CREATING 3D MODELS FOR CAD SYSTEMS OF OFFLINE PROGRAMMING ROBOTS

Ing. Jaroslav Hricko, PhD.
Institute of Informatics
Slovak Academy of Sciences
Ďumbierska 1, 974 01 Banská Bystrica
e-mail: hricko@savbb.sk

Ing. Marek Vagaš, PhD.
Technical University of Košice
Faculty of Mechanical Engineering
Department of Robotics
Park Komenského 8, 040 01 Košice
e-mail: marek.vagas@tuke.sk

Ing. Ľuboslava Šidlovská
Technical University of Košice
Faculty of Mechanical Engineering
Department of Production Systems
Boženy Nemcovej 32, 040 01 Košice
e-mail: luboslava.sidlovska@tuke.sk

Abstract

One of the ways to capture object is a photogrammetry. Currently we offer to create 3D models for new advanced methods by digital photogrammetry. Its advantage is high degree of process automation and precise realism. To digitize and create 3D models by using this method we need a digital camera and image processing of taken pictures with the help of photogrammetric software and PC.

Key words: Photogrammetry, methods of digital photogrammetry

INTRODUCTION

One of the ways to digitize an object is also photogrammetry. Currently, we offer to create 3D models of new advanced digital photogrammetry method. Its advantage is high degree of process automation and precise realistic painting. To digitizing and creating 3D models is using this method, we need a digital camera and processing photographing images of the object, photogrammetric software and PC.

"PHOTOMODELER" SOFTWARE

PhotoModeler (Fig.1) is a photogrammetric system for contact-free creation of 3D models.Also, the creation of a model we can perform by 2D and 3D measurements.

Object must be captured so that, different image capture of same part of the object at least two different angles [1]. The evaluation of object on multiple frames is increased measurement accuracy. PhotoModeler software environment allows calibrating digital photogrammetric camera and then using acquired data for accurate measurement and then evaluation of images taken by a calibrated camera with calibration field.

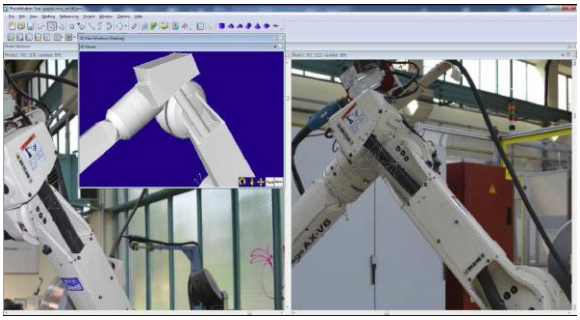

Fig. 1 Photogrammetric SW Photomodeler

Environment of photomodeler allows us to export result to CAD and DCC software such as AutoCad, MicroStation, 3ds Max, Rhino, Maya etc. (Figure 7). Modeled and textured object can be fitted to the real coordinate system and exported as a list of coordinates, orthophotos, 3D model, or video [2].

METHODOLOGY

PhotoModeler is software for Windows which transmits powerful options in photogrammetry computer, so that we can model real objects and scenes from photos [3]. The basis of this method is to measure spatial position of intersection point of frame at pre-measured coordinates of these points. The intersecting method requires at least two overlapping images. All calculations are performed automatically in the appropriate photogrammetric software.

If we want to create a 3D model of object, we first have to create its images. These will be subsequently treated in photogrammetric software [4]. The way the object will be taking pictures should not be anything. The following recommendations indicates that optimum shooting positions to choose from (where make photos) and how to choose direction of axis of image (such as images orient to object). Recommendations to object capturing for 3D model create:

1. Axis image should be at an approximate right angle (Figure 2). If it does not permit conditions of capturing, may be smaller intersection angle (less than 10 °). The smaller angle of intersection greatly affects accuracy of the resulting 3D model.

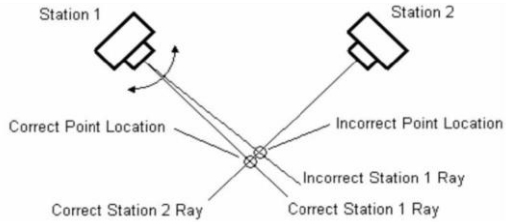

Fig. 2 Axis image position for camera

2. Photographing object should fulfill the maximum area of the image. Each point should be shown on at least three images (Figure 3).

3. The spatial model will be more accurate if points are displayed on multiple images [5].

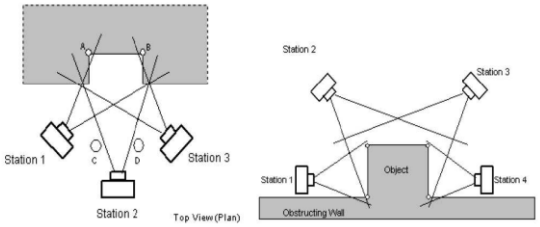

Fig. 3 Axis image position, camera position for accurate space model

4. For capturing, we can use circle method or method for multiple ring rings (Figure 4).

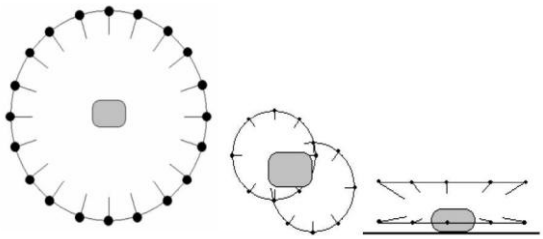

Fig. 4 Circle capturing method

5. The optimal position of cameras with capturing object displays Fig.5.

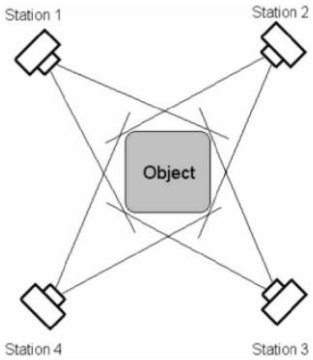

Fig. 5 Optimal position for camera

6. Check the battery status before frame rate of object, because during capturing cannot turn off digital camera, it could be a change in values of elements at internal orientation photographic apparatus [6].

