

# Automated Detection of Calcified Plaques - A Human vs. Machine Inter-Observer Study

Melanie Ganz, Rabia Granlund and Naga P. K. R. Dandu  
DIKU, University of Copenhagen and Nordic Bioscience A/S

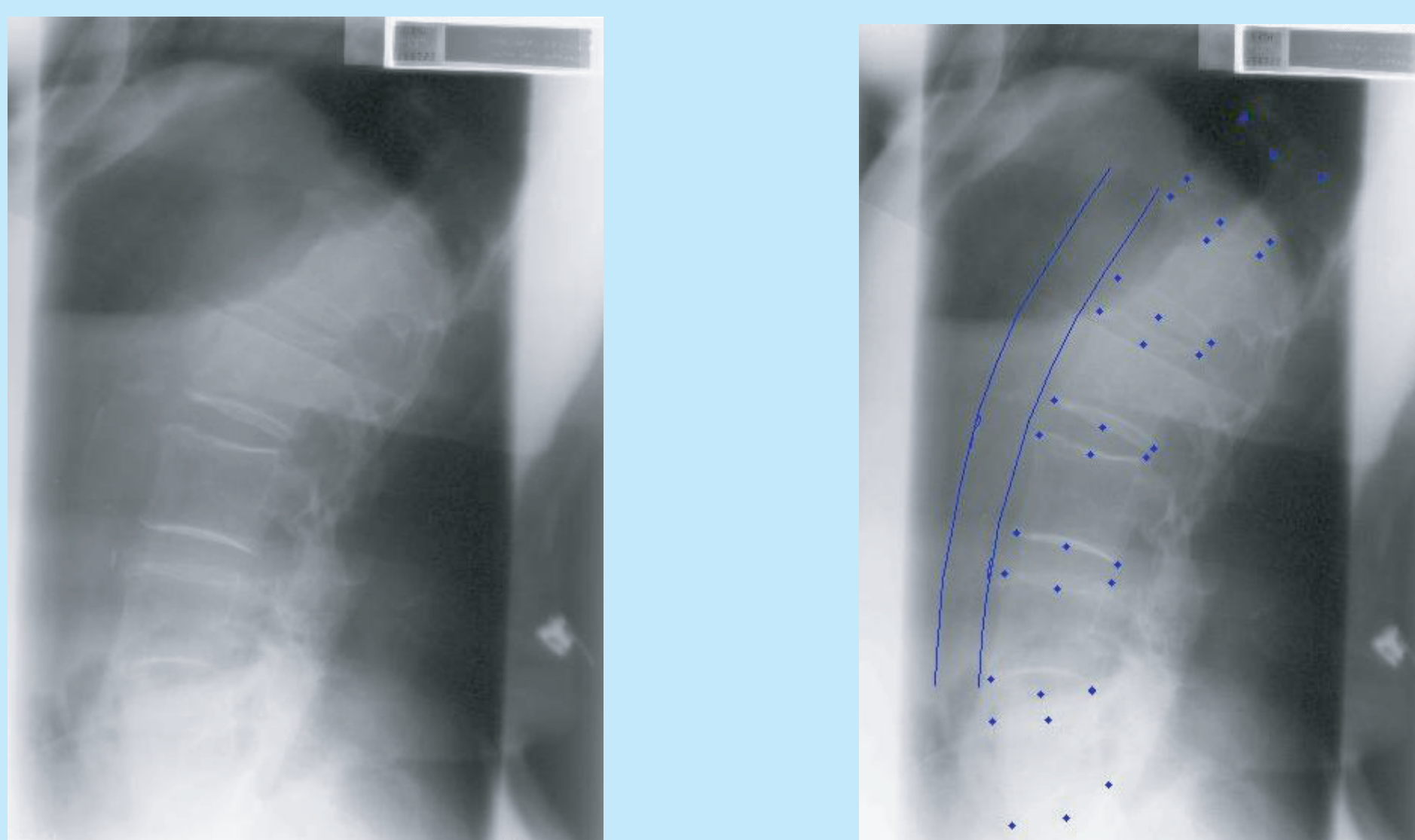
## The Problem:

Cardiovascular disease is still the most common cause of death in the industrialized world. At present tools for the detection, diagnosis and risk estimation are too time and cost consuming, leaving room for new and improved methods.

