Automatic Detection of Left Ventricle in 4D MRI Cardiac Images using Autoencoders

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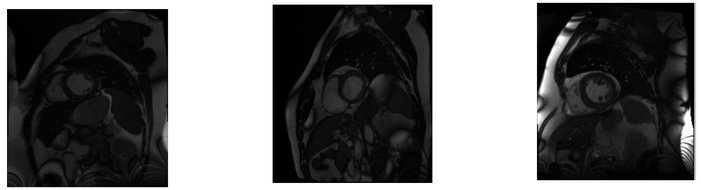
CENTER FOR RESEARCH IN COMPUTER VISION

Problem and Motivation

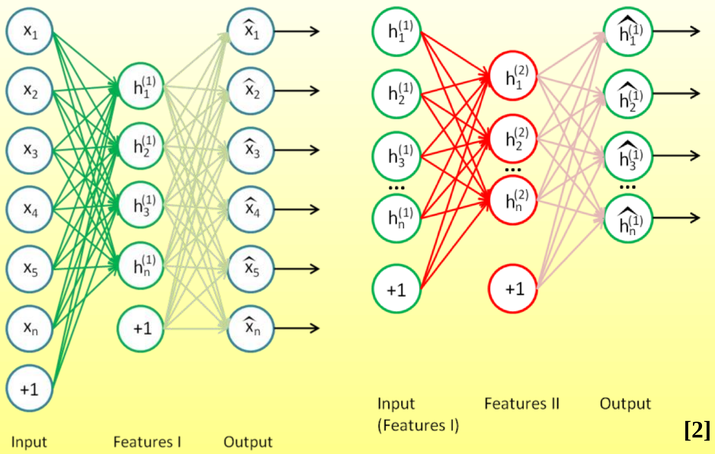
- Automatic detection of Left Ventricle
- LV detection can aid in segmentation
  - Segmentation can help calculate volume of heart
  - Can determine rate of blood flow

Dataset

- Kaggle Cardiac MRI Dataset [1]
  - 4D Images of the heart
    - Varying dimensions for each image
    - 2D images with about 7-11 different slices of the heart per image and 30 frames in time
  - 21 patients for training
  - 1 test subject



Stacked Autoencoders



[2]

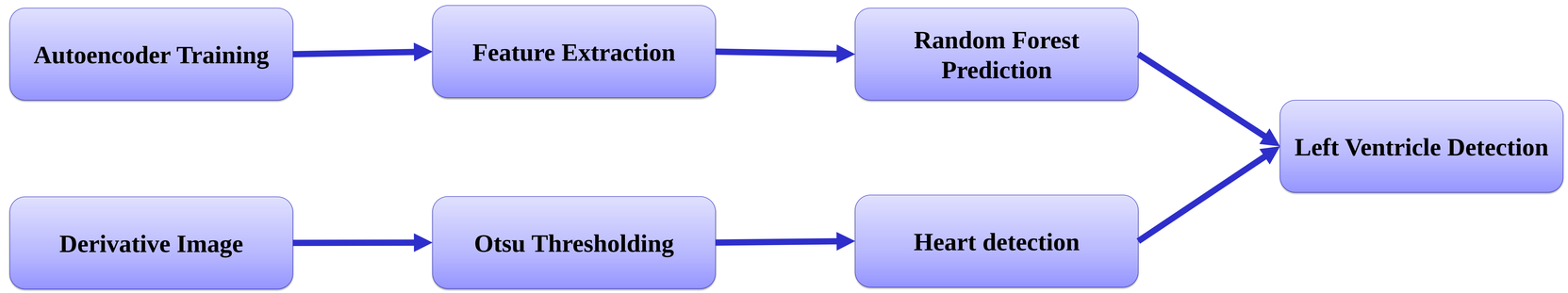
6 Autoencoders with 2D patches from 4D images as input:

- XY (21 x 21), XS (21 x 5), XT (21 x 5), YS (21 x 5), YT (21 x 5), ST (5 x 5)

