centre universitaire Condorcet

MAIA

Quantification of Trabeculae Inside the Heart From MRI Using Fractal Analysis

Medical Sensor Project Defense 2018
Semester 1, MAIA, M-1

SUPERVISOR

Dr. Alain LALANDE

Group Members

Md. Kamrul Hasan
MAIA, M-1

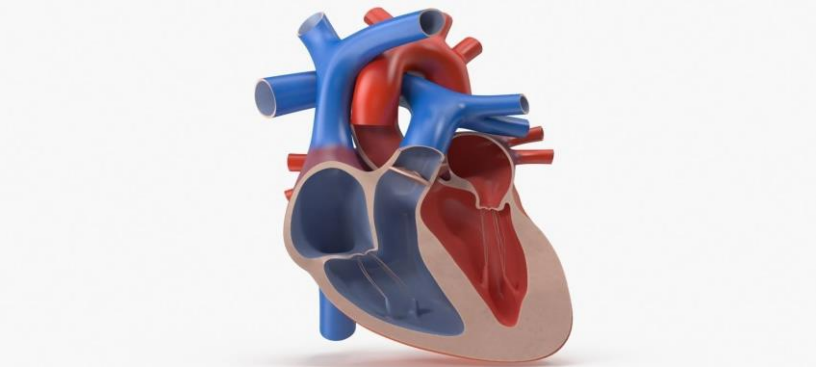
Fakrul Islam Tushar
MAIA, M-1

Contents of The Presentation

What is heart and why it's so Important ??

Heart weighs less than a pound

- ✓ **Responsible for system of Blood Vessel**
- ✓ **Beats 2.5 billion times over a average life time**



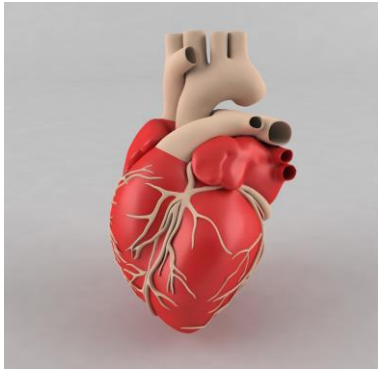
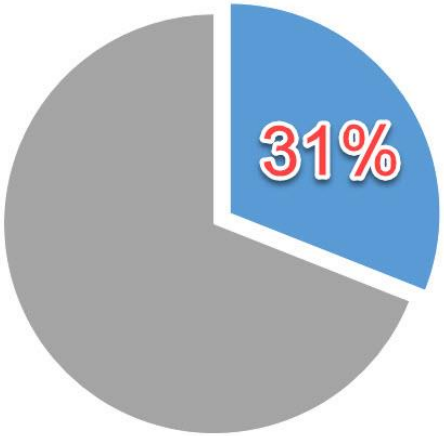


Fig.1: Image of heart [1]

Cardiovascular Diseases (CVDs)

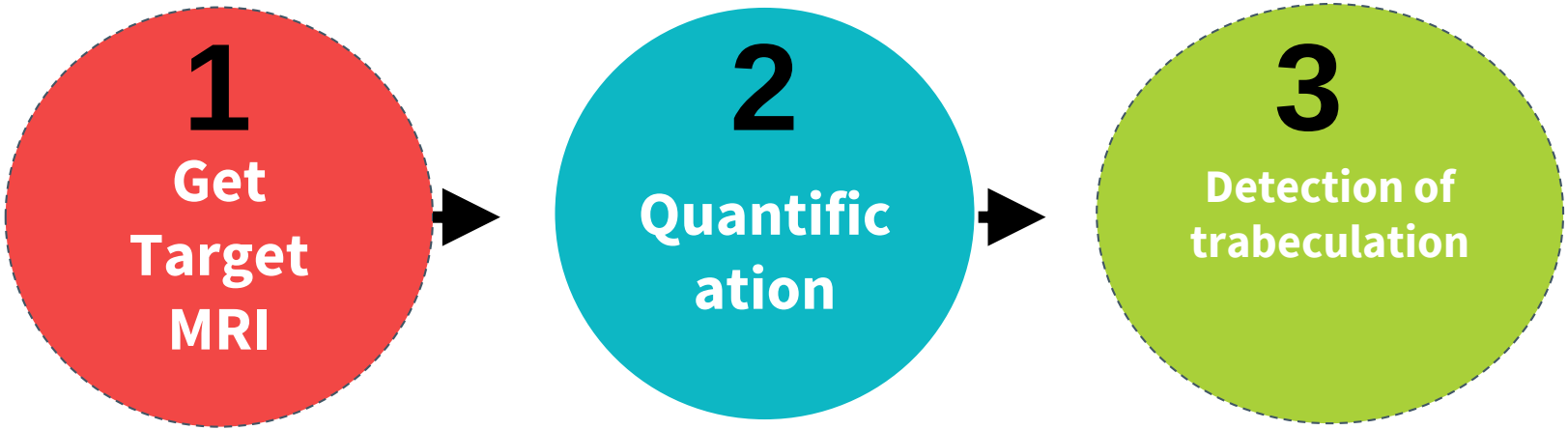
According to World Health Organization (WHO) in 2015