## Our Solution:

- Automated detection of lumbar aortic calcifications (well established predictors of cardiac diseases)
- Risk assessment on the basis of the automated detection and segmentation

## The Images:



An x-ray in its pure and its annotated form. Trained, blinded radiologists annotated the digitized images on a Sectra radiological reading unit with annotation software implemented in MatLab.

## The Normalization:

### Why?

Images from different x-ray modalities have very different intensity ranges

### How?

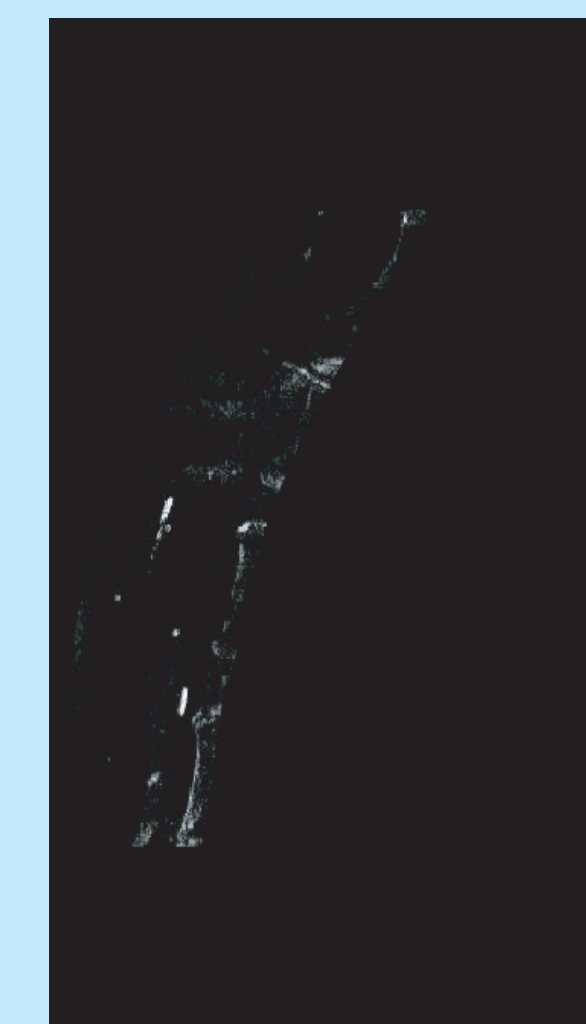
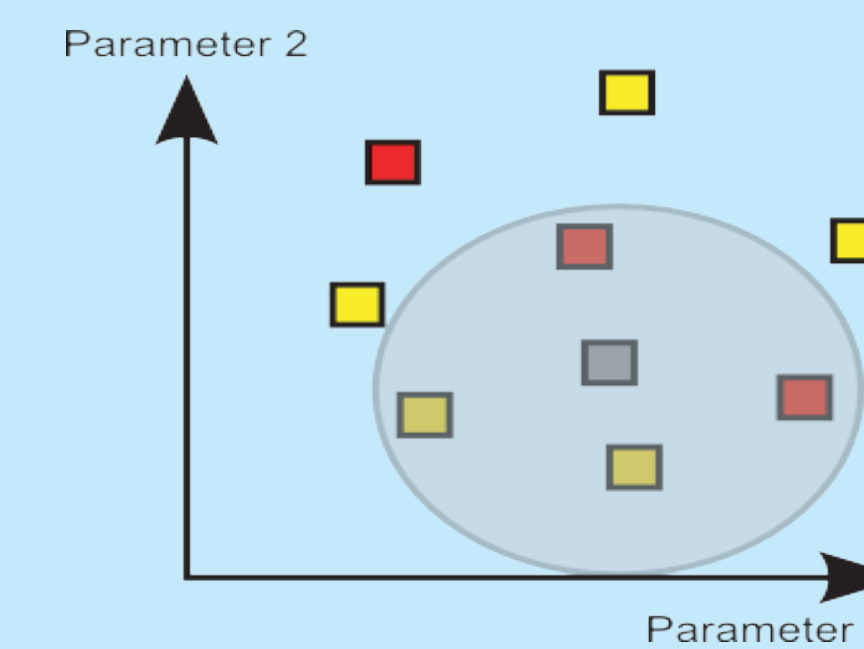
Find the 15% and 85% fractiles of the intensities - do a linear transform

