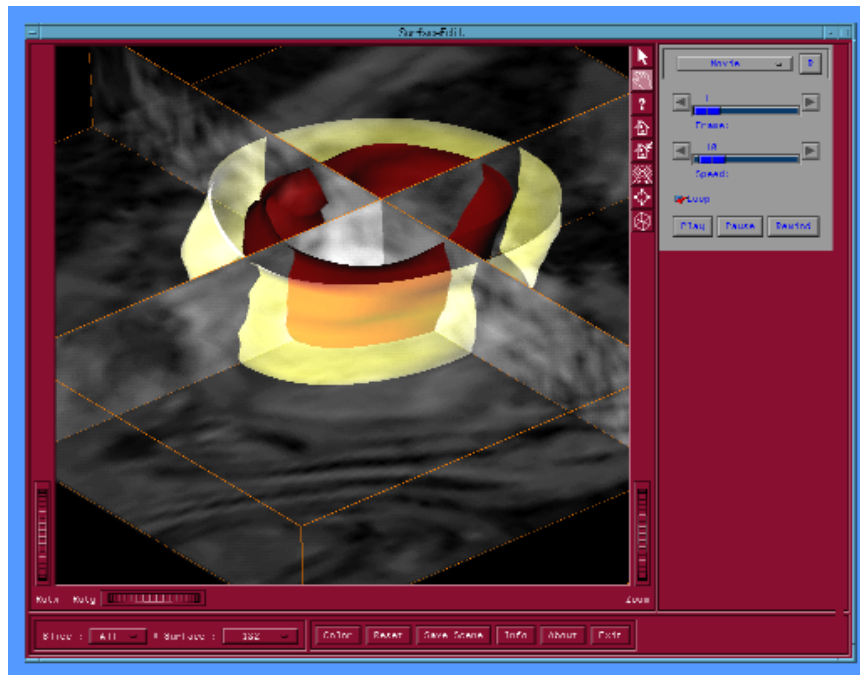# Visually Interactive Cine-3D Segmentation of Cardiac MR Images

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For estimating quantitative regional myocardial surface deformation and volume changes from Cine-3D Cardiac MR images, a fast and accurate segmentation method is needed as this is a time consuming process. This handout describes a software package *SurfaceEdit* designed to reduce the time needed to accurately segment cardiac images.

SurfaceEdit has an intuitive user interface and can simultaneously display orthographic views of the 3d-image and multiple surface sections as well as multiple 3D surface rendering

from any angle. All of the above can also be displayed in cine-mode. The colors and transparency of the surfaces can be edited to allow the user to display one surface inside another. The software development was done in C++ using the Open Inventor 3D Graphics Toolkit and the Motif toolkit on the Silicon Graphics(SGI) Platform. The machine we use at Yale to run this program is a low-end SGI O2 workstation, costing less than $6000.

We use a deformable contour-commonly known as snake- based segmentation to extract contours on short-axis slices and then form the surfaces using a Delaunay Triangulation. The contours are parameterized using B-Splines which allows for easy editing by moving control points, so that the expert user can easily correct for cases where the image data is not ideal. The editor also allows the user to edit upto four contours at any given time.
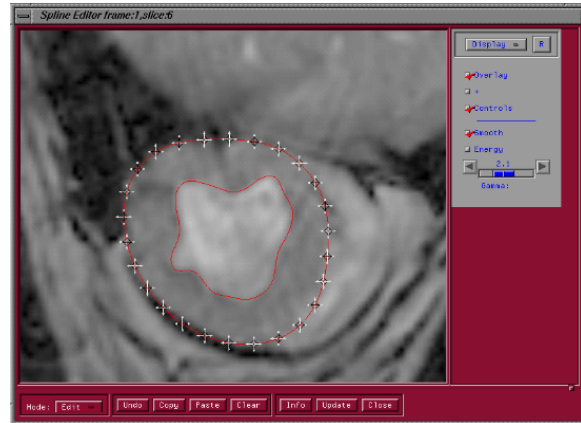

Figure 1: The Editor Module

The user has almost instantaneous feedback in 3D of any changes made in the 2D contour editor. Contours can be propagated both spatially and temporally which reduces the amount of manual input necessary and takes advantage of the smooth variation of the contours across time and space.

We are currently using this program in two projects; the evaluation of Transmyocardial Laser Revascularization and as part of on-going research in developing algorithms for the estimation of myocardial deformation from image data. In the future we are hoping to add facilities for editing data acquired in non-parallel slices, such as echocardiography.
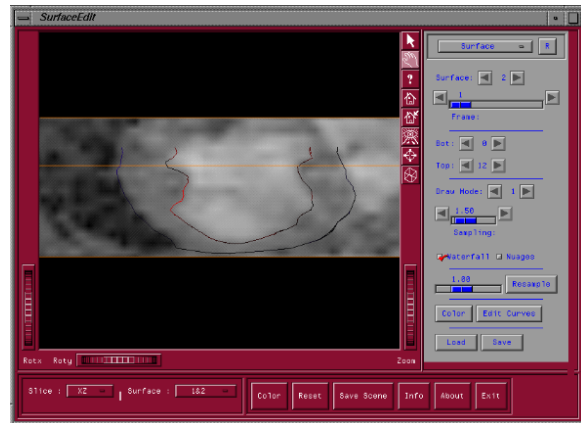

Figure 2: A long axis view

Conclusion: This software package is designed to allow for fast, accurate segmentation with easy user feedback. This coupled with the simultaneous display of 3D images and surfaces in both static and cine-mode has resulted in a 70% reduction of the time taken to process a complete set of images(from around 16 man-hours per study). The reduction in processing time is an important step towards clinical applications of cardiac MR images.

For more information about obtaining and using *SurfaceEdit* please contact the £rst author.