- ✓ **17.7 million people died from from various CVDs**
- ✓ **31% of all world's Deaths**



Objective of the Project

Quantification of Trabeculation Due to Left Ventricular Non-compaction (LVNC).



What is Left Ventricle Non-Compaction??

LVNC is a condition of heart

- ✓ **Where the wall of the left ventricle are non-compacted**
- ✓ **This causes channel to form in heart muscle, called trabeculations.**

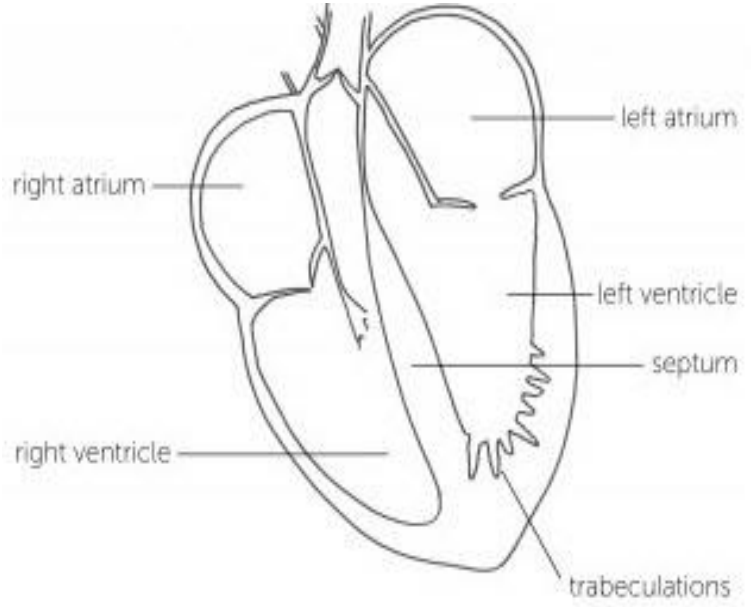


Fig.2: The structure of heart with LVNC [2] .

How Trabeculations form ??

