

Mvox: Interactive 2-4D Medical Image and Graphics Visualization Software

Morten Bro-Nielsen

Department of Mathematical Modelling, Technical University of Denmark
e-mail: mvox@imm.dtu.dk

1. INTRODUCTION

Mvox is a new tool for visualization, segmentation and manipulation of a wide range of 2-4D grey level and colour images, and 3D surface graphics, which has been developed at the Department of Mathematical Modelling, Technical University of Denmark.

The principal idea behind the software has been to provide a flexible tool that is able to handle all the kinds of data that are typically used in a research environment for medical imaging and visualization. At the same time the software should be easy to use and have a consistent interface providing locally only the functions relevant to the context. This has been achieved by using Unix standards such as X/Motif/OpenGL and conforming to modern standards of interactive windowed programs.

2. DATA

Mvox can handle images with different no. of slices, no. of colours, no. of time instances and has been successfully used in the past to visualize and segment:

- 2-3D medical images with stacks of slices (CT, MR, etc.)
- 2-3D RGB images such as histological slices from the Visible Human [1]
- 2D remote sensing images with many channels
- 3D surface graphics - as used in CAD programs and produced by the built-in Marching Cubes-like [2] iso-surface routine - which can be exported in VRML format for use on the World Wide Web (WWW)
- Time sequences of all the above.

With support for this wide range of different data types, Mvox covers most needs and, therefore, allows the user to stay in one software package instead of having to use many different programs.

3. FUNCTIONALITY

Segmentation can be performed manually on both RGB colour and grey level images using the drawing and contour definition facilities, thus allowing manual segmentation of eg. 3D CT images or 2D colour images of histological slices. For semi-automatic segmentation, Mvox provides interactive/automatic thresholding and statistical classification using discriminant analysis.

Segmented images can be visualized along with the original images using either 3D iso-surfacing [2] (similar to Marching Cubes [3]), Volume Rendering (using the VolPack library [4]) or the built-in fast display of orthogonal slices. In addition, stacked contours can be combined into 3D structures (using the Nuages package [5]).

In cases where several modalities (eg. MR and CT) have been acquired of the same patient, Mvox can register these multimodal images using landmark based registration. Voxel based multimodality registration is being incorporated into Mvox at the moment.

Additional features include Histogram, Histogram stretch, Statistics, Enlargement, Colourmaps, Overview window, Advanced command line interface, User-defined functions etc.

Mvox can read and write the following image formats: ANALYZE, TIFF, SGI, TGA, BMP, Inimage, HIPS, BRIMG. For 3D surface graphics renderings it supports the 3D formats: Import: CyberWare, OFF, Flex3D - Export: VRML, DXF, Inventor, Flex3D.

The images in this paper show different screen shots from Mvox giving an impression of the user interface and the functionality. For more information and a free demo version, please refer to the Mvox WWW homepage:

<http://www.imm.dtu.dk/documents/users/mvox/>

REFERENCES

1. M.J. Ackerman, *Accessing the Visible Human Project*, D-Lib Magazine, October 1995
2. G. Wyvill, C. McPheeters and B. Wyvill, *Data structure for soft objects*, The Visual Computer, 2:227-234, 1986
3. W.E. Lorensen and H.E. Cline, *Marching Cubes: A high resolution 3d surface reconstruction algorithm*, Computer Graphics, 21(4), July 1987
4. P. Lacroute and M. Levoy, *Fast Volume Rendering Using a Shear-Warp Factorization of the Viewing Transformation*, Proc. SIGGRAPH '94 (Orlando, Florida, July 24-29, 1994). In Computer Graphics Proceedings, ACM SIGGRAPH, pp. 451-458, 1994
5. B. Geiger, *Three-dimensional modeling of human organs and its application to diagnosis and surgical planning*, INRIA Technical Report 2105, Dec 1993

