



The  
University  
Of  
Sheffield.

# IMAGE SEGMENTATION FOR HEART USING DEEP LEARNING

By: Valentin Craciun

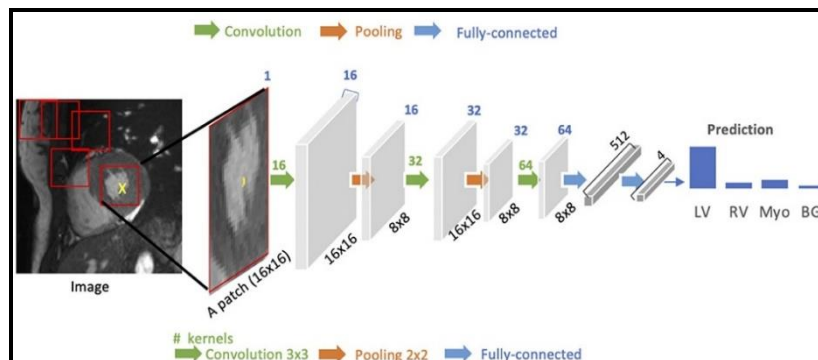
Supervised by: Dr. Haiping Lu

## Introduction

**Cardiovascular diseases** represent the problems related with heart or blood vessels. In United Kingdom the mortality rate caused by cardiovascular disease was in 2019 (255 deaths in 100,000 people) and following the reports published by World Health Organization, about 17.9 in the world [1][2].

## Background

**Artificial neural networks** are used for predictive modeling, the self-learning process resulting from allowing the network to train itself over a number of epochs.



(Fig 1. Convolutional Neural Network [3])

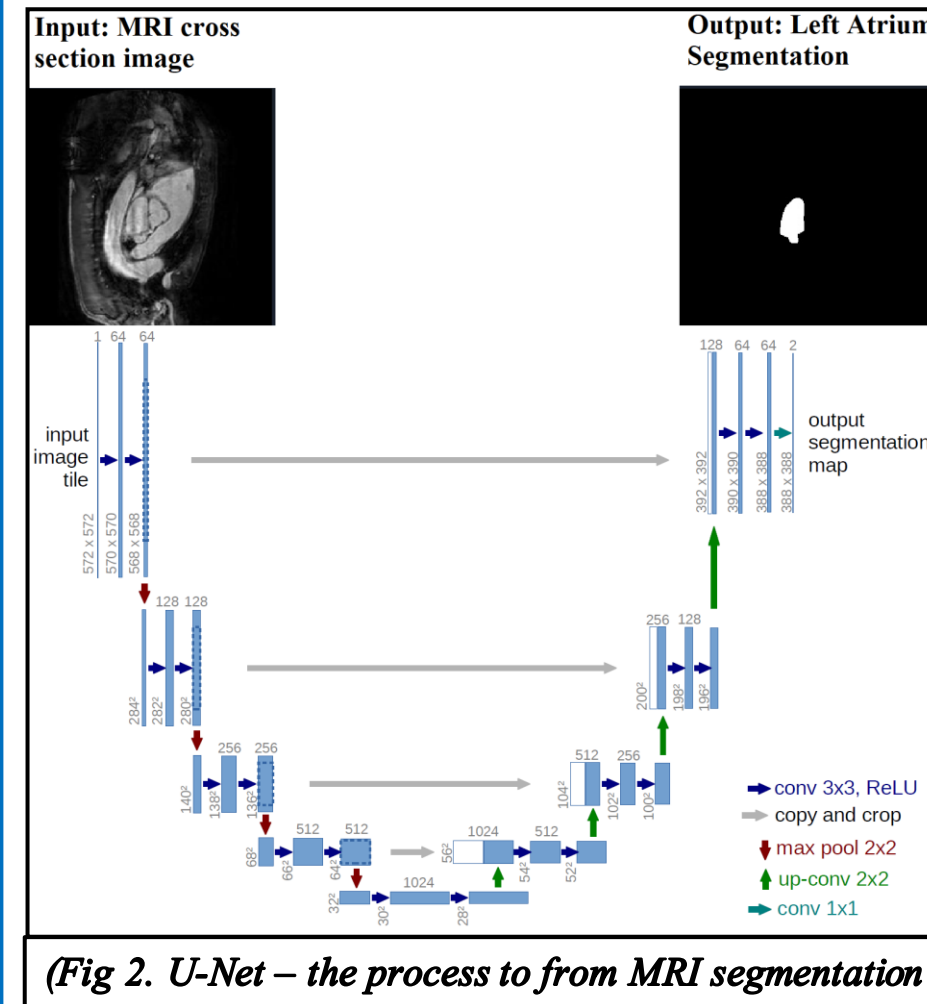
**Segmentation** is the process of dividing a digital image into multiple sub-areas in order to be easier to analyze while keeping relevant information from the input image.

There are multiple ways to achieve image segmentation: thresholding, grouping similar regions by values, bounding all the pixels delimited by a contour in a class and neural networks.

## Method

### Program flow:

- split the dataset (training 85% and testing 15)
- apply normalization
- train convolutional neural network (U-Net architecture)
- post processing output enhancement
- left atrium volume, 3D cloud points, overlays



(Fig 2. U-Net – the process to from MRI segmentation)

## Results

Accuracy obtained: **87.97%**

Training time: **9 minutes and 20 seconds**

Patient(0)	Output volume: 10902.0 mm <sup>3</sup>	True volume: 10219.0 mm <sup>3</sup>
Patient(1)	Output volume: 12323.0 mm <sup>3</sup>	True volume: 11348.0 mm <sup>3</sup>
Patient(2)	Output volume: 17742.0 mm <sup>3</sup>	True volume: 18865.0 mm <sup>3</sup>
=====		
Patient(0)	Output volume: 10.902 ml	True volume: 10.219 ml
Patient(1)	Output volume: 12.323 ml	True volume: 11.348 ml
Patient(2)	Output volume: 17.742 ml	True volume: 18.865 ml

(Fig 3. Volume comparison using the segmentation)



Fig 4. Overlay output compared to ground truth

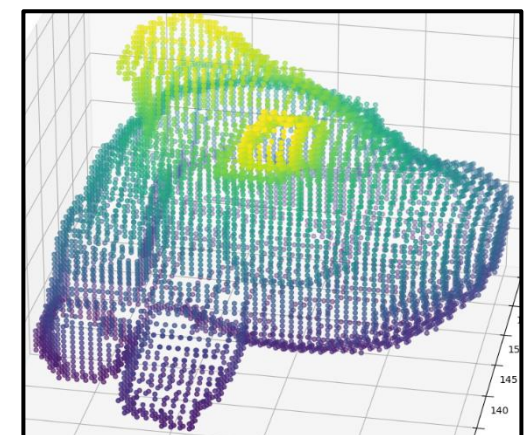


Fig 5. Intractable 3D point cloud volume

## Novel Contributions

- **Training speed increase** (from 8h to 9 minutes) while maintaining a high accuracy for the segmentation
- A combination of **output visualization** (volume, 3D point cloud representation, video overlays comparison)

## BIBLIOGRAPHY

- [1] statista - mortality rates in UK
- [2] World Health Organisation - Cardiovascular Disease
- [3] Chen Chen, et all. - Deep Learning for Cardiac Image Segmentation