The Integration of 3D Rendering Technologies and Its Application to Medical Imaging

張喬萍、張顧耀

E-mail: 9607552@mail.dyu.edu.tw

ABSTRACT

Three dimensional rendering technologies have been play a vital role medical imaging applications, including surface rendering and volume rendering. In clinical applications, however, only one rendering method is adopted at a time. The surface rendering allows physicians to view an object in three dimensional shape, but no gray level information of voxels is available. The volume rendering, on the contrary, can display only the voxels' gray level information, not its three dimensional structure. This paper describes an approach to the integration of the above-mentioned rendering methods. And based on the visualization features provided by VTK, we combine these two different approaches into a new one. The integrated results can display not only an object's three-dimensional structure, but also its gray level information on a user-specified plane. Furthermore, we apply this integration approach into the virtual colonoscopy application. This makes it possible for a physician to not only navigate the colon, but also see the gray level information on the plane of interest. Such integration can help a physician save a lot of time and decide whether a polyp exists or not.

Keywords : Three-dimensional Rendering, Surface Rendering, Volume Rendering, Virtual Colonoscopy

Table of Contents

REFERENCES

[1] Abhir Bhalerao, Hanspeter Pfister, Michael Halle, Ron Kikinis, “ Fast Re-Rendering Of Volume and Surface Graphics By Depth, Color, and Opacity Buffering, ” Medical Image Analysis, Volume 4, Number 3, pp. 235-251(17), 2000.

[2] Roberts, J.C., “ An Overview of Rendering from Volume Data including Surface and Volume Rendering, ” Technical Report 13, Computer Science at Kent, University of Kent, Canterbury, UK, 1993.

[3] Kitware Inc., “ The Visualization Toolkit, ” U.S.A., Kitware Inc., 2004.

[4] Lorensen, W.E., Cline, H.E., “ Marching cubes: A High Resolution 3D Surface Construction Algorithm, ” Computer Graphics, Volume 21, Number 4, pp. 163-169, 1987.

[5] Suya, You, Lichan, Hong, Ming, Wan, Junyaprasert, K., Kaufman, A., Muraki, S., Yong, Zhou, Wax, M., Zhengrong, Liang, “ Interactive volume rendering for virtual colonoscopy, ” IEEE Visualization, pp. 433-436, 1997.

[6] Ooijen, P. M. A. van, van Geuns, R. J. M., Rensing, B. J. W. M., Bongaerts, A. H. H. de, Feyter, P. J., Oudkerk, M., “ Noninvasive Coronary Imaging Using Electron Beam CT: Surface Rendering Versus Volume Rendering, ” American journal of roentgenology, Volume 180, pp. 223-226, 2003.

[7] Summers, RM, Feng, DH, Holland, SM, Sneller, MC, Shelhamer, JH, “ Virtual Bronchoscopy Segmentation Method for Real-Time Display, ” Radiology, Volume 200, pp. 857-862, 1996.

[8] Christian, Tietjen, Tobias, Isenberg, Bernhard, Preim, “ Combining Silhouettes, Surface, and Volume Rendering for Surgery Education and Planning, ” IEEE VGTC Symposium on Visualization, 2005.

[9] Chen, D., Wax, M.R., Li, L., Liang, Z., Li, B., Kaufman, A.E., “ A Novel Approach to Extract Colon Lumen from CT Images for Virtual Colonoscopy, ” IEEE Transactions on Medical Imaging, Volume 19, Number 12, pp. 1220-1226, 2000.

[10] Ramin, Shahidi, “ Surface Rendering versus Volume Rendering in Medical Imaging: Techniques and Applications, ” IEEE Visualization, pp. 439-440, 1996.

[11] Wei, Li, Arie, Kaufman, Kevin, Kreeger, “ Real-Time Volume Rendering for Virtual Colonoscopy, ” Volume Graphics, 2001.
[12] Kitware Inc., “ The VTK User ’ s Guide, ” U.S.A., Kitware Inc., 2004.
[13] Sato, M., Lakare, S., Wan, M., Kaufman, A.E., Liang, Z., Wax, M.R., “ An Automatic Colon Segmentation for 3D Virtual Colonoscopy, ” IEICE Transactions on Information and Systems, E84-D(1), pp. 201-208, 2001.
[14] 黃千芳、賴世偉和劉秋松, “ 大腸癌的篩檢 ”,基層醫學, 第二十 一, 第七期, 頁193-196, 民國94 年。
[15] Ko, C.C., Jang, J.W., “ Interactive Polyp Biopsy based on Automatic Segmentation of Virtual Colonoscopy, ” Proceedings of the Fourth IEEE Symposium on Bioinformatics and Bioengineering, pp. 159-166, 2004.
[16] Hong, L., Kaufman, A., Wei, Y.C., Viswambharan A., Wax M., Liang Z., “ 3D Virtual Colonoscopy, ” Proceedings of the 1995 Biomedical Visualization, pp. 26-32, 1995.
[17] Lee, T.Y., Lin, P.H., Lin, C.H., Sunm, Y.N., Lin, X.Z., “ Interactive 3-D Virtual Colonoscopy System, ” IEEE Trans on Information Technology in Biomedicine, Volume 3, Number 2, pp. 139-150, 1999.
[18] Ronald, M. Summers, Christopher, F. Beaulieu, Lynne, M. Pusanik, MEng, James, D. Malley, R. Brooke Jeffrey, Jr, Daniel, I. Glazer, Sandy, Napel, “ Automated Polyp Detector for CT Colonography : Feasibility Study. Radiology, ” 216:284 – 290, 2000.
[19] Yoshida, H., Nappi, J., MacEneaney, P., Rubin, D.T., Dachman, A.H., “ Computer-aided Diagnosis Scheme for Detection of Polyps at CT Colonography, ” Radio Graphics, Volume 22, Number 4, pp. 963-979, 2002.