AORTAGEOMRECON SOFTWARE ASSURANCE CASES

AORTA GEOMETRY RECONSTRUCTION SOFTWARE

ASSURANCE CASES

BY

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A REPORT

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                    Cases

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Abstract

Assurance cases has been proven to be effective developing a real-time system software.

Another domain that requires the high standard correctness, completeness is medical software.

Throughout the development of the Aorta Geometry Reconstruction software, we implicitly listed the evidences that are essential to build our confidence in the software for assurance cases, build the artifact and the evidences simultaneously.

Finally, we present this software with the list of the evidences built for assurance cases, to show that the assurance cases can apply well on the medical software

Your Dedication

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Acknowledgements

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Notation, Definitions, and Abbreviations

Notation

$A \leq B$ A is less than or equal to B

Definitions

Challenge   With respect to video games, a challenge is a set of goals presented to the player that they are tasks with completing; challenges can test a variety of player skills, including accuracy, logical reasoning, and creative problem solving

Abbreviations

AI   Artificial intelligence

Declaration of Academic Achievement

The student will declare his/her research contribution and, as appropriate, those of colleagues or other contributors to the contents of the thesis.

Chapter 1

Introduction

This chapter includes an introduction for AortaGeomRecon assurance cases project.

1.1   Objective

The main goals of this project starts with building a software that can quickly build the 3D geometry of the Aorta from CT Chest scans, while applying the assurance cases for this academic medical software. This project shows the assurance cases can indeed help build up our confidence in the medial software in general, because medical software like real-time system software, needed completeness and correctness.

1.2   Background

Aorta

The largest artery that carries blood from the heart to the circulatory system.

Aorta segmentation in CT scans is important for:

- Coarctation of the aorta

- Aortic calcification quantification

- To guide the segmentation of other central vessels.

Assurance cases

3D Slicer

Image Processing

1.3 Problem Statement

Build Software and Assurance cases for this software. Start with a list of Functional and Non-Functional requirements.

Chapter 2

AortaGeomRecon Research and Development

This chapter will discuss about the research and development of the AortaGeomRecon.

AortaGeomRecon stands for Aorta Geometry Reconstruction. The main objective of this software is to semi-automatically build 3D geometry of the Aorta from the patient's chest ct scans. The existing methods are often involved of extensive manual works with very complex software, with a minimum of 10 minutes of human operator, who is a medical domain expert.

The implementation till the date of this report can let the users who have the user characteristics described in SRS get the Aorta 3D geometry with only a few hyper-parameters and 2 minutes of execution time.

2.1   Existing Methods

There are many segmentation software available to the users, we will discuss the two main methods on two softwares.

- ITK-Snap

  ITK-Snap provides a segmentation method that first let user to select multiple voxels with a custom intial size and expanding size within any volume. We refer this method as "bubble method".

  Through many iterations, the voxels expand to fill the entire volume, finally user will need to cut the extra part of the volume.

  The advantages of the bubble method is that it guarantes to produce a correct the segmentation result. A medical domain expert can manually control the wanted area, and visually observing the segmentation result expanding, shrinking and the user can erase the unwanted part.

  The disadvantages of this method is that the operations described above are complicated. Eeasier to say then do, an opeartor who has previous experience building the geometry with this method still needed 20 minutes of manual work building a new aorta geometry. ITK-Snap software can only read VTK file, therefore the chest CT scans are usually DICOM needed a manual conversion before using this software and its segmentation method.

- 3D Slicer

  3D Slicer is another well-known medical image processing software for academic. 3D Slicer provides multiple segmentation methods, and one of the quickiest and easiest to use is the intensity based segmentation.

This method first let user select a small area that belongs to the wanted area on a 2D plane (Axial, Sagittal, and). 3D Slicer read the pixels' intensity of the surrounding area, and segment based on the intensity. Any pixels's intensity that are within the range will be segmented as the segmentation result.

Like the bubble method, this method often reads extra volume, and requires user to cut the unwanted parts. A Youtube video shows an experience user who gets the aorta 3D geometry with 10 minutes of manual works.

2.2   GitHub and Workflows

This project uses GitHub for version control.

GitHub issues tracker use to keep track the items to work on throughout the development of the project

GitHub Project is used for dividing a large issue into smaller tasks, expected date of the completion. This is useful for project management.

GitHub Workflow is a great tool for Continuous Integration tests.

We uses GitHub Workflow for Linter and Continuous Integration tests.

2.3   3D Slicer Extension Development

The project has started with the a simple segmentation algoritm build on the jupyter notebook. When getting a new patient's data, the user will need to investigate the chest ct scans using another software (3D Slicer, ITK-Snap), in order to know the

starting voxel and the size crop the volume, and get the index of the aorta seed. This Figure 2.1 shows an example of the aorta seeds.
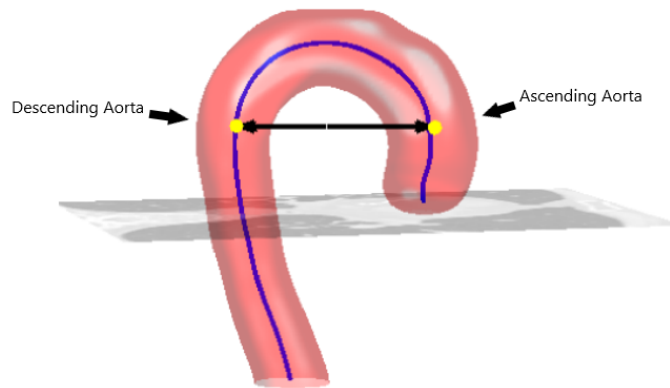

Figure 2.1: The aorta seeds

2.4   Segmentation Algorithm

This is a sample chapter

If you need to use quotes, type it "like this".

2.5   Referencing

These are some sample references to GAMYGDALA (Popescu et al., 2014) from the `references.bib` file and state effects of cognition (Hudlicka, 2002) from the `references_another.bib` file. These references are not in the same .bib file.

Chapter 3

Assurance Cases and Selected Evidence for AortaGeomRecon

3.1 Scope Determination

3.2 Assurance Case Development

3.3 Software Rerequirements Specification Development

3.4 Design Document Development

3.5 Test Case Development

3.6 Algorithm Review

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Chapter 4

Conclusion

Every thesis also needs a concluding chapter

Appendix A

Your Appendix

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Appendix B

Long Tables

This appendix demonstrates the use of a long table that spans multiple pages.

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Adrian Popescu, Joost Broekens, and Maarten van Someren. 2014. GAMYGDALA: An emotion engine for games. *IEEE Transactions on Affective Computing* 5, 1 (2014), 32–44.