

# Chapter 4

## Conclusion and Future Works

In this chapter, we provide a summary of the thesis as well as the future work.

### 4.1 Thesis Summary

In this project, <sup>I</sup> we developed a software as a 3D Slicer extension to semi-automatically extract the 3D geometry of the aorta, while applying assurance case arguments to build our confidence in this medical software. The project has started from a Jupyter Notebook program, then explored from the point of view of a patient such that what can we do to trust the software enough to let the doctor using it while being confident and certain that the software will not fail our expectation. We have then developed an idea of developing a software that is first convenient to use, at least on gathering parameters. This lead to developing a 3D Slicer extension module, because 3D Slicer already provides useful features such as Volume Rendering, Volume visualization, Crop Volume, etc. While building the software, we build the assurance cases

in Goal Structuring Notation with the bottom-up approaches; we keep ask ourself

(Section 4.1)

(Section 4.2)

To build confidence in the software I applied

as left by a previous student,

new Paragraph

With this as a starting point, I explored how to watch changes

to the documentation,

design, implementation and verification activities are necessary

for the assurance case.

I like the idea of summarizing what you did, but this is too confusing when it is all lumped together.

Introduce your steps as a list of steps. In each step give details of how this supported your goal of building an assurance case. The steps you have are good (1. Build a graphical user interface because the existing approach ~~even~~ had poor usability since it required using other software to determine the necessary parameter and then editing the code.

what are the evidences that are necessary to support our claim in requirements, implementation, operational assumptions and inputs assumptions? Keep that question in mind, we have finalized our SRS document, Module Guide document, wrote user instructions, built design document in HTML and publish it on a website, and linking all assurance cases to support our arguments. Finally, we have used GitHub's features for Continuous Integration infrastructure, and project management. We have built 2 automated process that act as a linter and continuous integration tests, these processes helped a lot in detecting bugs and errors in implementation. As for project management, GitHub Issues, Discussions, and Pull requests were used throughout the development of the software. Me and Dr. Spencer Smith were able to keep up good communication through these features.

In the course of this project, we have summarized a list of challenges and tasks that we could have done better. The first challenge was looking for an ideal platform to develop AortaGeomRecon software. Until the point where we see that it is nearly impossible to build from scratch a volume visualization system like the volume visualization provided by 3D Slicer, time and efforts have been wasted in design a UI, finding the right tool to build the UI, etc. 3D Slicer itself is a very complex software, the development resource is limited and difficult to understand.

Another obstacle that we have is having a domain expert to examine the quality of our segmentation result and other documentation. This medical software's intended user is a university student studying in medical science or medicine, who likes to get an aorta's image or quantified volume. Throughout the development of the AortaGeomRecon, we did not have an intended user or a domain expert to review our software. However, me and Dr. Spencer Smith were also lacking the knowledge

2 ... )  
+ put this in  
a subsection  
for the  
steps in  
your work

- put this in  
a subsection  
on  
challenges

better by whom? I'm not  
give what  
you  
are  
improving?  
your  
work?  
Karl's  
work?

revise  
this  
using  
your  
the  
list  
ideas  
and your  
improved  
Ch.3.

and do not know the expectation of the intender user or domain expert, this causes ambiguity in understanding the true requirements of AortaGeomRecon.

Finally, it is very challenging of understanding assurance cases with a limited time, and building the assurance cases for AortaGeomRecon was unclear for me. Gathering the evidences and support our arguments was not in my imagination at the beginning of the project, without truly understanding our goals of the project, I was not certain what I was really doing for this project. Until we have several pieces linking together, I was finally understanding and making more efforts in the right direction.

## 4.2 Future Works

In this section, we will discuss some possible future works that can continue to make AortaGeomRecon better. <sup>the</sup> the first improvement can be done in segmentation algorithm, and the second improvement <sup>can finalize</sup> our assurance case.

### 4.2.1 Segmentation Algorithm

<sup>Like the current work, this algo also</sup> In this paper [12], we were able to discover a <sup>an improved</sup> new segmentation algorithm that also <sup>[12] is available</sup> needs a cropped volume and the aorta seeds to perform segmentation. However, it required <sup>fewer</sup> less hyperparameters, <sup>For instance, it doesn't need</sup> such as the parameters for SimpleITK's ThresholdSegmentationLevelSetsFilter. Using this algorithm <sup>with</sup> effectively reduces the number of hyperparameters, which lead to a better and <sup>safer</sup> safer segmentation results.

<sup>Why safer? explain</sup> You should point out that your CI infrastructure can be used ~~for~~ to ensure the new algo is at least as good as the current one.

→ Also describe Dr. Ingalls's algo with the coordinate relation to make the 2D segmentation always on circles.

### 4.2.2 Assurance Case

There is room for improvements on the arguments of the requirements of Aorta-GeomRecon. The correctness of the document is reviewed and approved by a domain expert, where there should be evidences that can support the argument.

(point out the items of evidence that you didn't get to. Your revised Chapter 3 should make this clear.