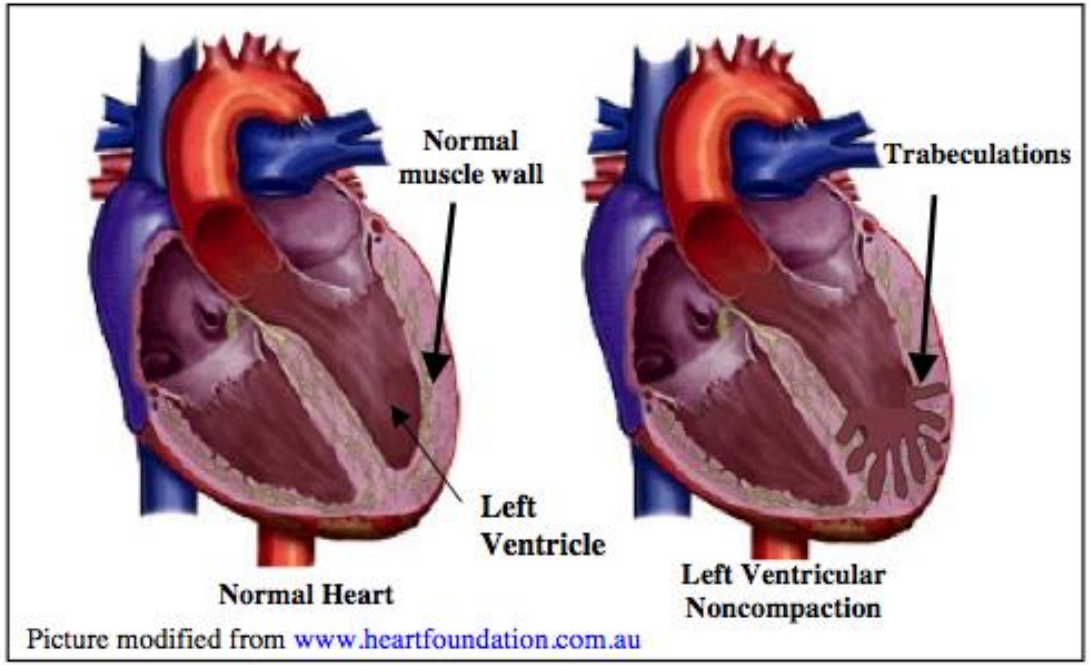


Fig.2: Normal heart vs LVNC heart structure [3] .

What is Fractal Dimension ??

Quantify the complex geometric patters of biological and natural patterns.

- ✓ **Fractal Dimension (FD)**
- ✓ **Complexity of the structure**
- ✓ **FD of Endocardium border is an Non-integer between 1 and 2.**
- ✓ **1<FD< 2**

What is Snake Algorithm??

Active contour model called snake.

- ✓ **Energy minimizing, deformable spline**
- ✓ **Influenced by constrain and image forces**
- ✓ **Energy function**

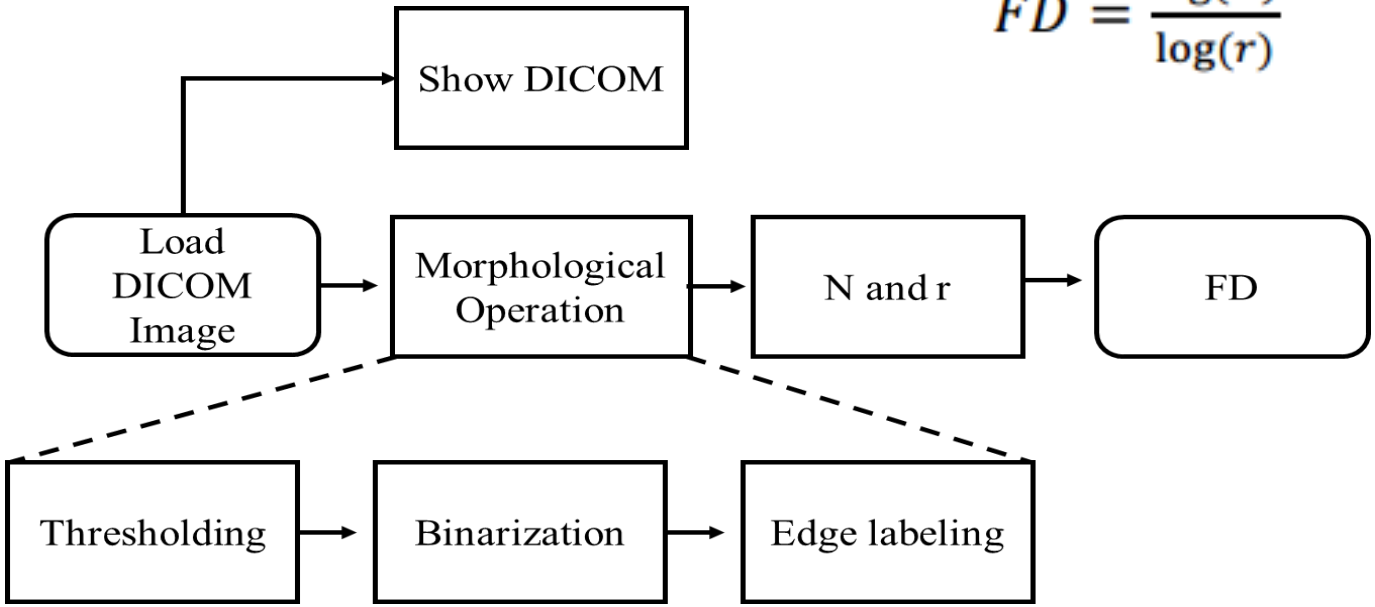
✓ $E^*_{snake} = \int_0^1 E_{snake}\big(v(s)\big)ds = \int_0^1 \big(E_{internal}(v(s)) + E_{image}\big(v(s)\big) + E_{con}(v(s))\big)ds$

