National University «Lviv Polytechnic»
Institute of Geodesy

“Software products analysis for 3D modeling of large-scale topographical plans of Ukrainian Vernadsky station on Antarctic region”

Fulfilled:
st. gr. GIS-45
Biala M.S., Parijchuk Y.V.
Scientific supervisor:
Hlotov V.M.

Lviv 2018

The purpose

1. Software products analysis for create 3D modeling of large-scale topographical plans and their practical application.
2. Creating 3D-model of Ukrainian Vernadsky station on Antarctic region.

Topicality

The analysis of this scientific work on the basis of literary sources shows the relevance of the chosen topic. The presence of unexplored issues and many scientific tasks to achieve this goal, as well as a small number of articles on similar topics, testify to the necessity of research in this field.

That is why the analysis and selection of the most optimal software for creating a 3D model of a given territory is an actual task.

The research needs to realize **the following tasks**:

1. choose the most optimal software for creating 3D model of a given area;

2. to make an apriori and aposteriori estimation of the accuracy of the selected software product, for further application;

3. create a 3D model of a given territory.

The object of the research is the territory of Ukrainian Vernadsky station on Antarctic region. It operates all year round and is a meteorological and geographic observatory.

The subject of the study is software for creating computer-generated 3D images and visualizing 3D models.

Software products for 3D modeling

Digitals

MapInfo

ArcGIS

AutoCAD

Advantages and disadvantages of software products

Software products	Advantages	Disadvantages
Digitals	➢allows you to exchange data without losing their content and design. ➢the possibility of opening and recording maps in different formats : AutoCAD DXF/DWG, ArcGIS Shape, MapInfo MID/MIF and others. ➢the possibility of processing theodolite and tachymetric survey. ➢the price of the licensed version.	➢ slow processing of large-scale topographical plans. ➢ "Hang" program when computer processing a large number of layers of maps information.
MapInfo	➢the program allows you to open multiple windows at the same time which containing the same file. ➢quite simply realized raster opening function ➢ data visualization allows you to display tabular data on the map in different views.	➢a small number of standard functions. ➢ all the coordinates which are used in the program have a projection in the mathematical coordinate system. ➢there is no possibility of creating two-dimensional models.

ArcGis	➢a large number of geodatabase tools ➢the ability to work in several applications at once by importing and exporting the files between applications. ➢the ability to support different file formats.	➢high license cost. ➢The licensed version only includes the main application ➢The function of filtering incorrect data doesn’t work properly.
AutoCAD	➢the possibility of constructing a two-way map, which will contain the data of the difference between these maps. ➢the possibility of creating two-dimensional models. ➢a large number of tools for working with maps.	➢the ability to export to other software products ➢not very handy vector editor.

Apriori estimation of the accuracy

$$X_ф = \frac{B}{p} x_л$$

$$Y_ф = \frac{B}{p} f$$

$$Z_ф = \frac{B}{p} z_л$$

$$m_{X_ф} = \sqrt{\left(\frac{x_л Y}{Bf}\right)^2 m_B^2 + \left(\frac{Y}{f}\right)^2 m_{x_л}^2 + \left(\frac{x_л Y^2}{Bf^2}\right)^2 m_p^2}$$

$$m_{Y_ф} = \sqrt{\left(\frac{Y}{B}\right)^2 m_B^2 + \left(\frac{Y}{f}\right)^2 m_f^2 + \left(\frac{Y^2}{Bf}\right)^2 m_p^2}$$

$$m_{Z_ф} = \sqrt{\left(\frac{z_л Y}{Bf}\right)^2 m_B^2 + \left(\frac{Y}{f}\right)^2 m_{z_л}^2 + \left(\frac{z_л Y^2}{Bf^2}\right)^2 m_p^2}$$

$$m_{X_Ф} = 0{,}07 \text{м}$$

$$m_{Y_Ф} = 0{,}24 \text{м}$$

$$m_{Z_Ф} = 0{,}05 \text{м}$$

where, **f** – focal distance of the CTC,

$\boldsymbol{B}$ – basis of survey,

Y – distance to the subject of survey,

$\boldsymbol{x_л}$, $\boldsymbol{z_л}$, **p** – coordinates of points on the left image and longitudinal parallax,

$\boldsymbol{m_{X_Ф}}, \boldsymbol{m_{Y_Ф}}, \boldsymbol{m_{Z_Ф}}$ –medium square error of coordinates $X_ф, Y_ф, Z_ф$,