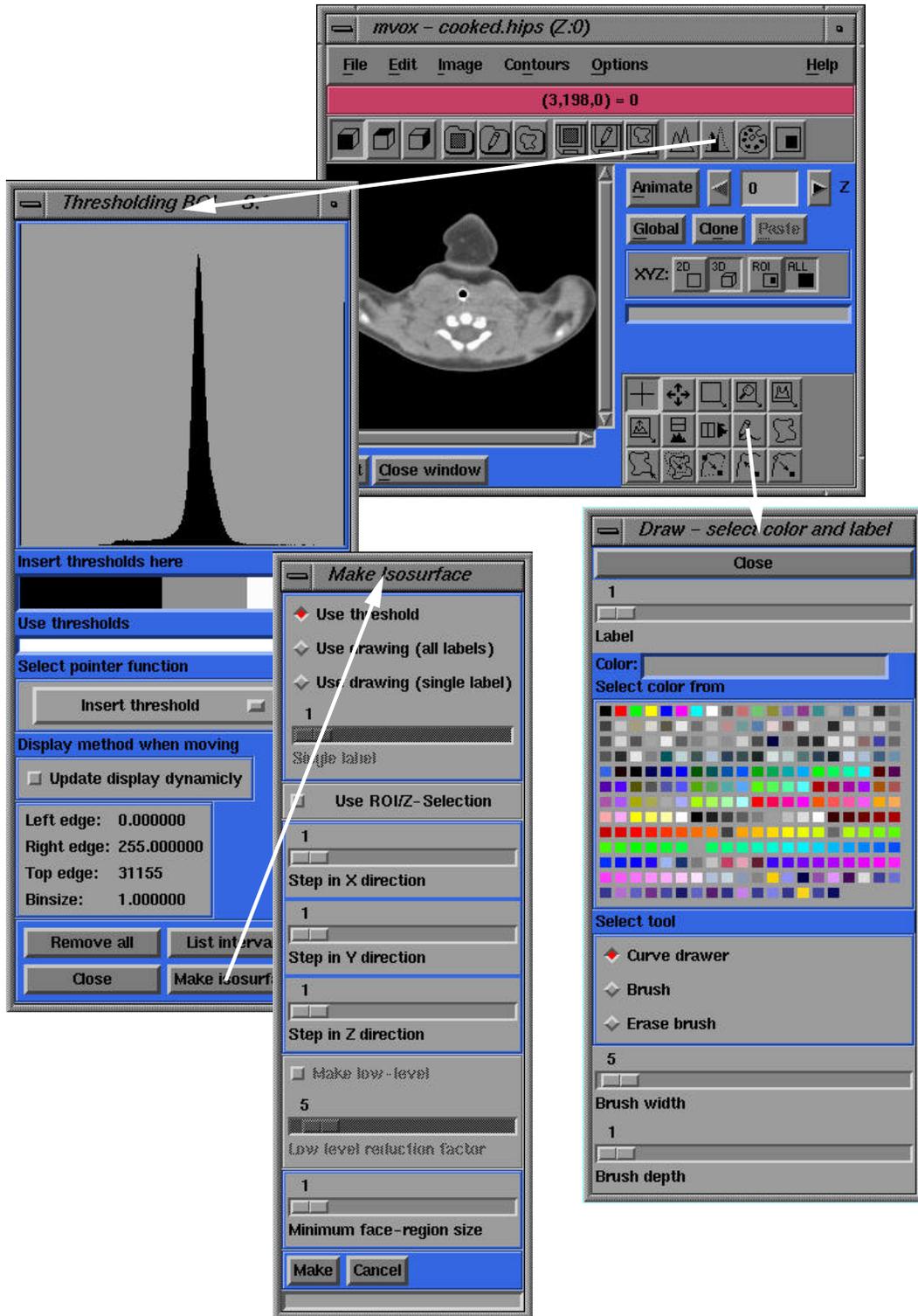


Figure 1: Mvox image viewer with threshold, iso-surface and draw windows.