Project Outcomes

Quantifications of Trabeculae

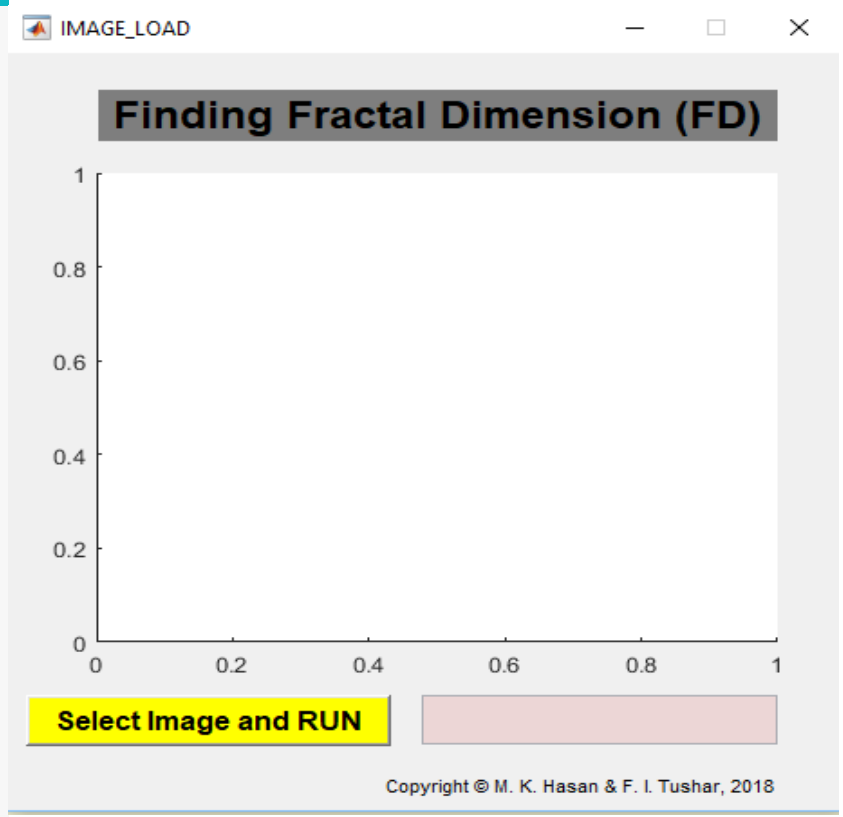
Complexity Analysis Block Diagram

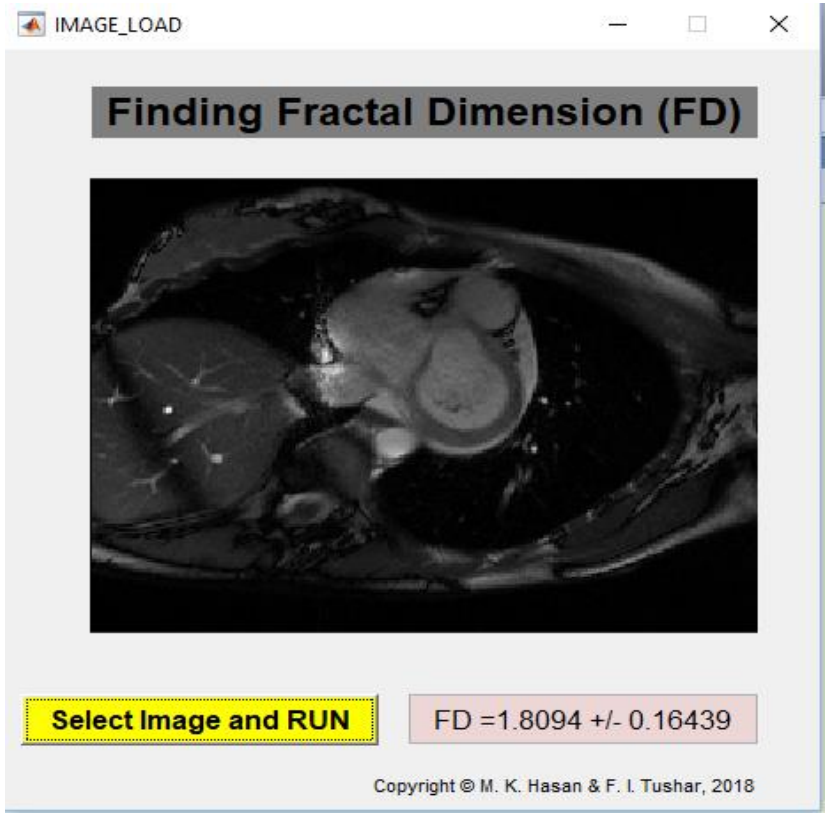
$$FD = \frac{\log(N)}{\log(r)}$$



Complexity Analysis Block Diagram.

