Signal Processing LABORATORY

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Automatic detection and tracking of heart ventricle using machine learning

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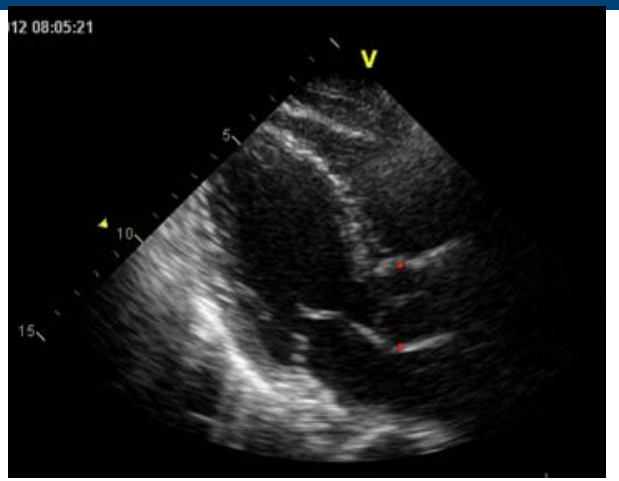
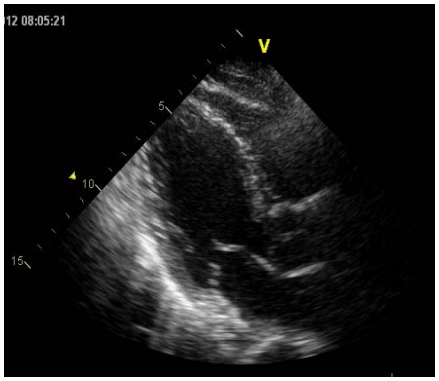
Overview

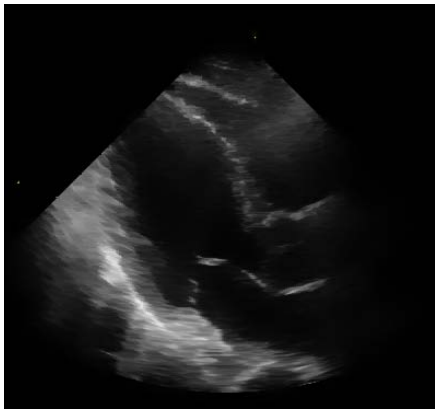


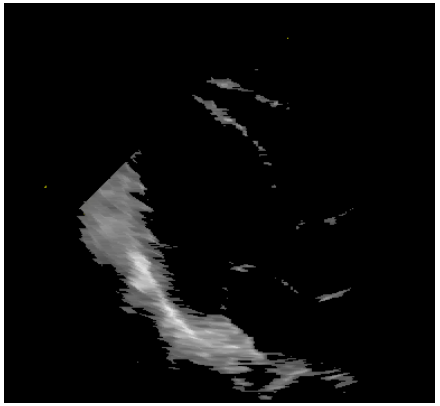
- What do we need to detect?
- Why do we need to detect this?
  - Diagnosis of CVD
  - Long term monitoring
  - Quantitative functional analysis
  - Accurate more than other measures on other places
- Why do we need to automate it?
  - Different experts give different results

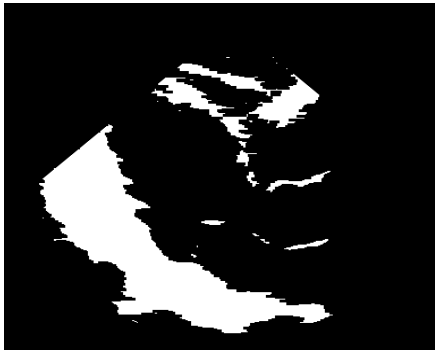
Approaches used for this task

- Bottom-up
  - Morphological operators and classical image analysis
  - Cannot deal with the US problems