### Gain?

The intensity ranges are approximately the same for all images

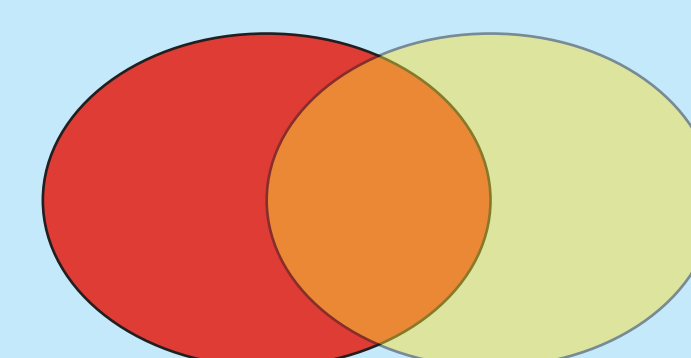
## The Classification:

- The classification is done pixelwise on the basis of local intensity features
- The features are the original image and the Gaussian derivatives up to and including the third order at three different scales
- The classifier is an approximate k-Nearest-Neighbor classifier with  $k = 25$ .



## Area Overlap Measure:

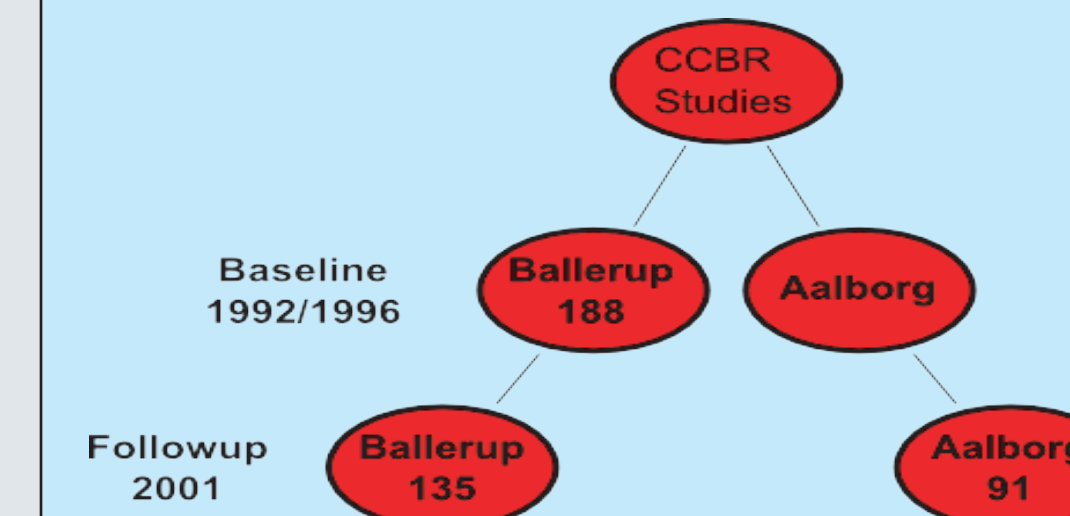
DICE volume overlap metric is used  $\frac{A \cap B}{A \cup B}$



The area overlap varies from 0 (which equals no overlap) to 1 (corresponding to complete overlap)