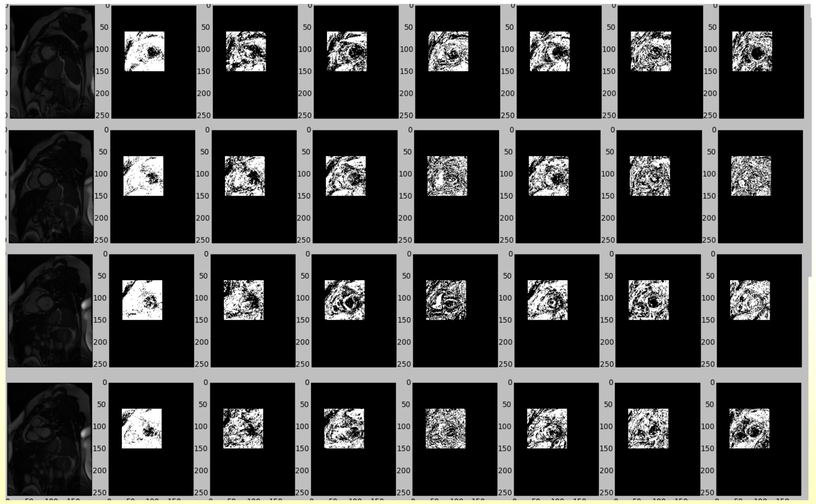
Length of feature vectors in Autoencoder 1 and 2, respectively:

- XY [64, 36], XS [36, 16], XT [36, 16], YS [36, 16], YT [36, 16], ST[16, 9]

Method / Pipeline

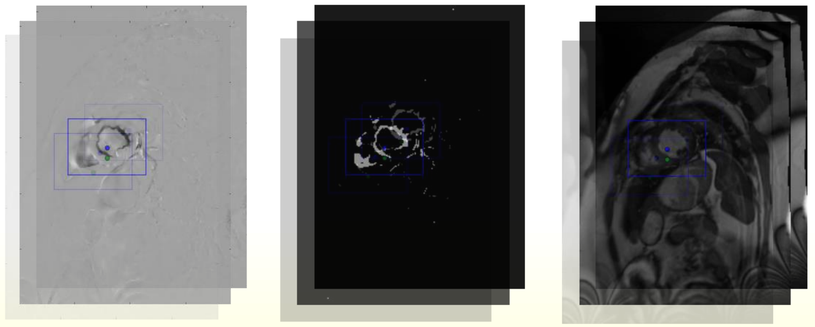


Visualization of Random Forest Predictions



Columns of the image display the original image, average prediction, XY, XS, YS, XT, YT, and ST predictions in order. The average is used in LV detection.

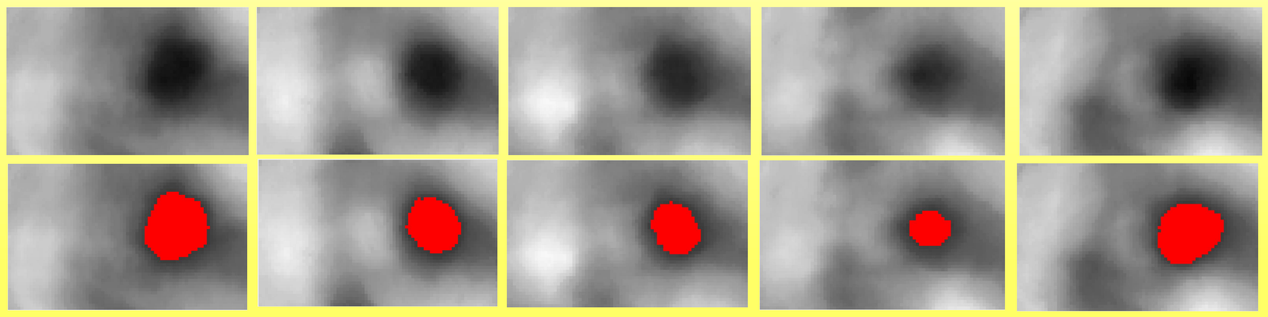
Heart Detection



These images show a 3d bounding box surrounding the heart.
The blue dot in each frame shows the average location of white pixels in the threshold image (center image)
The green dot shows the average location of blue dots across all time frames.

- 1st image: Derivative image of slice in respect to time
- 2nd image: Otsu thresholding applied to derivative image
- 3rd image: Original image shown with bounding box around the heart

Left Ventricle Detection



References

[1] Kaggle MRI Heart Dataset

- https://www.kaggle.com/c/second-annual-data-science-bowl/data

[2] Stacked Autoencoder Images

- http://ufldl.stanford.edu/wiki/index.php/Stacked_Autoencoders