

Development of Equipment for 3-D Picturing and Measurement of the Brain Ventricles

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***Abstract:** Recently there are also papers in literature (Germany) showing the possibility of measurement of the brain ventricles – third and both lateral ventricles – with ultrasound and thus interpret progression of brain atrophy. Ultrasound is non-invasive, whenever reproducible and comparing with magnetic resonance cheap method. Extension of the indications of this method with the measurement of brain ventricles in various neurological diseases is needed. In ultrasound B-mode the brain ventricles are hypoechogenic structures with hyperechogenic edge – the walls of the ventricle.*

***Keywords:** image segmentation, treshholding, binary image, mathematical morphology, recognition.*

1 Introduction

This contribution deals with the photogrammetric system (FOTOM), which has been developed for several years on Department of Computer Science at VSB-TU Ostrava. FOTOM originally served to mine holes measurement. The new version serves to define and process objects of interest in medical field. A new version of Fotom1 is described.

2 Image analysis and object recognition

Image segmentation

Image segmentation is the most important and the most difficult operation of image analysis. The endeavour is to separate an image to regions, that represent the objects and areas of real world. (Ličev, L. 2001, 2002), (Sojka, E. 1999).

Tresholding

In most cases objects of interest feature from background. It means the brightness of pixels that belong to objects is different than brightness of background. The result of this operation is a binary image.

Binary image processing

Binary image is an image in which there are only two brightness values. Usually the pixels belonging to objects have this parameter equal to 1 and pixel of background have this parameter equal to 0. Binary image is generally a result of image segmentation methods.

Points of interest recognition

Procedure to points of interest recognition we can divide to:

- recognition directly from spot of light,
- recognition by means of neuron nets.

Recognition directly from spot of light:

This procedure is suitable in cases, when we can not separate the object of interest sufficiently. We have to determine the points of interest or points defining this object and to define the object of them.

Recognition by means of neuron nets:

This way we can use in case, that we can sufficiently separate the object of interest. First we separate the object and then we determine points of interest as border of this object.

3 Points and objects recognition in FOTOM system

Toolbar

Most of important controls of Fotom1 modulus is in toolbar:

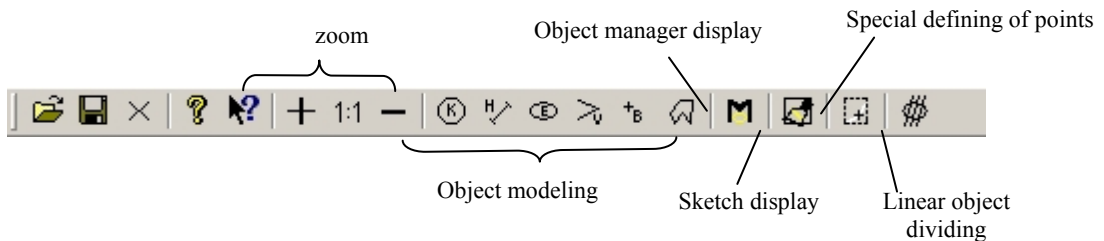


Figure 1 – Toolbar 1

Special defining of points – on/off mode of special defining of points.

Sketch display – on/off sketch mode. When on, a board with graphic tools displays.

Linear object dividing – starts a linear 2D object dividing.

Another part of toolbar serves to deal with objects:

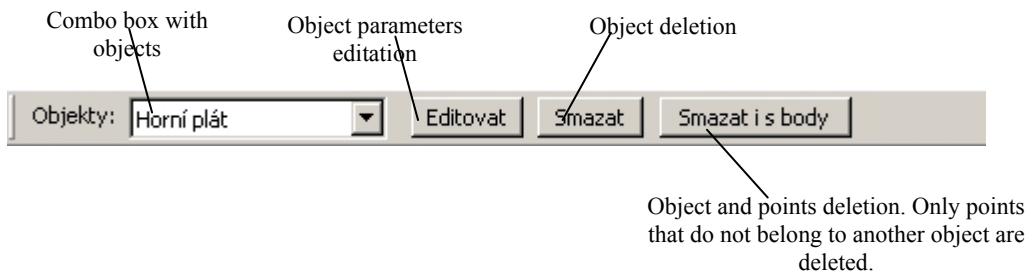


Figure 2 – Toolbar 2

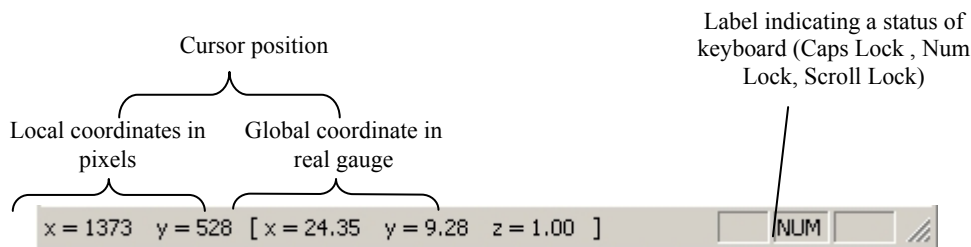


Figure 3 – Status row

Object manager

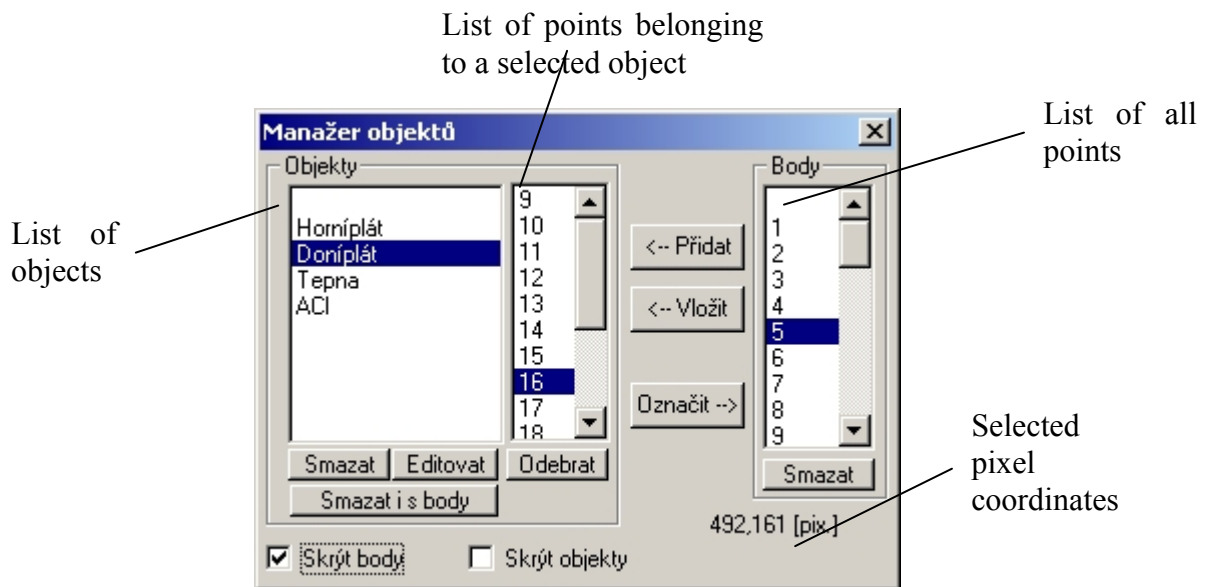


Figure 4 – Object manager

Object manager provides a comfort work with FTM scene possibility.

Linear object dividing

The main function of this tool is to provide inputs for Fotom2, Fotom5 and Fotom6. Sometimes we need to observe change of spatial parameters of object (e.g. transverse of object) We can easily use Fotom 2, 5, 6 moduluses, but they can deal only with a series of images. Linear object dividing generates FTM files that inherit a picture and parameters from the original image, but the objects of interest are different (e.g. different transverse).

Grid – image and objects dividing

helps an user to points of interest determining and objects analyzing (see Figure 8) Grid can be:

Rectangular - allows „X“ and „Y“ axes dividing

Cylindric- allow to reference coordinate setting. „Y“ axis dividing can be performed in mm or in degrees. „X“ axis can be linear or spheric.

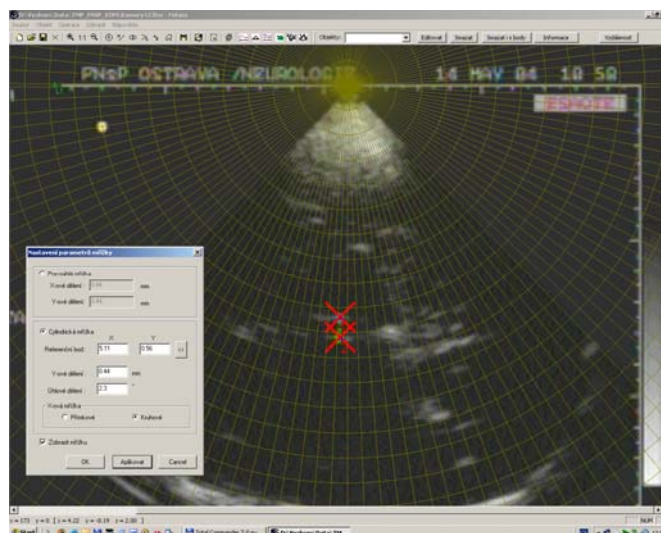


Figure 5 – A grid tool

Graphic tools

There is a „sketch“ tool to make the work with an image more comfortable. The sketch works in two modes. In first mode a original bitmap is displayed on background. In another mode a copy of original image is displayed and an user have graphic tools set to modify this copy. One can switch between these modes and can compare a modified sketch with an original image. Graphic tools are described below:

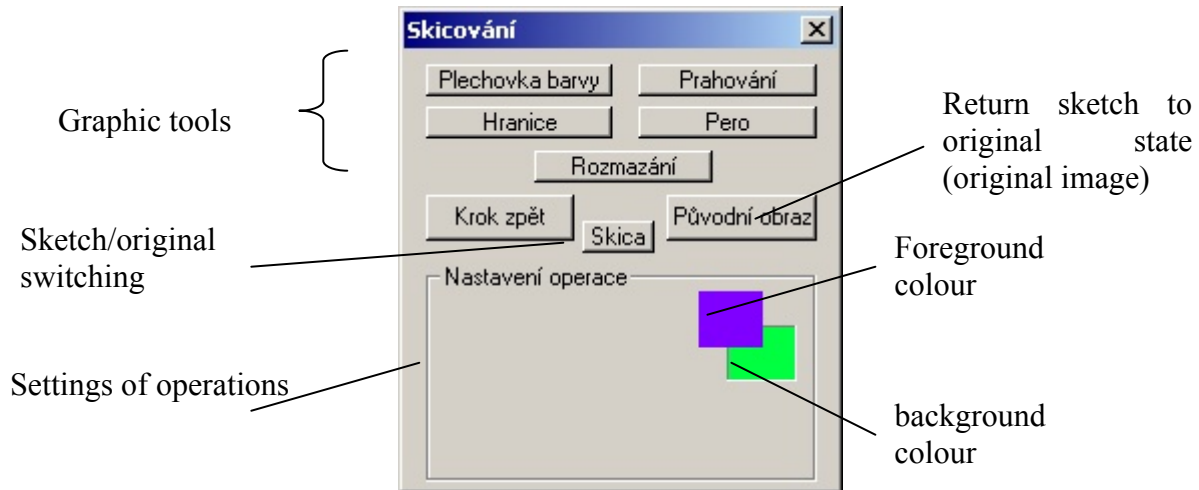


Figure 6 – Graphic tools - „Sketching“

Thresholding (Prahování)

Thresholding is very often used as one of the simplest methods of regions detection. The output of this method is a binary image.

Filling

A tool known as „tin of colour“. It serves to fulfil a region of pixels with similar brightness value.

Border

By the mean of thresholding or fulfilling we determined regions belonging to objects, but to metering we need an explicit knowledge of these objects border.

This tool generates a set of points that describe object border.

Smoothing

A border tool makes objects and points defining more comfortable and effective, but due to a small signal/noise ration, the border is very often furrowy. Smoothing serves to flatten a border to approximate it to real state.



Figure 7 – An object (A) and object after smoothing (B)

An algorithm results from averaging of brightness in the surround of each pixel.

Pen

It is useful for a specialist who can complete a border of object if a part is missing.

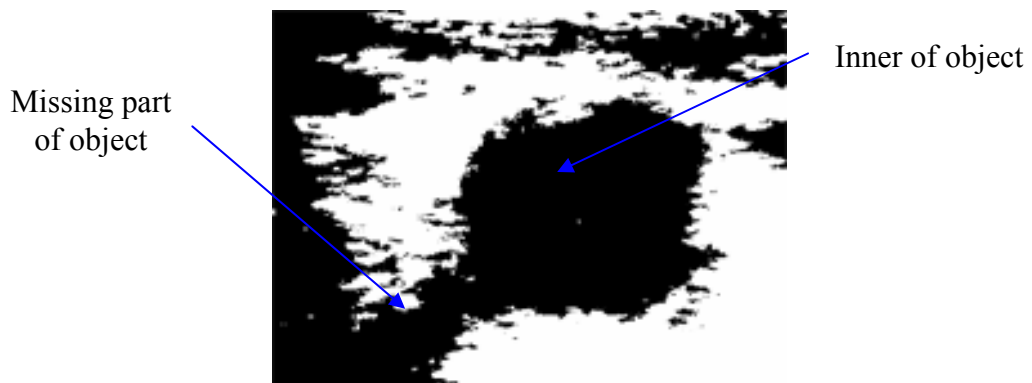


Figure 8 – Transversal image after thresholding

4 Conclusion

Detailed image analysis is very important because it is the major factor of efficiency of photogrammetrical information included on image. Methods described were experimentally verified. The contribution described application in FOTOM system.

Results achieved confirm process rightness and this system can be successfully used for objects metering by the mean of photogrammetric method.

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9 References

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