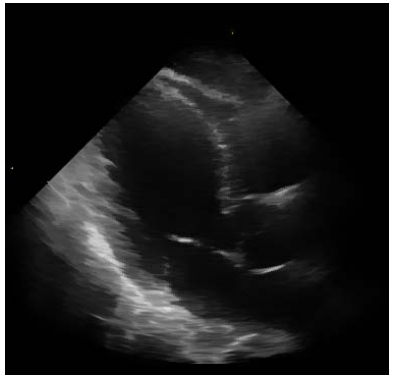
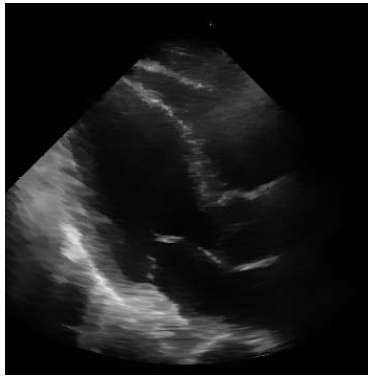
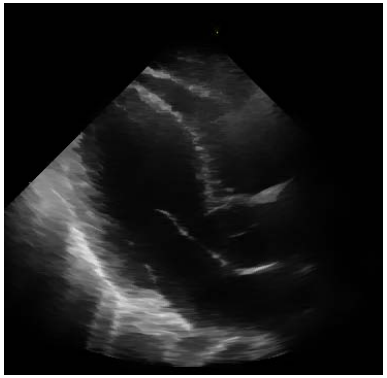
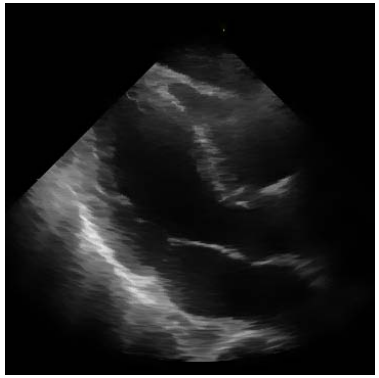


Approaches used for this task

- Model-based
  - Building a prior shape that evolves (Snakes, deformable models,Condensation)
  - Assumes that the ventricle shape is smooth and has strong edges
  - Successful, but the priori model must be very similar to the real shape
  - Not clear if it can cover all possibilities (most of the research focused on engaging new forces to deform the model/contour)
- Pattern recognition
  - Database of annotated images
  - Does not assume a prior model
  - Robust
  - Rely on the richness of the database
  - Usually complex and expensive

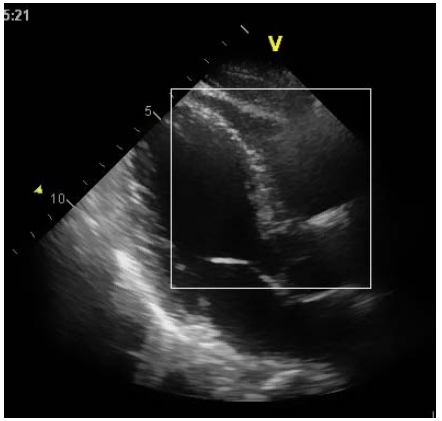
Using machine learning for this task

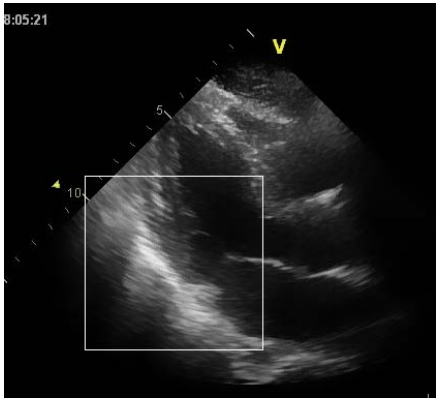
- The idea:
  - Proved to work well with US (CCA)
  - Two patterns are almost constant through the cardiac cycle
  - Train two classifiers (cascade with HAAR/HOG)

