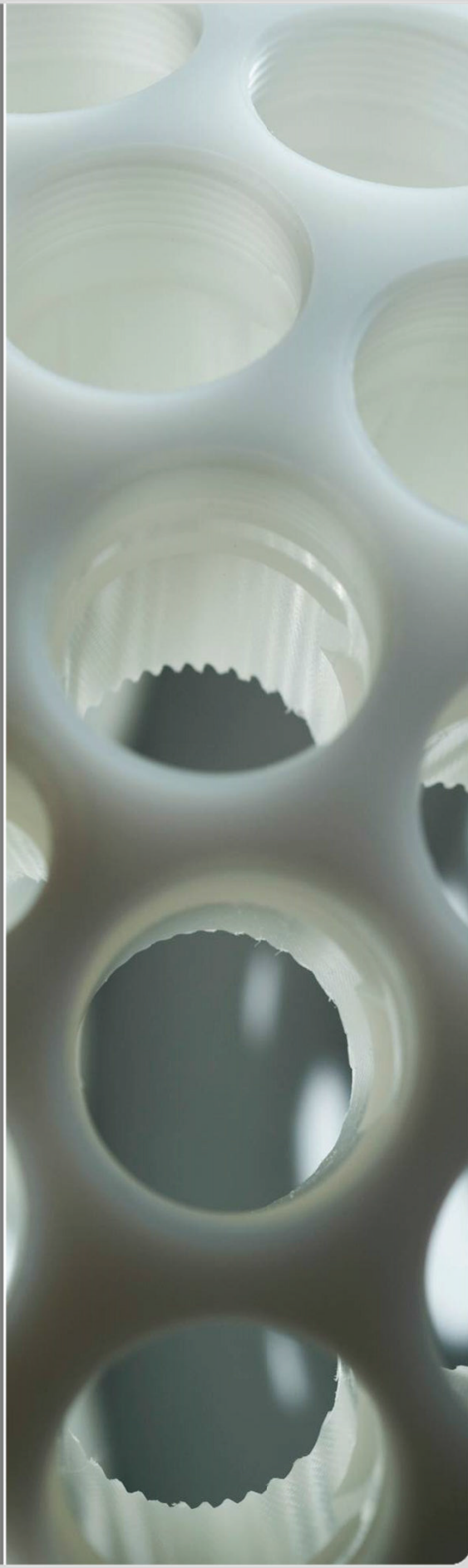


# Preliminary results: Pilot study with 3D Ultrasound Computer Tomography

N.V. Ruiter, H. Gemmeke et al

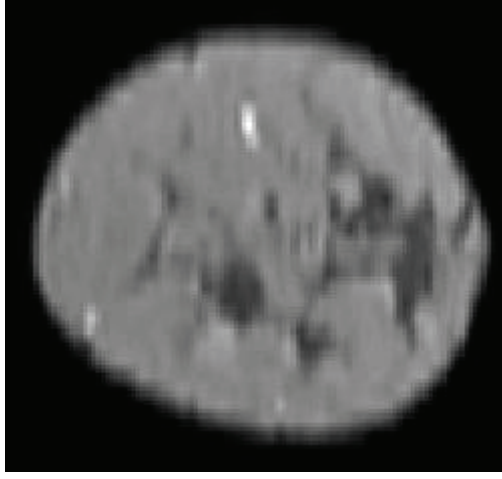
INSTITUTE OF DATA PROCESSING AND ELECTRONICS



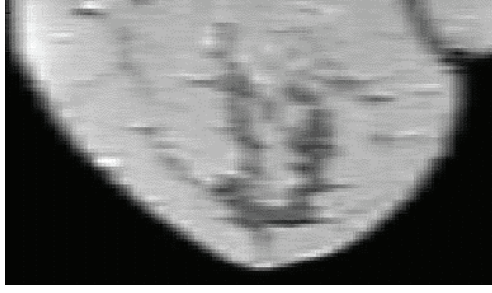