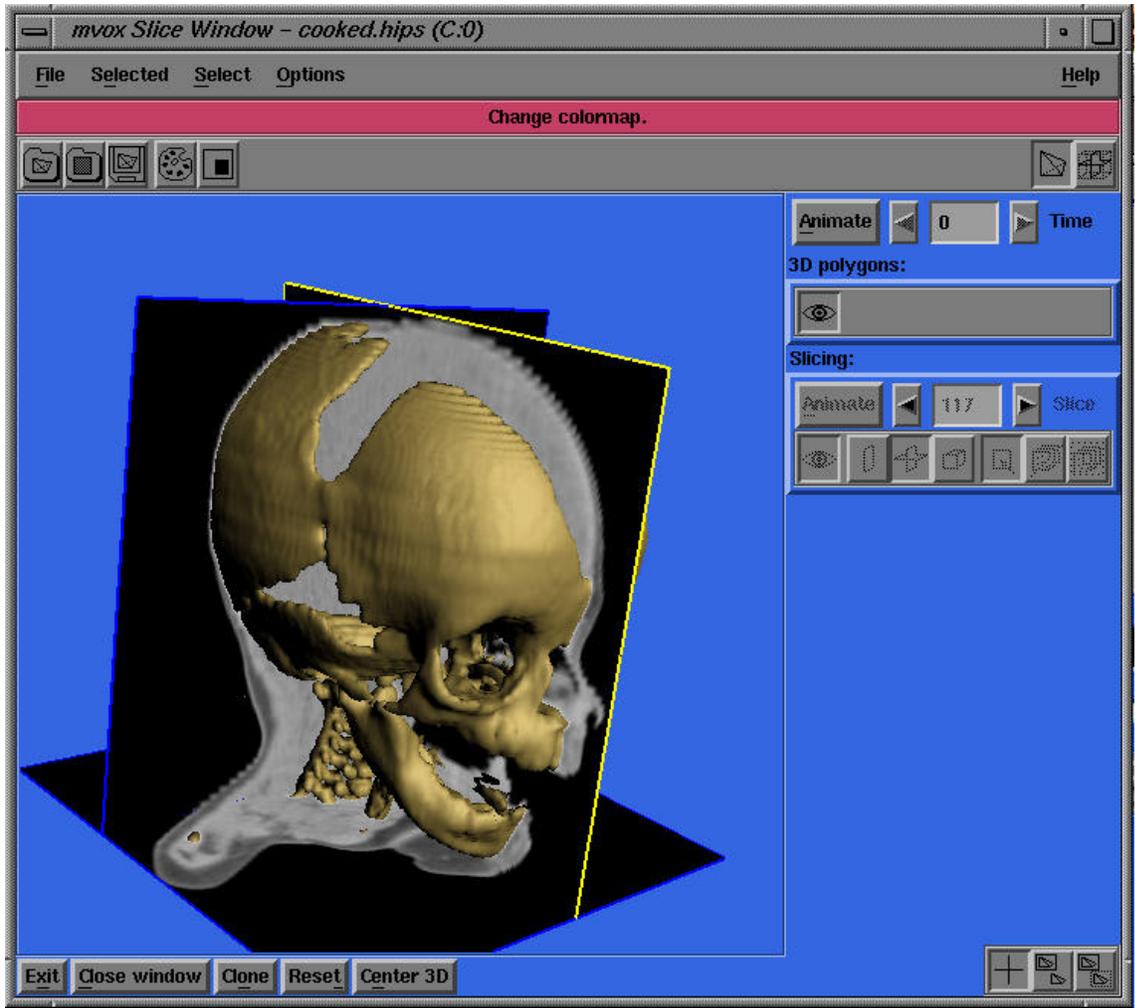


Figure 2: Mvox 3D visualization of fast slices and iso-surface

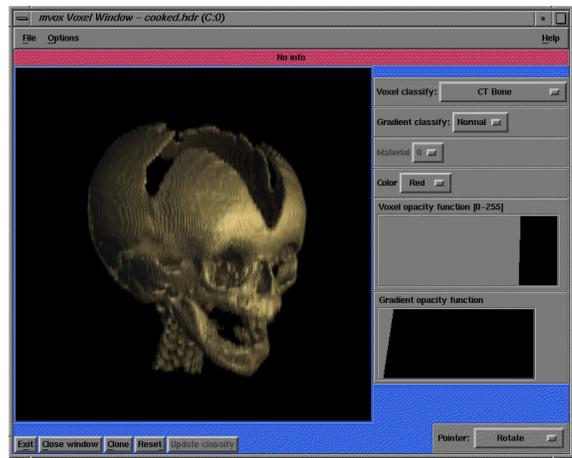


Figure 3: Mvox volume rendering