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PARAMETERS AND SHAPE OF METERED OBJECTS OF INTEREST IN ULTRASOUND IMAGES MONITORING

PARAMETRY A MODELOVÁNÍ ZÁJMOVÝCH OBJEKTŮ VE ZPRACOVÁNÍ ULTRAZVUKOVÝCH SNÍMKŮ

Abstract

Contribution describes the photogrammetric system FOTOM, developed at the Department of Computer Science FEI VSB TU Ostrava for the medical diagnostics, especially for the ultrasonic picture evaluation. The main goal of 2D and 3D simulation of objects of interest in ultrasound images is to present measured data in other way than in form of records displayed in tabular or result sets. The contribution deals with modern methods of image processing in terms of objects of interest metering. The system FOTOM is described bellow together with its functions. Especially new modulus for comparing of metering, 3D modelling and 2D animation are described.

Abstrakt

Příspěvek se zabývá popisem fotogrammetrického systému FOTOM, který byl vyvinut na Katedře informatiky FEI VŠB TU Ostrava pro diagnostiku v medicíně, konkrétně při hodnocení snímků ultrazvuku, magnetické rezonance a rentgenu. Zde je popsáno použití systému FOTOM při hodnocení snímků ultrazvuku. Cílem řešení systémem 2D a 3D simulací zájmových objektů na ultrazvukových snímcích je poskytnout měřená data jinak, než formou čísel v tabulkách. Příspěvek pojednává o moderních metodách zpracování obrazu ve smyslu měření zájmových objektů. Je zde popsán systém FOTOM spolu s jeho funkcemi. Zvlášť jsou popsány nové moduly 3D modelování, 2D animace a srovnání měření.

1 INTRODUCTION

The main goal of form and parameters metered objects on ultrasonic pictures monitoring and 2D and 3D simulation of the process metering is to present measured data, namely in a standard way but also and in quite other way than are records displayed in tabular or result sets.

2 2D MODELING

FOTOM2 is the modulus, which solves 2D simulation (see. Fig. 1).

There are six kinds of object of interest: point, edge, cusp, circle, ellipse and polygon. These objects are defined in point editation mode.

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Description of the objects:

Point – The simplest object, simple point. The only parameters are the coordinates of the point.

Edge – Object defined by two points forming abscissa. The parameters are coordinates of those points and the centre of abscissa.

Cusp – It is a point of intersection of two lines. Every line is defined by two points. Cudo is also defined by four points. The important parameter is coordinate of the cusp.

Circle – The parameters of circle are centre, radius, volume and intensity. A circle is defined at least by three points.

Ellipse – The parameters are: centre, size of half axles, rotation about an x-axle, volume and intensity of the ellipse. Ellipse is defined by five points.

Polygon – Polygon is closed path defined by n-points bound together with n-1 lines. We observe decision point coordinates, volume and intensity of the polygon.

2.1 Rotation of objects

Let's imagine an object with circle form. If we watch the object abeam, we can get various resolutions. It depends on angle we watch the object. This is the purpose, why various possibilities of angle options is needed, so called objects rotation.

2.2 Distance between objects

If we watch plot with distance between objects on y-axis, we can see the position change between objects in terms of all profiles together.