# Pre Study Experiments



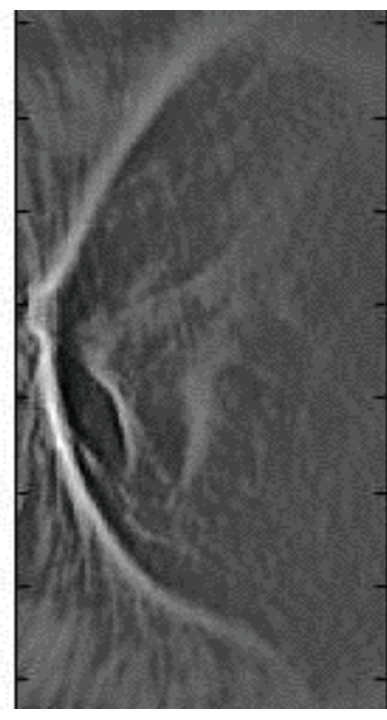
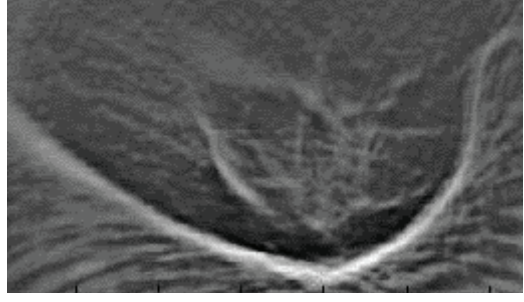
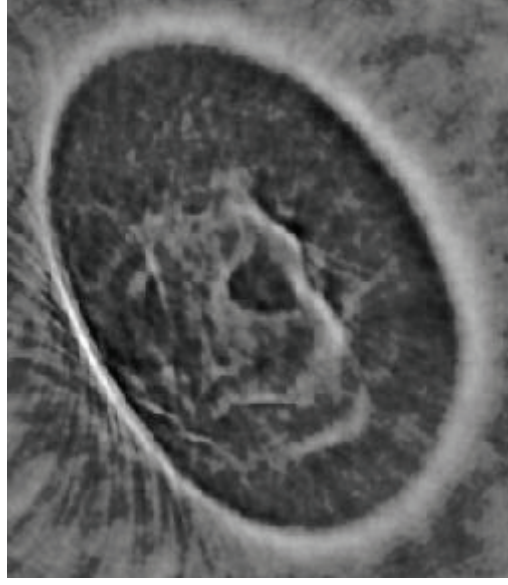
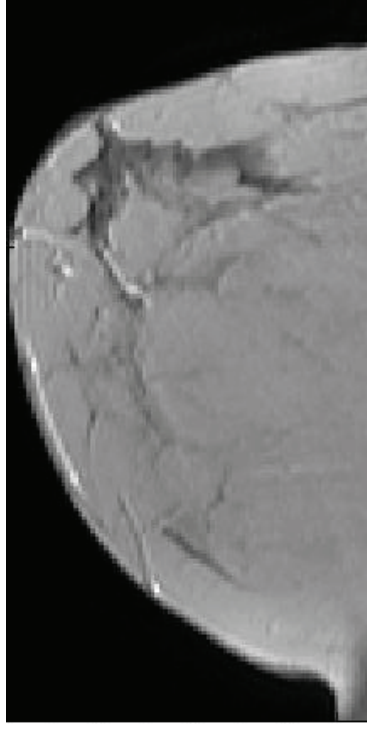
# MRI and USCT slices of first volunteer (P1)