7. Also, when we have switched mode for power saving of digital camera so we must it turn off in the camera menu.

8. All images we take picture with same focal length (not using zoom - disable auto focus), with which the subject later be captured.

9. It is appropriate to manually set focus on a given distance.

10. Set maximum resolution for digital images.

11. Images must be a contrast.

12. Turn off image stabilizer.

13. We will ensure sharpness so that we use a tripod when shooting.

14. We will keep the original format image, do not change their size by adjusting the graphic programs, or otherwise alter.

CREATE 3D OBJECT FROM REAL OBJECT

Methodology for creating of 3D models of real objects describes process from photographing images of real object according to the principles of imaging to export 3D models into a suitable format (Fig. 6). When creating 3D models of complex objects must monitor and eliminate factors that influence the resulting uncertainty model [7].

It is especially suitable photographic camera calibration and the size of calibration field, because the very process of creating a 3D model occurs in images created by cameras, therefore it should be appropriately chosen photographic camera [8].

If is 3D model completed, the final phase is its export. Before export we must recognize for what purpose model were created to serve and depending on him export to the corresponding output format.

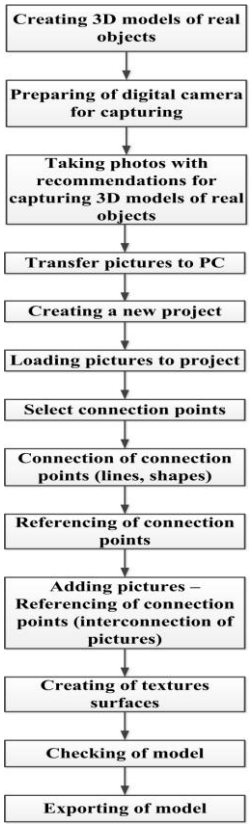

Fig. 6 Methodology for creating 3D model of real object

CONCLUSION

Digital photogrammetry represents modern technology to create 3D models of objects by using digital photos. It is a new method that still looking for their place in the creation of 3D models and if we compare with laser scanners, is much cheaper. The application of this method can be found in construction and architecture. Development of this method brings into the field of 3D models of real objects new business possibilities based on digital photos.

Creating 3D models from digital photos by using photogrammetric software offers a potent and powerful tool for acceptable price for use in different areas. It can be assumed that the development of ICT technologies together with ever-increasing power of computers, this method simplifies and will be available for a wider range of applications.

References

[1] B, V. – Beloveščík, A. – Dulenčin, P. – Páchniková, L.: Možnosti využitia virtuálneho systému - MSEVR, In ROBTEP 2011 : Automatizácia / Robotika v teórii a praxi : zborník príspevkov z 11. medzinárodnej konferencie : 16.12.2011, Košice. - Košice : TU, SjF, 2011 S. 17-22. - ISBN 978-80-553-0846-3.

[2] Tolnay, M. et al. Využitie virtuálnej reality a 3D modelovania v simulácii systémov [elektronický zdroj]. - Bratislava: Nakladateľstvo STU, 2011. - 86 s. : CD ROM. - ISBN 978 80-227-3612-1

[3] Popeová V. - Cubonová N. - Urícek J. - Kumicáková D.: Automatizácia strojárskej výroby. Žilina EDIS - vydavatelstvo ŽU, 2002, ISBN 80-8070-009-5.

[4] Semjon, J., Vagaš, M., Baláž, V.: The process projecting automated and robotized system based on CA methods and modularity, In: International Scientific Herald. Vol. 3, no. 2 (2012), p. 156-160., ISSN 2218-5348.

[5] Nieszporek T., Piotrowski A.: Parametric Programming of CNC Machine Tools - 2013. In: : Applied Mechanics and Materials Vol.282, Robotics in Theory and Practice, p.203-210 ISSN 1660-9336

[6] Swic A., Zubrzycki J., Taranenko V.: Modelling and Systematic Analysis of Models of Dynamic Systems of Shaft Machining - 2013. In: Applied Mechanics and Materials Vol.282, Robotics in Theory and Practice, p.211-220 ISSN 1660-9336

[7] A. Olaru: Virtual LabVIEW instrumentation, Bren Publishing House, Bucharest, (2001).

[8] Novotný, F. Horák, M.: Computer modeling of suction cup sused for Windows cleaning robot and automatic handling of glass sheets. In: MM Prumyslove spektrum – MM Science Journ., 2009, s. 113-116, ISSN 1803-1269

Acknowledgments

This publication is the result of the project implementation: Research modules for intelligent robotic systems (ITMS: 26220220141) supported by the Research & Development Operational Program funded by the ERDF.

This paper presents the research work supported by the national scientific grant agency VEGA under project No.: 2/0048/13 "(Micro) Electro-mechanisms for robotics and extremely work spaces (environments)."