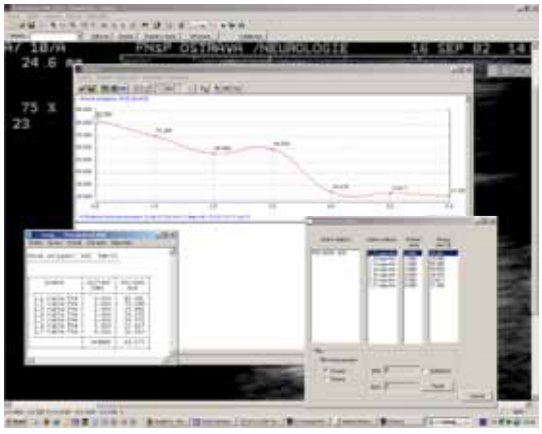

Fig. 1 FOTOM2 modulus – 2D simulation

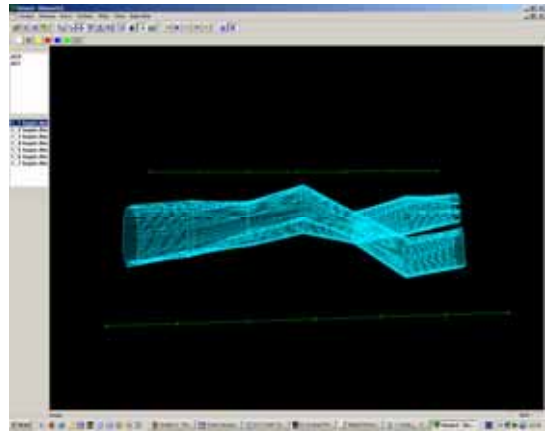

Fig. 2 FOTOM3 modulus – 3D simulation

3 3D SIMULATION

FOTOM3 modulus solves 3D simulation, see Fig. 2. To display 3D scene on monitor, we must transform this scene. Following sections describe some methods of transformation.

3.1 Central projection

Central projection transformation is defined by realization:

$$P_2 = \begin{bmatrix} x_1 & y_1 & z_1 & 1 \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & -1/d \\ 0 & 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} x_1 & y_1 & 0 & 1 - z_1/d \end{bmatrix}, \qquad (1)$$

where:

P_1 – point position $P_1=(x_1, y_1, z_1)$,

P_2 – explored point position $P_2=(x_2, y_2, z_2)$,

d – projection plane distance.

3.2 Parallel projection

$$M_{prav} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}, \tag{2}$$

where:

M_{prav} – rectangular projection matrix.

4 METERING PROCESS ANIMATION

The main goal is to present metered data in the other way than in graphs. Each image is rotated and scaled to obtain regular join of images.

Objects animation – Objects animation is the main representative mode in FOTOM4 modulus. It displays object of interest and we can analyze or present metering by observing position or geometrical properties of objects of interest.

Image animation – It can give us the first conception about quality of the images, about quality of scanning process.

5 DIVERGENCE METERING AND SYNTHESIS OF TWO METERING

5.1 Divergence metering

There are two methods how to establish a divergence:

Divergence from arithmetic mean – This method establish a divergence as a difference of the value of object and the arithmetic mean.

Divergence from project values – In this case we suppose that we know prototypal values of the parameters. We have to create a project file that defines all the parameters needed.

FOTOM5 solves problem of divergence metering, see Fig. 3.

5.2 Two measurement comparison

In some cases we need to find out parameters changes since last metering. It is suitable to display parameters of last and actual metering to one graph. FOTOM6 serves to solution of this situation, see Fig. 4.

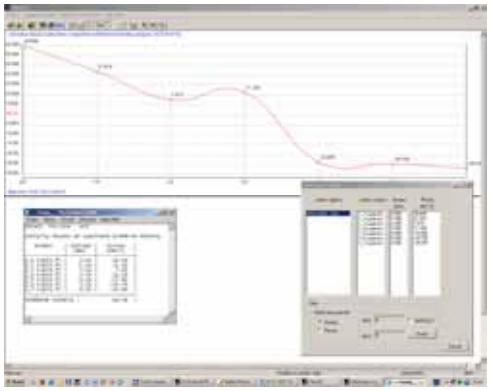

Fig. 3 FOTOM5 modulus example

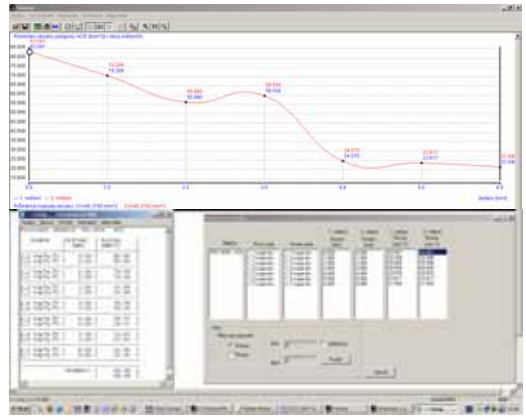

Fig. 4 FOTOM6 modulus example

6 CONCLUSIONS

This contribution deals with modern methods for picture processing, evaluation, objects recognition and measurement. System FOTOM, described in the contribution, allows 2D and 3D simulation and object animation, points and object recognition and measurement. Its usage for medical area is demonstrated by ultrasonic, magnetic resonance and RTG pictures evaluation. System FOTOM could be seen as a robust complex system for one-picture photogrammetry on a very high quality level.

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