14 cm



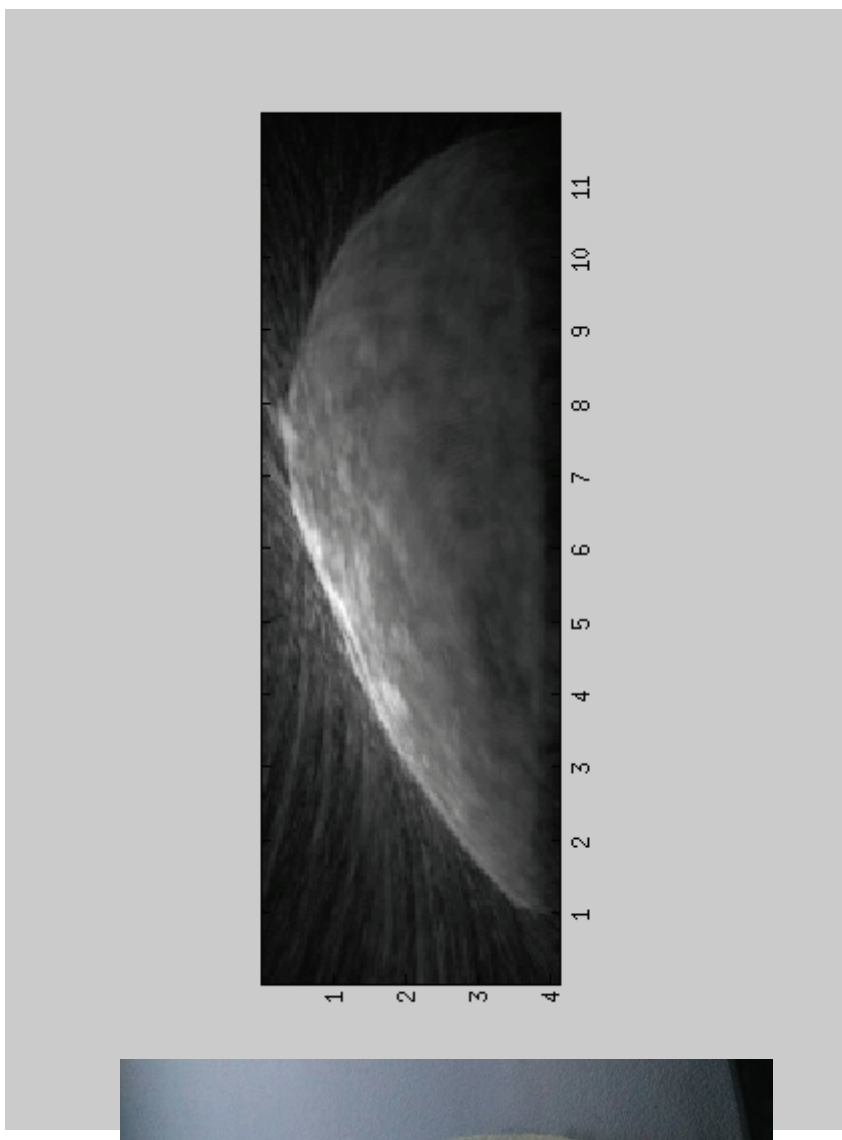
9 cm



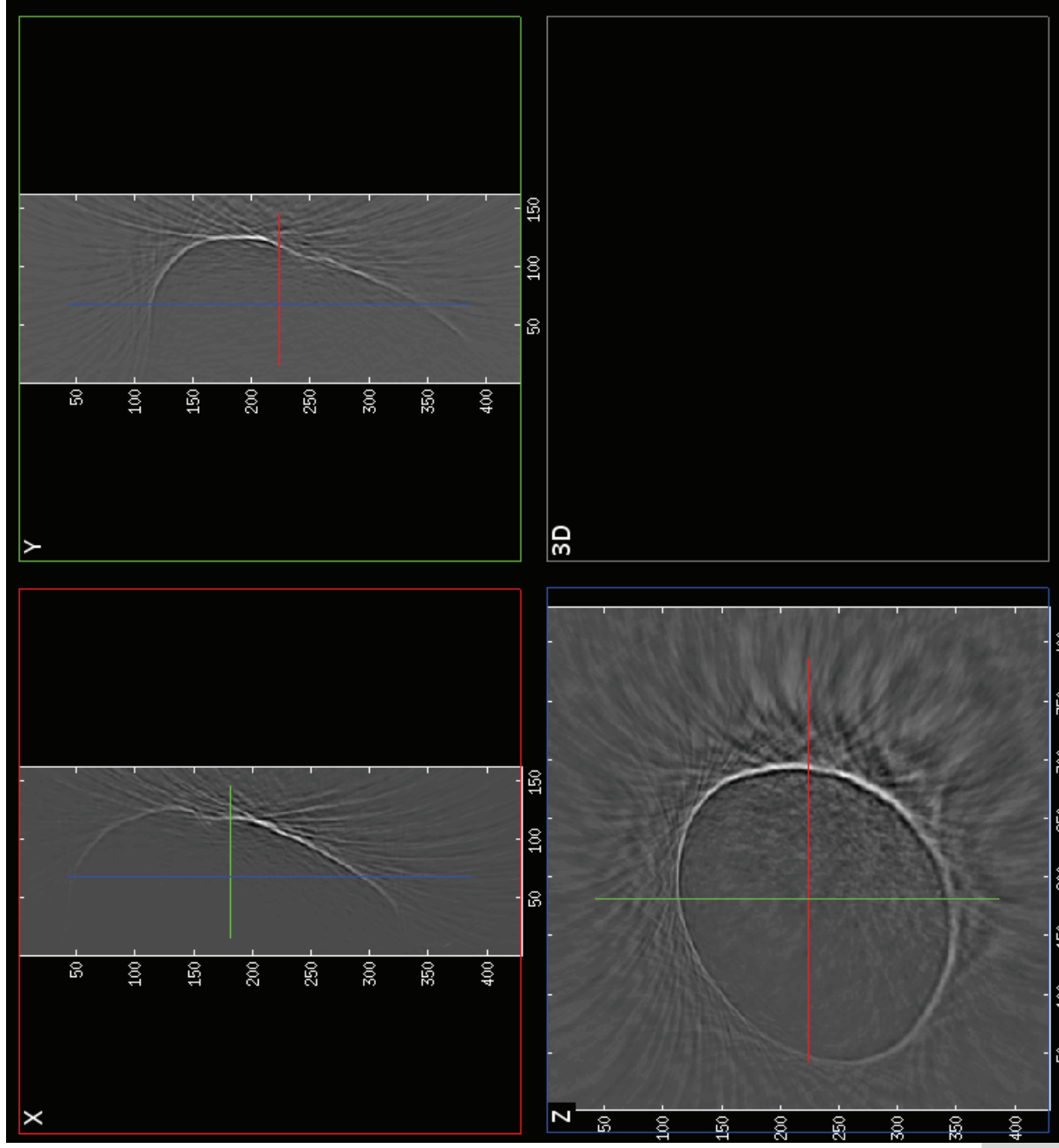
18 cm

## Additional Results: Breast implant