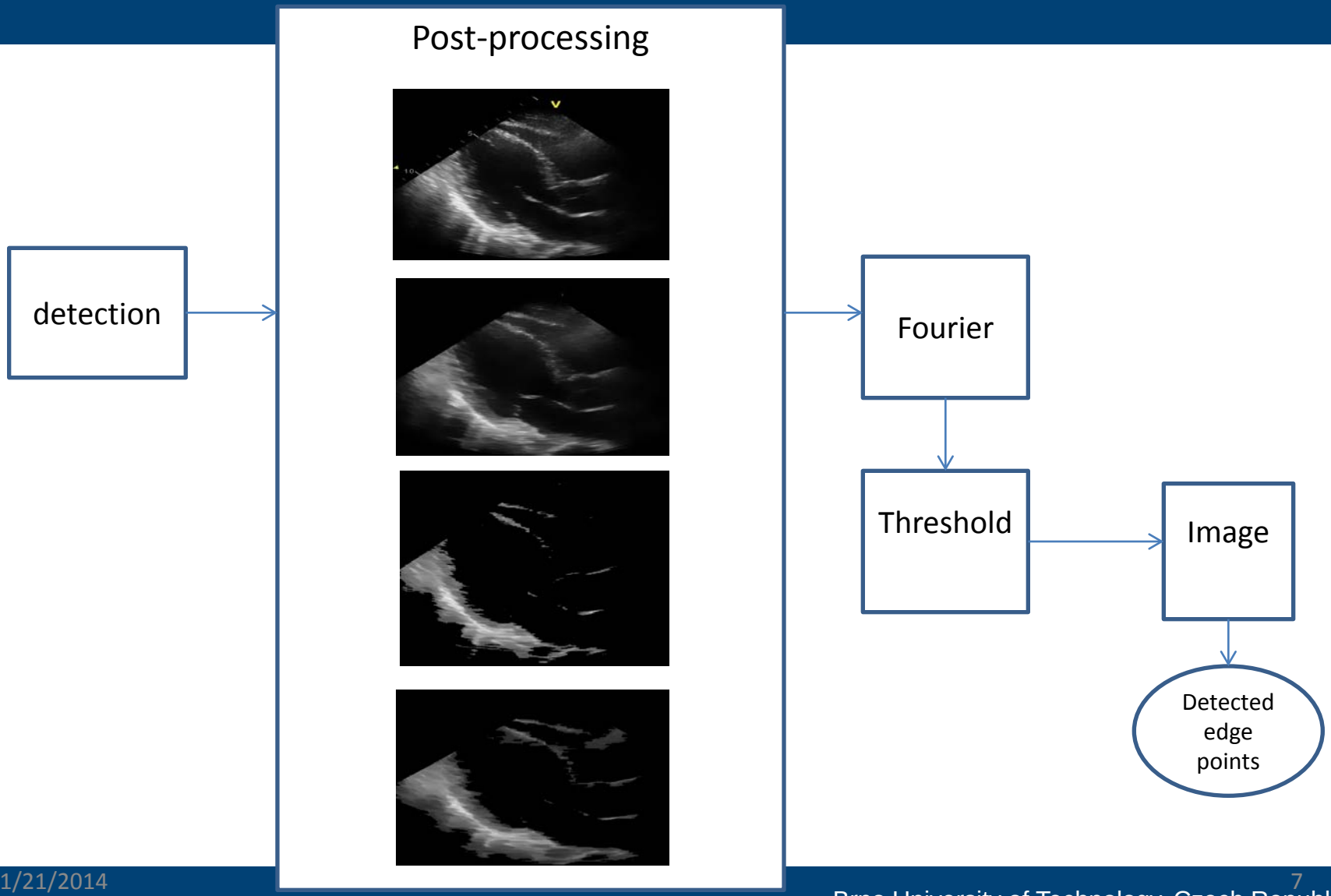
Promising results

- Training data: 91 frames
- Testing data: 77 frames
- Positive hit:
  - Lower boundary: 93%
  - Upper boundary: 77%
- More validation tests are needed..