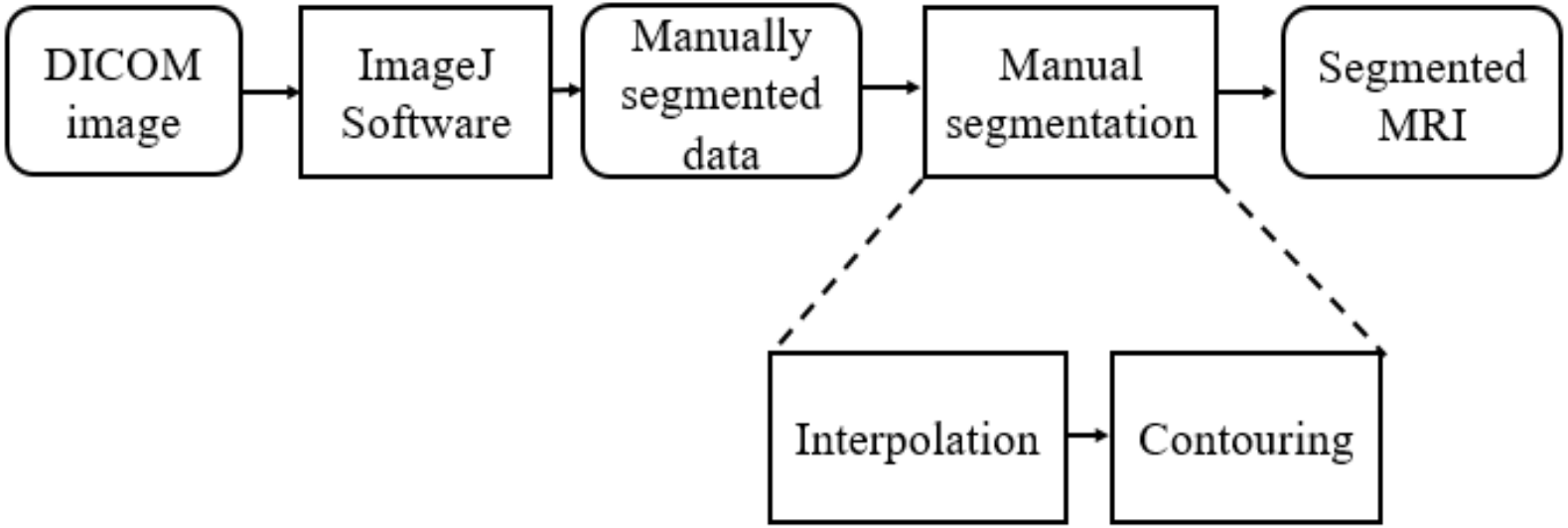
Implementations in GUI





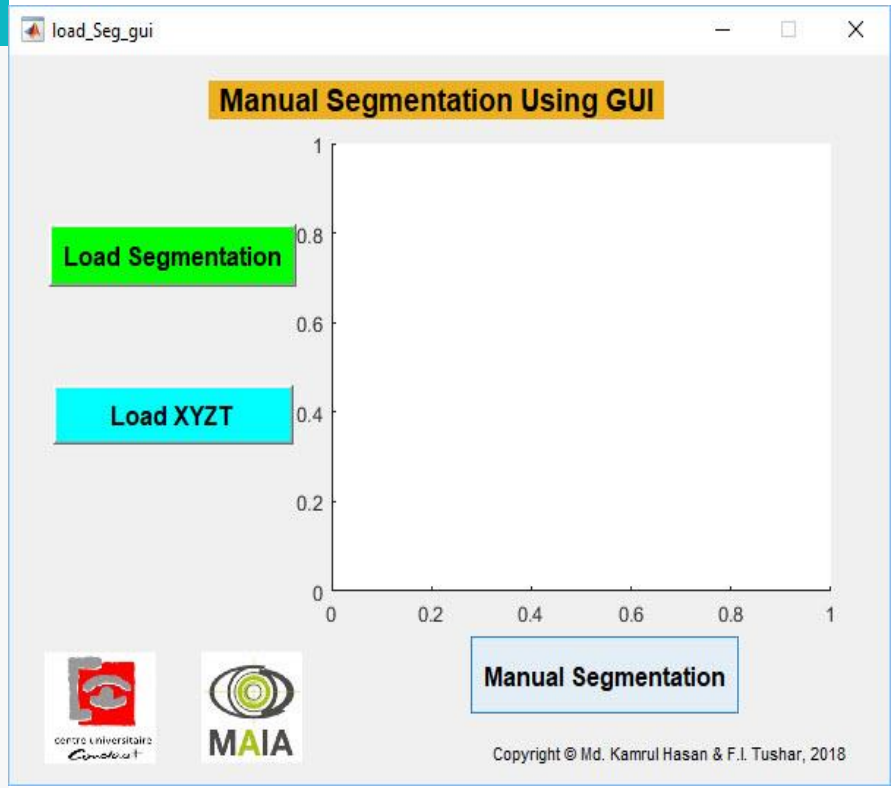
Manual Segmentations