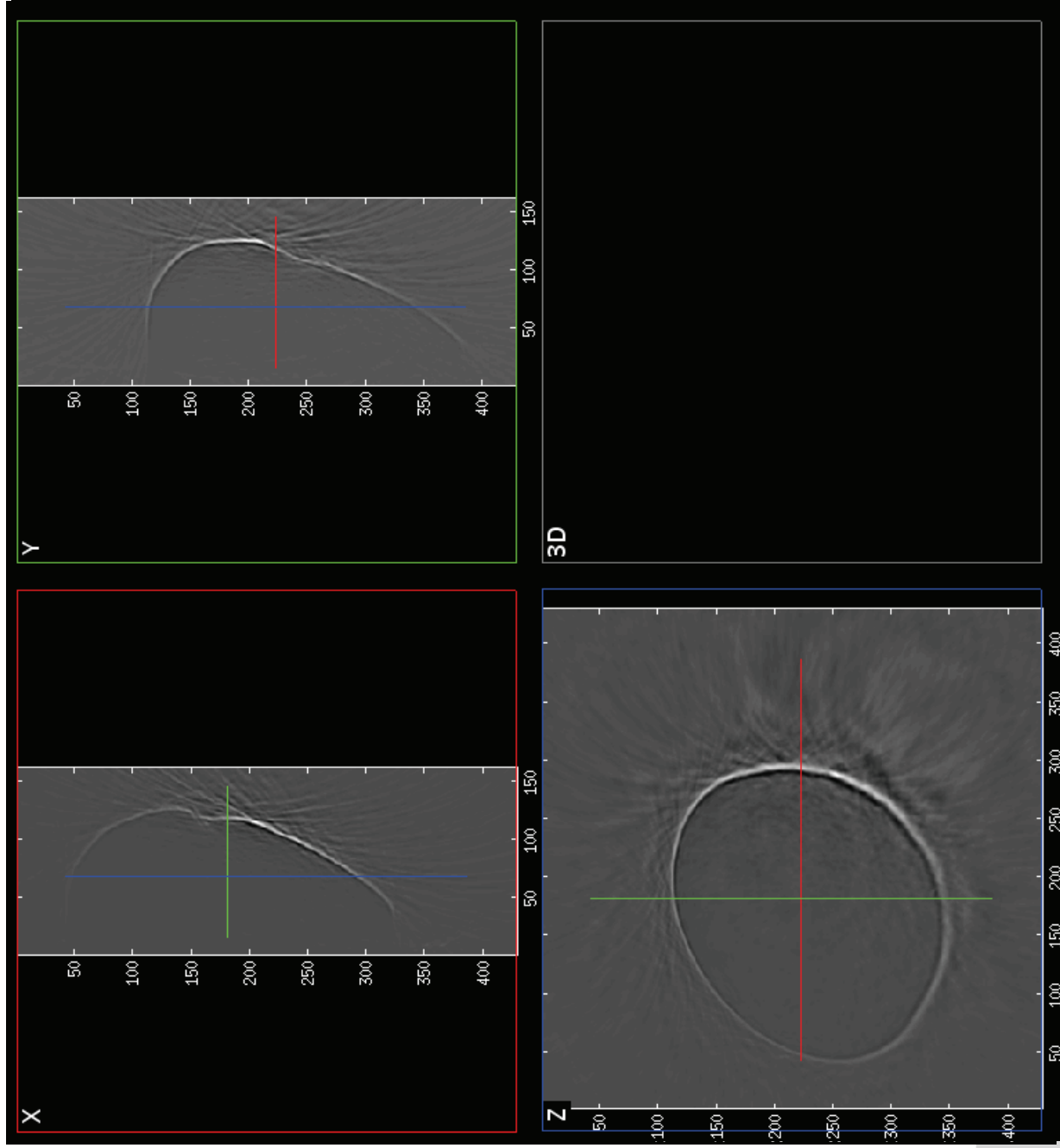
- Polytech Silimed, 210 ml



# Additional Results: Breast implant

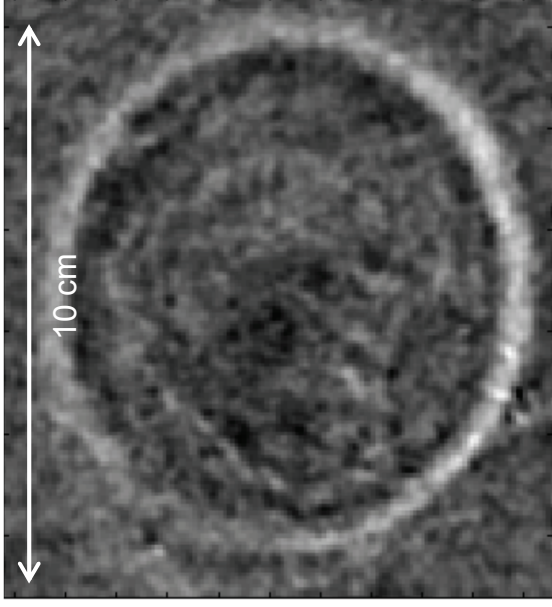