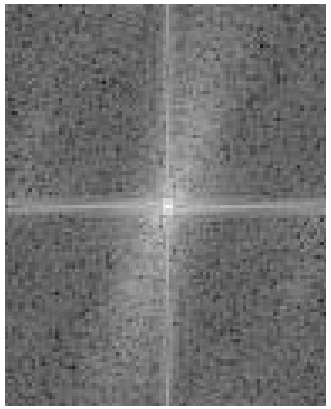


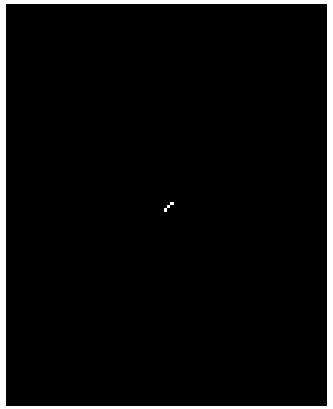
Post-processing



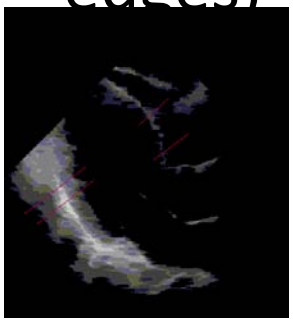
Using image profiles to detect the edges

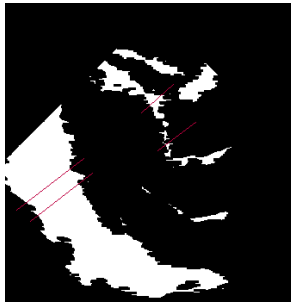
- The Fourier transform gives us the structural orientation of the image, so we can determine the slope of the profile lines



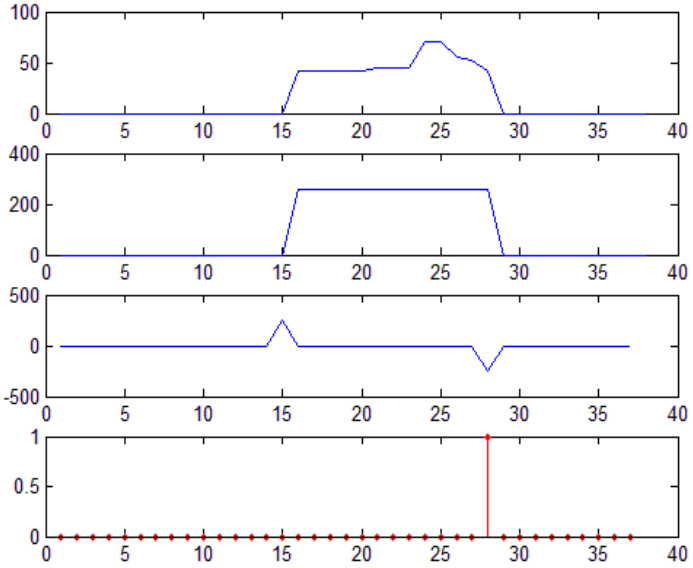


- Thresholding the image into binary makes detecting the edges easier (in our case we need negative edges)





Profile, upper boundary



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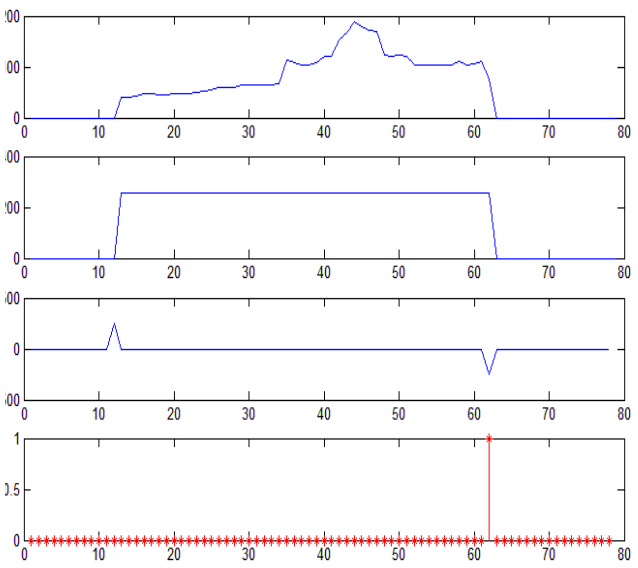

To DO..

- Test the performance on a bigger database
- Automatically detect the correct positions and track their movement

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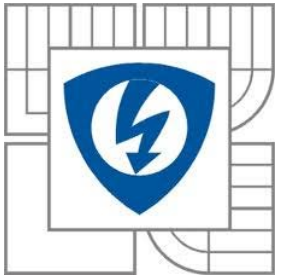

Thanks!

… questions / ideas?…

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