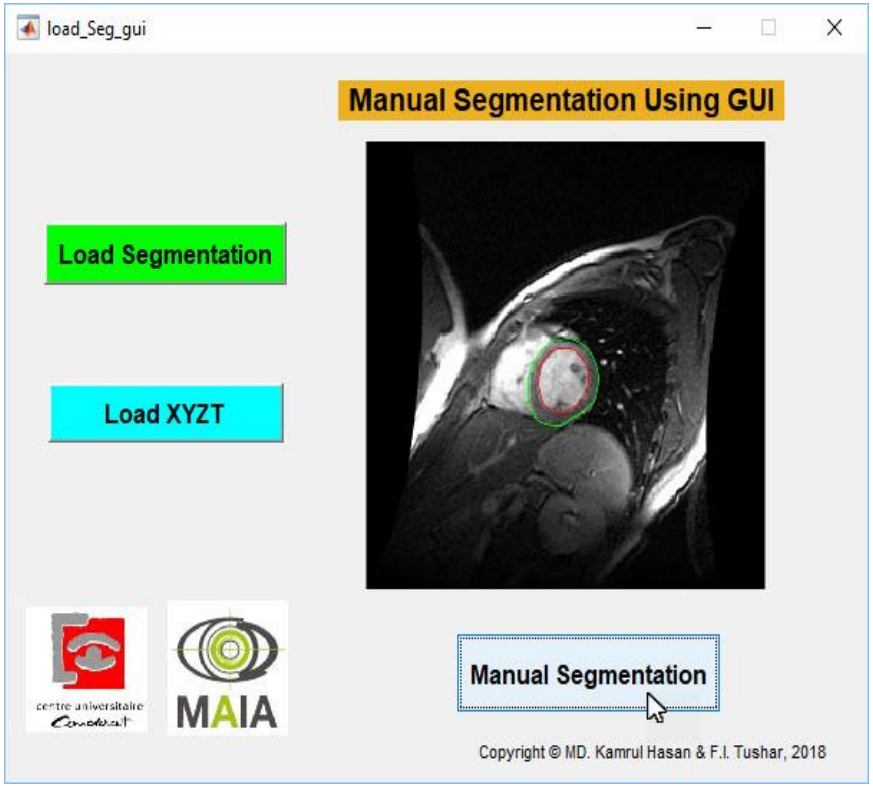
Manual Segmentation of Heart MRI/ CMRI



Block diagram for manual Segmentation.