# Additional Results: Breast implant/more data

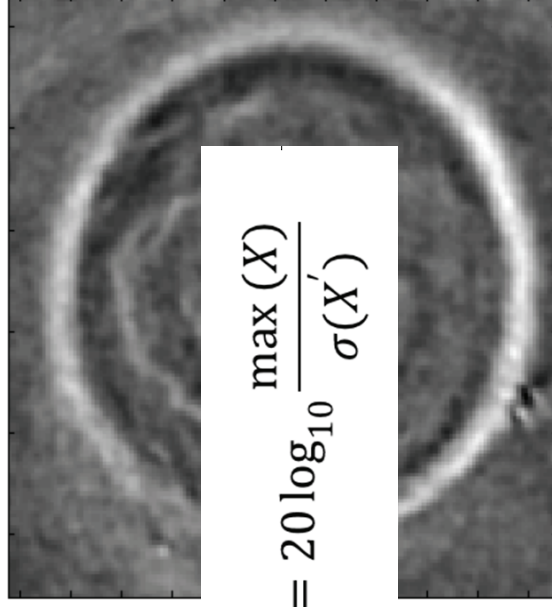
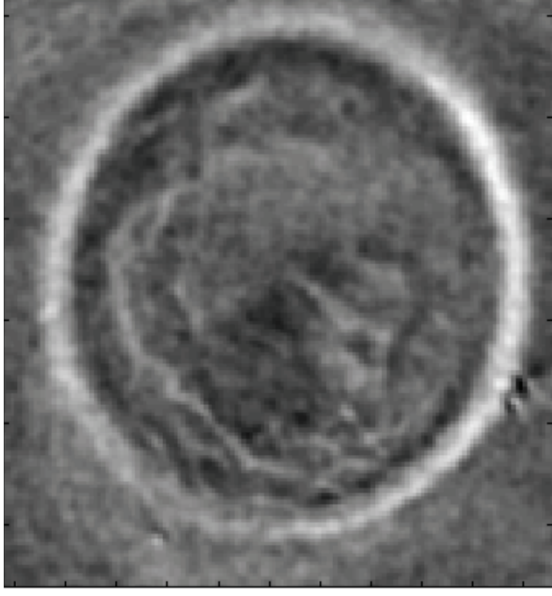


