's main purpose is to get the children's understanding about the aerophotogrammetric survey and make them comprehend that:

- The flights follow predefined lines, which the tracks fixed to the wood rods materialize in the model.
- These flight lines keep some distance (overlap of strips) showed by the movement of the wood rods along the wood base's crack.
- The flight's altitude is variable. This variation is provided by the hooks fixed in the wood rods in two different heights, as it has been described.
- More than one photo are needed to photograph the whole area, since each photo reaches a small part of all the area. When each compartment of the projection system is illuminated, the area reached by the photos is materialized.
- The photos of the area are taken following a sequence, which is materialized when the compartments' illumination presents a sequence and keep a distance between them (overlap of photo), given by the variation of the compartments' position on the track.

Another concept that can be studied is the scale. When the flight altitude is changed, the checkered projection gets smaller or bigger and more or less elements compose the photos. The study about scale can still present vertical photos those correspond to the checkered projections in both model's flight altitudes. So, children are able to visualize the component elements of photos in this flight altitudes and interpret that the bigger the photographed area is, the smaller its elements are.

### **FINAL CONSIDERATION**

The presented model is a composition of visual effects with the materialization of real or imaginary elements. Analysing its performance and the growing level of abstraction in the several human beings' life stages, it is noticed that the model can be directioned since the elementary school until the superior school (college). Nevertheless, it will first be applied in the eight years of the elementary school in different ways (respecting children's abstraction level) intending to guarantee the comprehension of since the visualization of a vertical photo and how it is taken (children between 6 and 8 years old), adding concepts like scale, altitude and contour line for children between 9 and 11 years old, until all the performance mentioned above for children between 12 and 14 years old.

Later, the model will be presented to superior school's students, but with some addictions of performances not mentioned in the previously item, for example: the study of the overlaps due to the relief's change; studies related to the flight planning, from others seen in aerophotogrammetric survey.

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