

Chapter IX

Software Framework of Medical Visualization Algorithms

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ABSTRACT

Real-time visualization algorithms which are fully integrated into software framework are of importance for the rapid development of medical visualization applications. This chapter gives an overview of different software frameworks for real-time visualization algorithms. These algorithms are fully integrated into some open-source freely-available software frameworks. First, we introduce the famous Visualization Toolkit (VTK), and we then describe some other specialized toolkits, for example, for image registration and segmentation, MAF (Multimod Application Framework) supported by an EC-funded project MULTIMOD. We discuss the majority of algorithms available that can be easily combined for rapid construction of visualization applications. Finally, we place emphasis on exploiting the characteristics of medical datasets for further utilizing the hardware-accelerated capabilities of modern graphics cards.

INTRODUCTION

Over the past three decades, computer graphics and visualization have played a growing role in adding value to a wide variety of medical applications. The earliest examples were reported in the mid 1970s when three-dimensional visualizations of computerized tomography (CT) data were first reported (McCloy, 2001). Today, a variety of imaging modalities (e.g., RX, CT, MRI, PET, endoscopy) are in common use by the medical profession for diagnostic purposes, and these modalities provide a rich source of data

for further processing using computer graphics techniques. Applications include medical diagnosis, procedures training, pre-operative planning, telemedicine, and many more (Robb, 1974). The researchers; use of new media technology demonstrates well how far the state-of-the-art has progressed since the early work in medical visualization, for several off-the-shelf surface and volume rendering techniques are available. Some typical medical visualization algorithms include surface rendering (e.g., Marching cubes iso-surface rendering), Volume Rendering, transfer function. However, researchers have to

re-develop or integrate some medical visualization algorithms for a specific medical application. Therefore, visualization algorithms which are fully integrated into software framework are of importance for the rapid development of medical visualization applications.

We can also find some open-source, freely-available software frameworks, and the main frameworks can be classified into five following categories:

1. The *Visualization Tool Kit* (VTK) (vtk, 2007), a visualization library developed and made available in the public domain by KitWare Ltd. The objective of the library is not for specific medical application, but for general visualization applications.
2. The *Surgical VTK* (SVTK) (svtk, 2007) is a collection of classes extending the VTK library with various new functions developed in the frame of the Multimod Project. It has been integrated in MAF software framework.
3. The *Insight Tool Kit* (ITK) (itk, 2007) is new software library aimed to provide the most extensive support to image registration and segmentation. It is the result of a collaborative effort between various research groups all located in the USA, promoted by the Library of Medicine to increase the exploitation of the visible human datasets.
4. The *Multimod Application Framework* (MAF) (maf, 2007) is the software framework that will be the final product of the Multimod project. Around the term “framework” in the software-engineering context, a document collecting some definitions from the literature is available. These definitions seem quite consistent with what we had in mind when we wrote the proposal, that is, a software infrastructure not aimed to solve a particular problem but rather to allow the rapid development of a variety of applications all within the same application context.

Since a framework is aimed to capture the context-specific intelligence we expect the patterns design approach to play a relevant role in the project.

5. The *Medical Imaging ToolKit* (MITK) (mitk, 2007), a C++ library for integrated medical image processing and analyzing developed by the Medical Image Processing Group, Key Laboratory of Complex Systems and Intelligence Science, Institute of Automation, the Chinese Academy of Sciences.

Below, we survey the history and development of the use of software frameworks, pay more concentration on MAF, and highlight the major medical visualization algorithms (e.g., volume rendering) that have been fully integrated into the software frameworks to date.

SOFTWARE FRAMEWORK OF MEDICAL VISUALIZATION ALGORITHMS

In this section, we will discuss the four software frameworks, and SVTK will be introduced in MAF section, for SVTK have been fully integrated into MAF framework.

VTK

The Visualization ToolKit (VTK) is an open-source, freely-available software system for 3D computer graphics, image processing, and visualization used by thousands of researchers and developers around the world. VTK consists of a C++ class library, and several interpreted interface layers including TCL/Tk, Java, and Python. Professional support and products for VTK are provided by Kitware, Inc. VTK supports a wide variety of visualization algorithms including scalar, vector, tensor, texture, and volumetric methods; and advanced modeling techniques such as implicit modeling, polygon reduction, mesh

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