## The Different Populations:

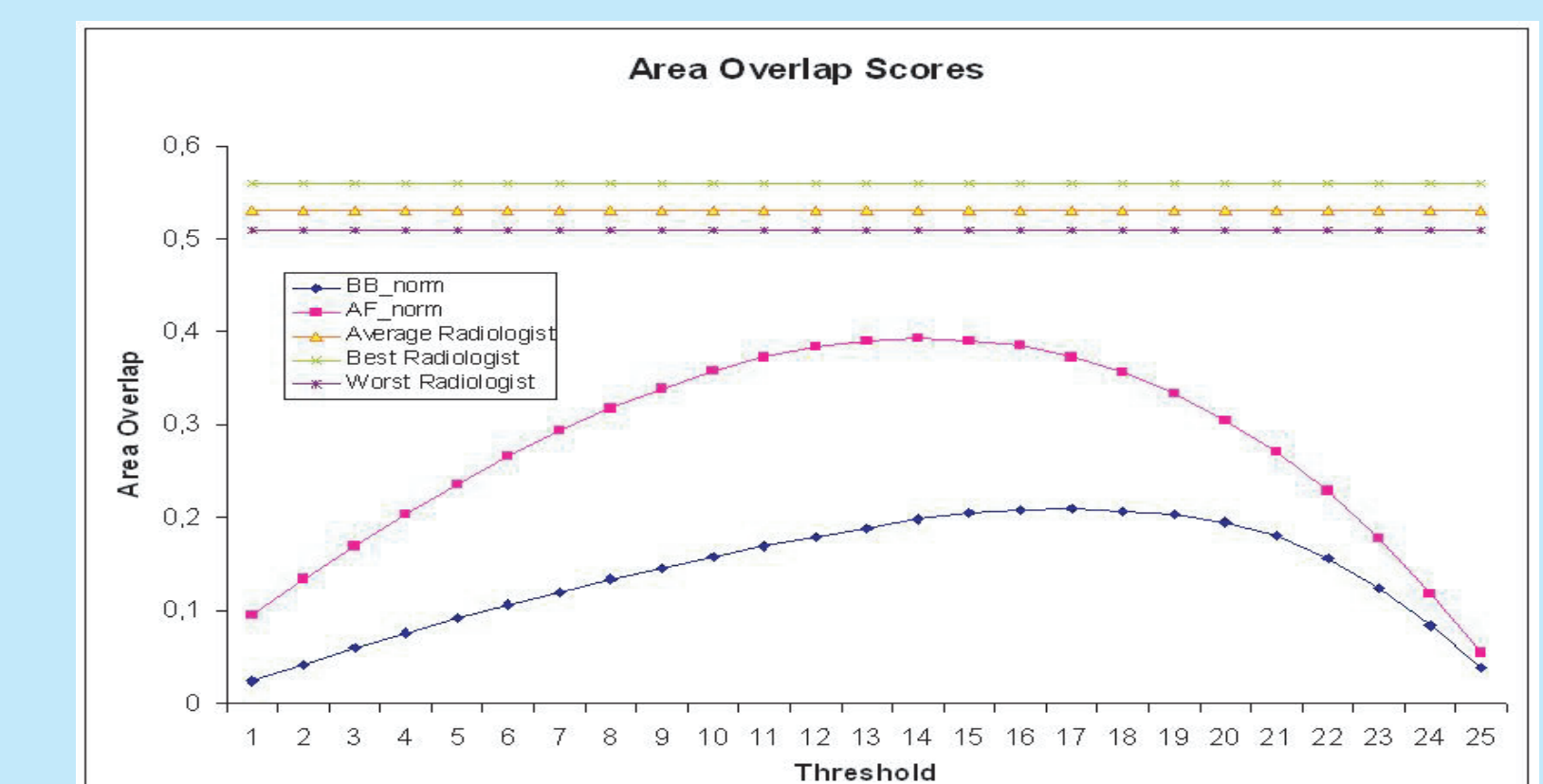
3 different populations from 2 different studies



All subjects were women and at Baseline between the ages of 50 and 70 y.

## Results:

- Best radiologist has an area overlap of 56% with his peers
- Worst radiologist has an area overlap of 51%



- Automated detection has in the case of old x-rays (acquired in 1992) a peak area overlap of 21%
  - In the case of newer x-rays (taken in 2001) a peak area overlap of 39% is achieved
- This is the performance without any post-processing and with a relatively simple classification approach!**

## Outlook:

- Aorta outline found automatically (shape analysis/particle filter)
- Re- or contextual classification
- Knowledge about growth patterns

Ongoing Work