# Contrast over increasing aperture positions (P2)

1 position  $\sim 18 \lambda$



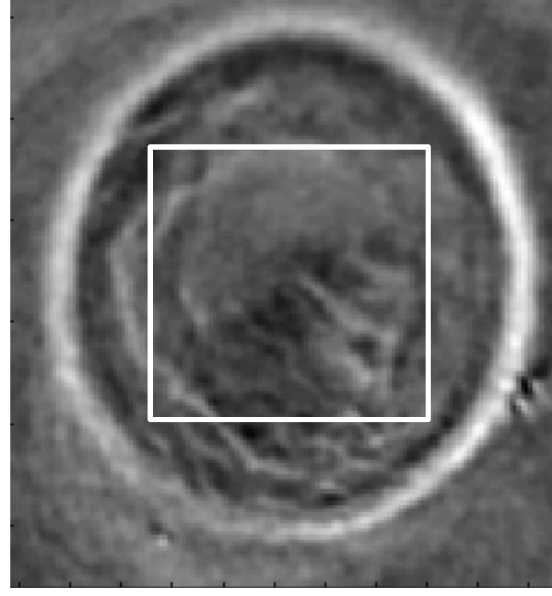
4 positions  $\sim 5 \lambda$



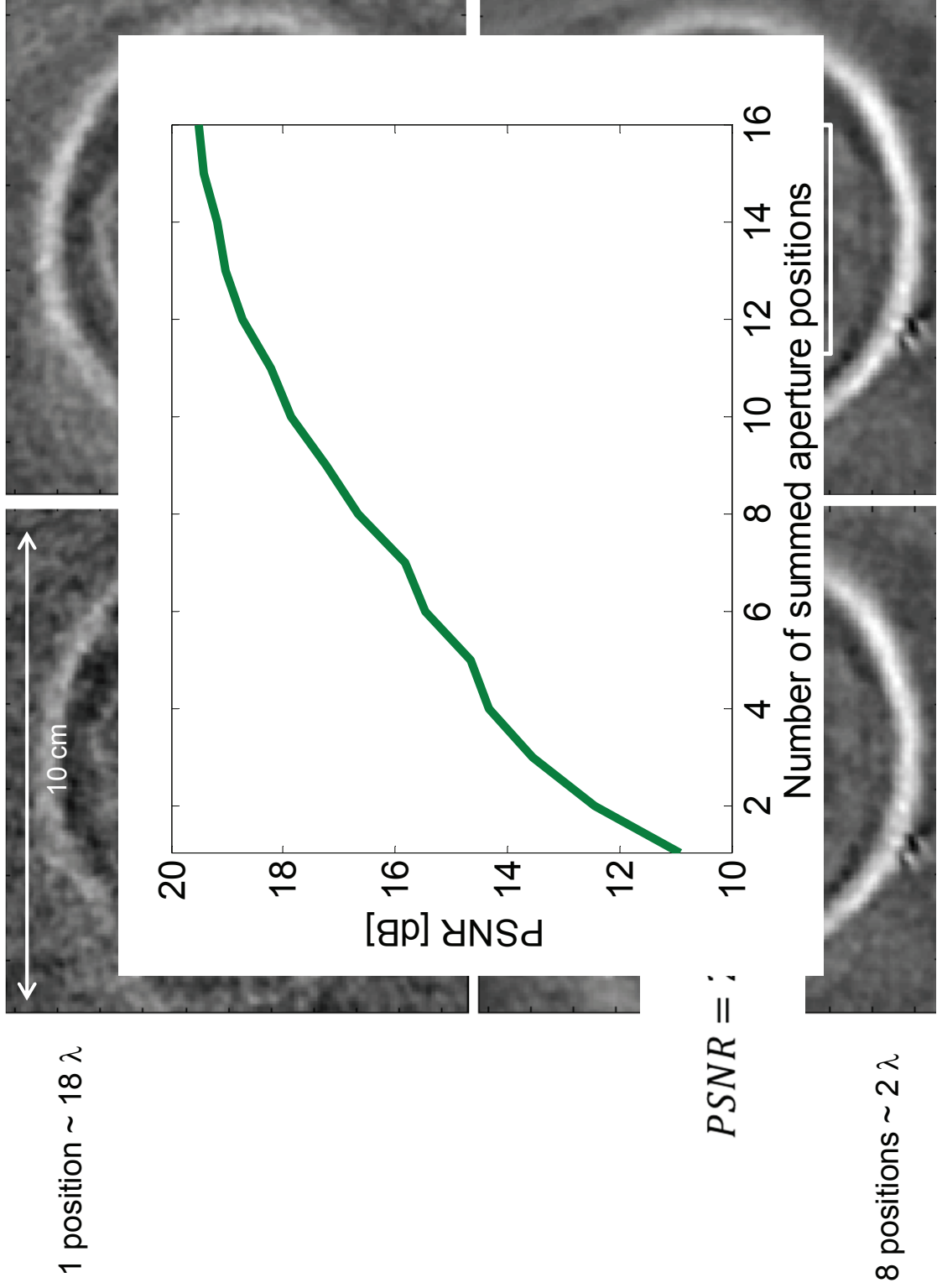
$$PSNR = 20 \log_{10} \frac{\max(X)}{\sigma(X')}$$

8 positions  $\sim 2 \lambda$

16 positions  $\sim 1 \lambda$



# Contrast over increasing aperture positions (P2)





# Pilot study



## Overview of Planned Clinical Studies

- First pilot study: Ten interesting cases
  - Evaluate and optimize imaging protocols
- Second measurements: Around 40 patients