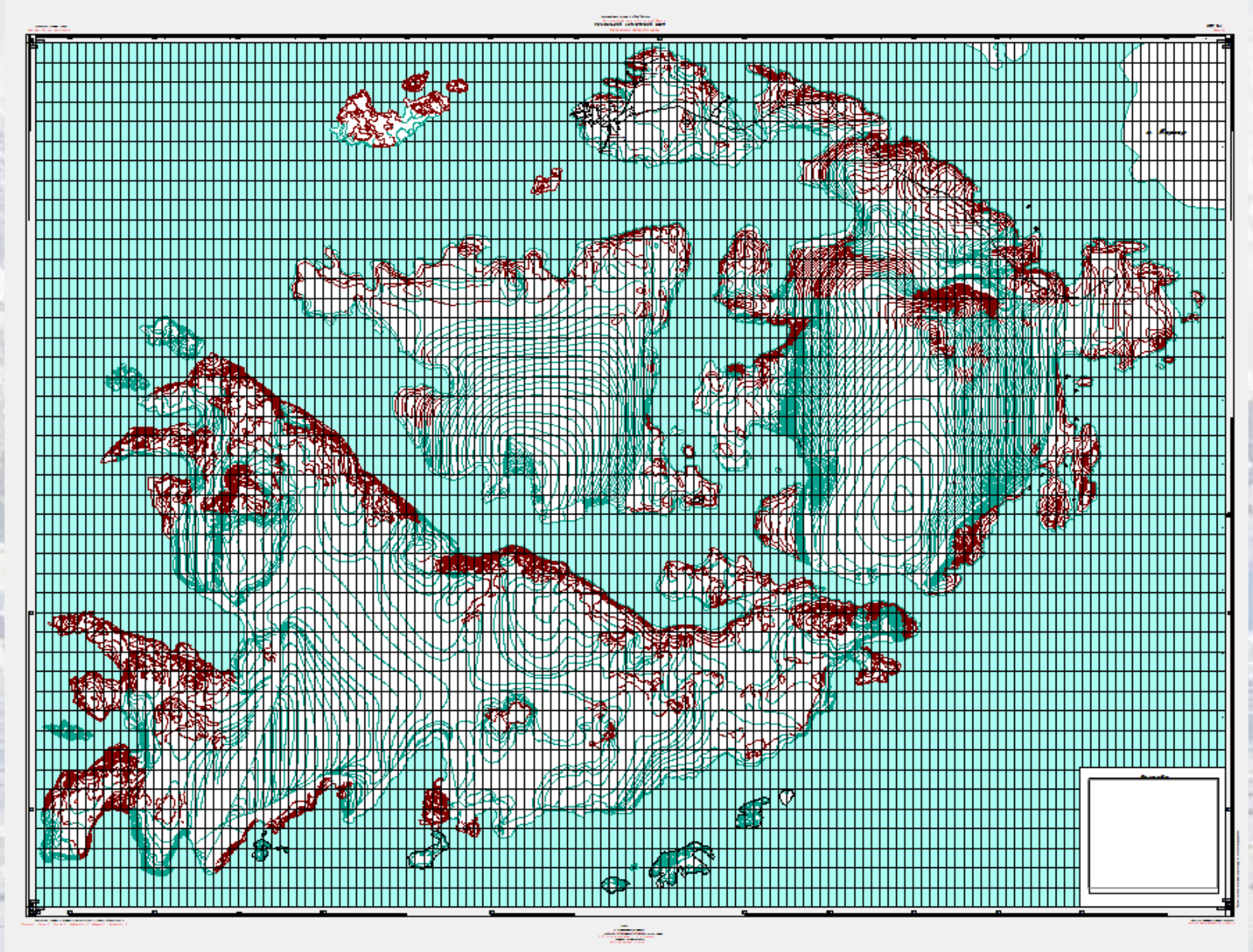
$\boldsymbol{m_b}$ – medium square measurement error of the basis of survey - 10 mm,

$\boldsymbol{m_p}, \boldsymbol{m_f}, \boldsymbol{m_z}, \boldsymbol{m_x}$ – medium square errors of coordinate measurement of the image, parallax and focal length.