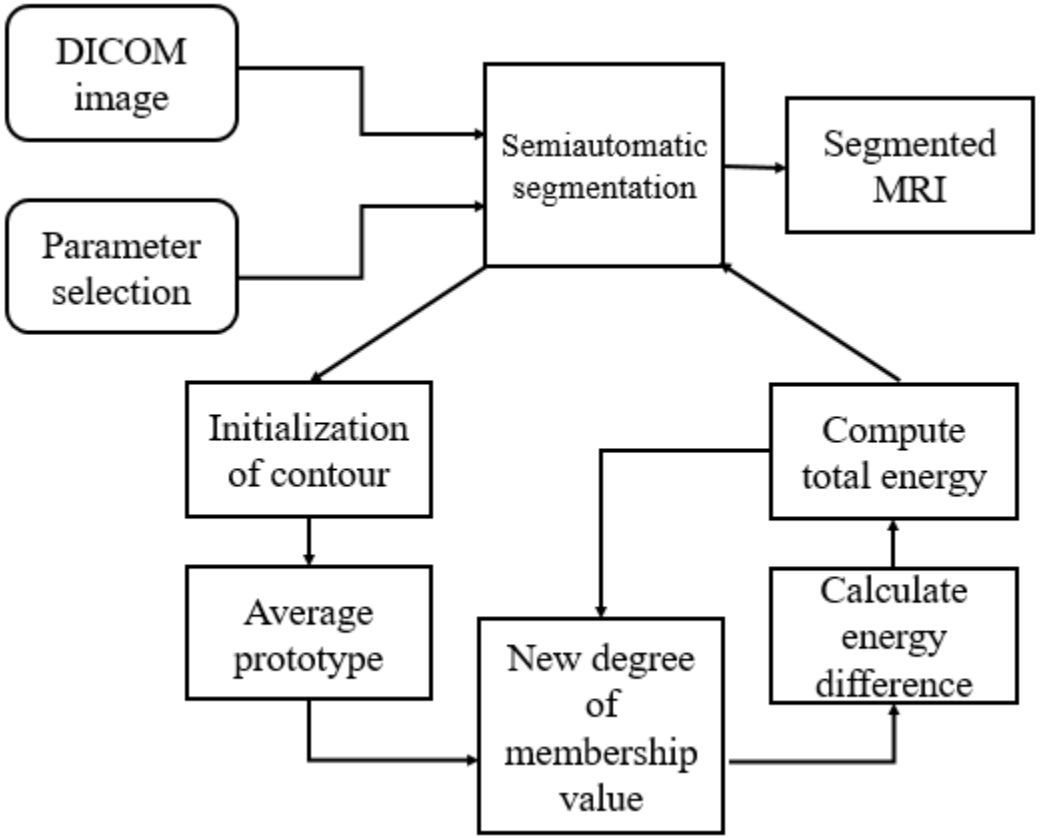
Implementations in GUI



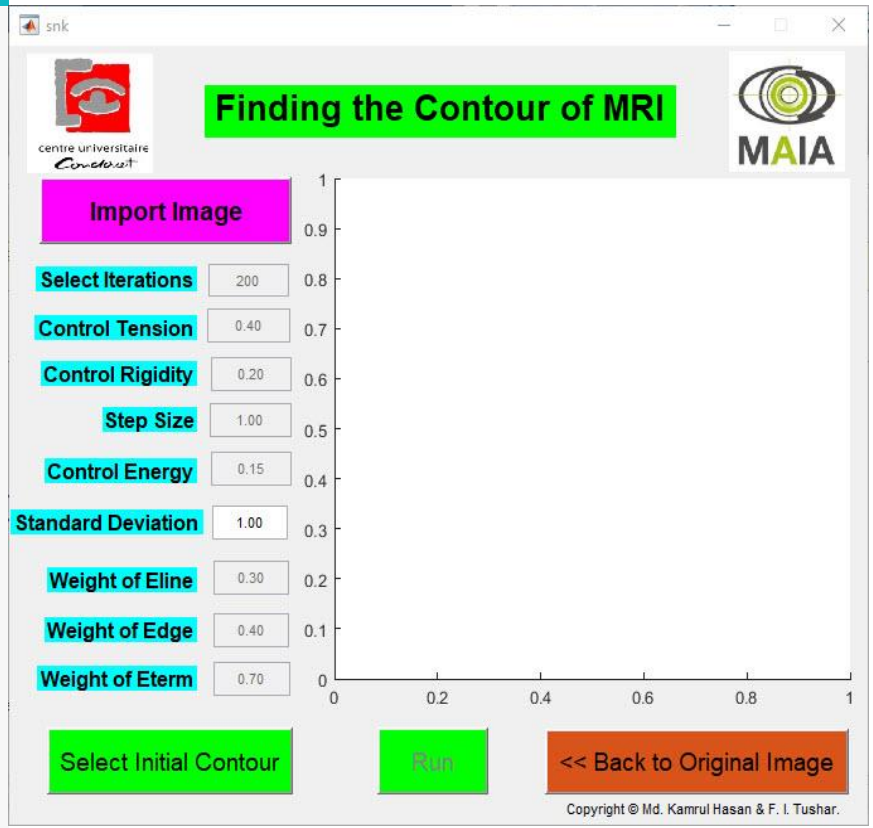


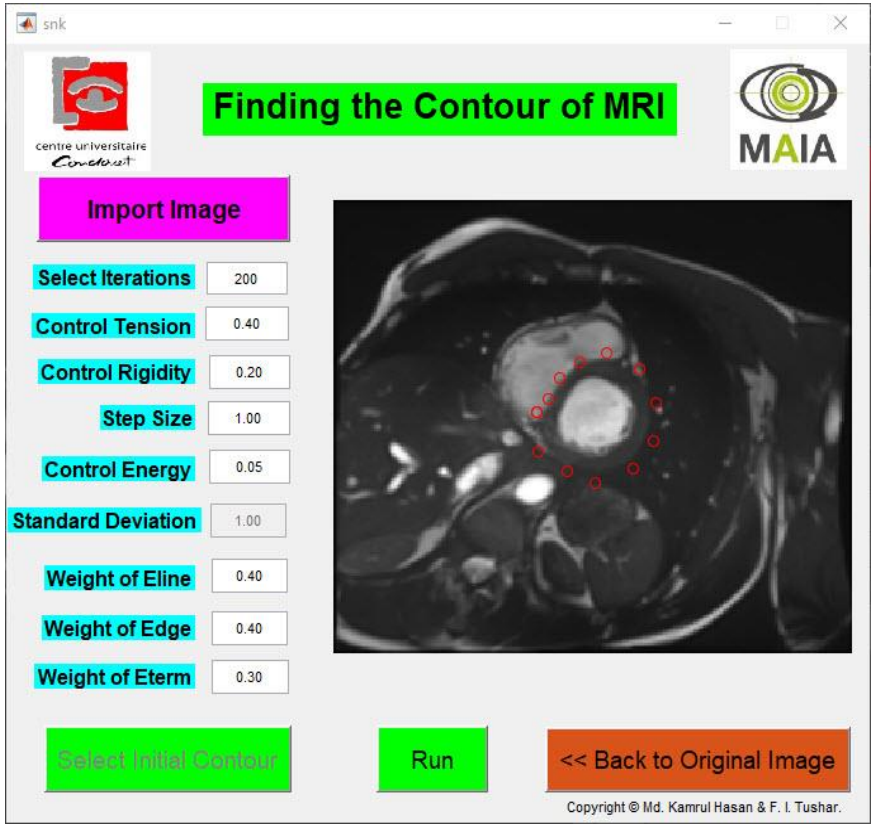
Semi-automatic Segmentations

Semi-automatic Segmentation of Heart MRI/ CMRI



Implementations in GUI





Conclusions

1. Due to the trabeculae, the geometric pattern of the inner part of the heart become more complex.

2. Semi-automatic segmentation is more reliable and easily implementable for heart MRI/ CMRI segmentations.

Future Improvement

1. Some segmentation algorithm like ***Watershed-Matching Algorithm*** can be implemented in Python in conjunction with OpenCV for better results.

References

1. Anatomyshop,“Heart Cutaway | 3D model,” *CGTrader*. [Online]. Available: https://www.cgtrader.com/3d-models/character/anatomy/heart-cutaway. [Accessed: 17-Jan-2018].

2. *Left ventricular non-compaction cardiomyopathy - Cardiomyopathy UK*. [Online].Available: http://www.cardiomyopathy.org/left-ventricular noncompaction/intro. [Accessed: 17-Jan-2018].

3. Cardiomyopathy,” *Left Ventricular Non-Compaction Cardiomyopathy (LVNC)*. [Online]. Available: https://www.cincinnatichildrens.org/service/c/cardiomyopathy/types/left-ventricular-non-compaction-cardiomyopathy. [Accessed:17-Jan-2018].

Thank you !!!