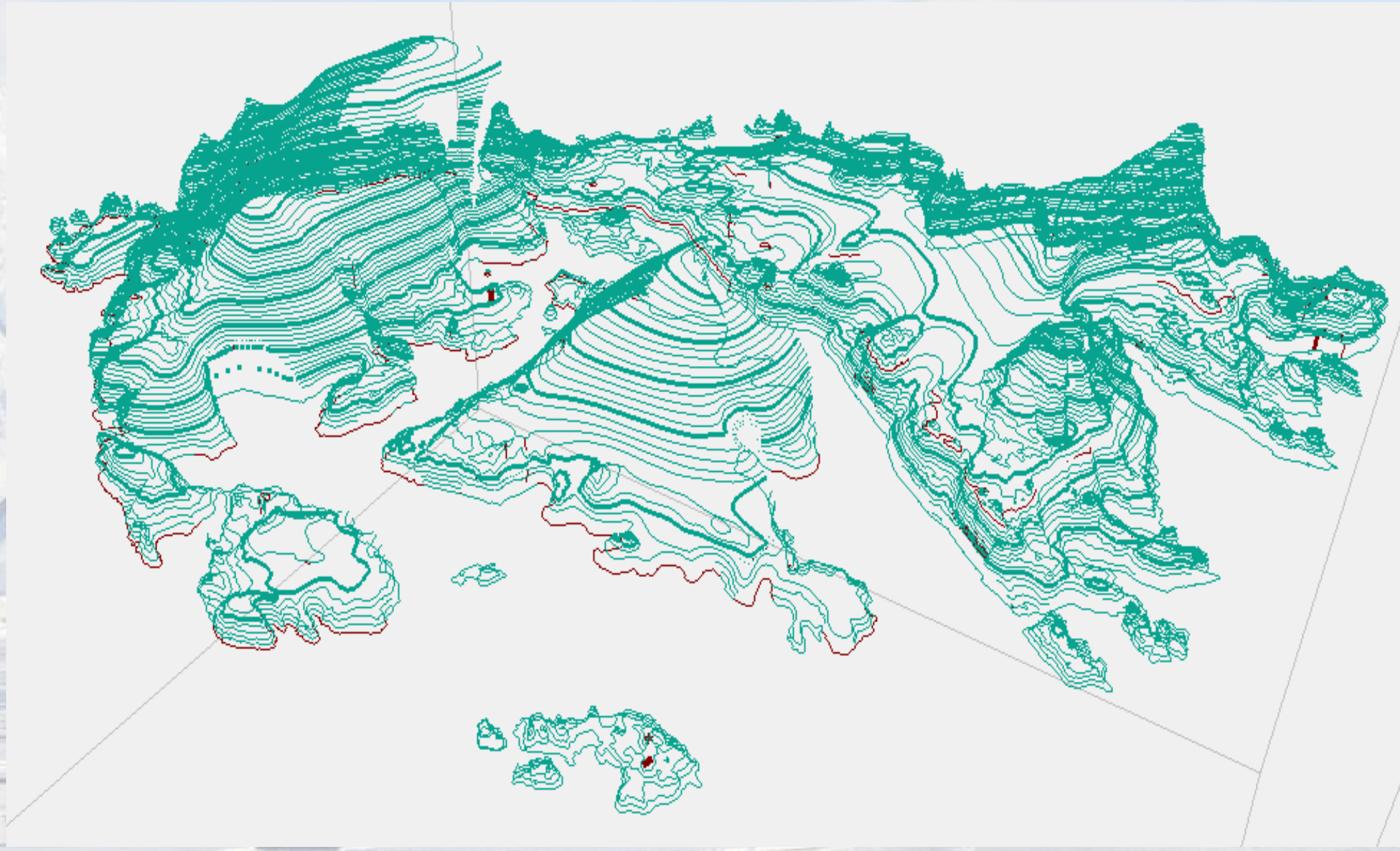
Localization of the Vernadsky station on the map

Photograph of the Vernadsky station

Large-scale topographical plan of Ukrainian Vernadsky station on Antarctic region



3D model of Ukrainian Vernadsky station on Antarctic region



Conclusions

1. Based on the processing of a large number of publications, which are devoted to this topic, made a conclusion about the relevance and novelty of the issue and the absence of its duplication.
2. Analyzed a number of software products, which provide the possibility of 3D-modeling. As a result of the analysis we have highlighted the advantages and disadvantages of software and the optimum product for implement research was selected.
3. Created 3D-model of large-scale topographic plan of Ukrainian Vernadsky station on Antarctic region
4. The analysis of the apriori estimation of accuracy showed that the available measurement accuracy satisfies instruction requirements of large-scale topographical plans.

The prospect of future research is to upgrade and supplement the 3D model, namely: analysis of aposteriori estimation of accuracy, the exclusion of incorrect data, three-dimensional model creation of buildings and their graphic design.


Thank you for your attention!