  - Evaluate visibility of lesions in multimodal images
- Ground truth available: Clinical MRI
  - Lesions ( $\geq 5\text{mm}$ ) are clearly visible in MRI
  - Further classification available or planned
- Engineering aim: Learn how to improve system for clinical routine
- First pilot study was carried out November 2012 at University Hospital Jena within 3 days.

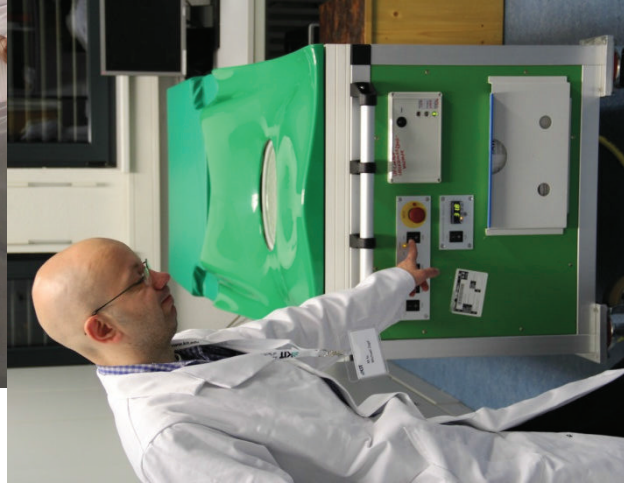
## Patient population

- 10 patients, all with suspicious lesions (follow ups, transferrals, BRCA patients)

The following diagnoses where included:

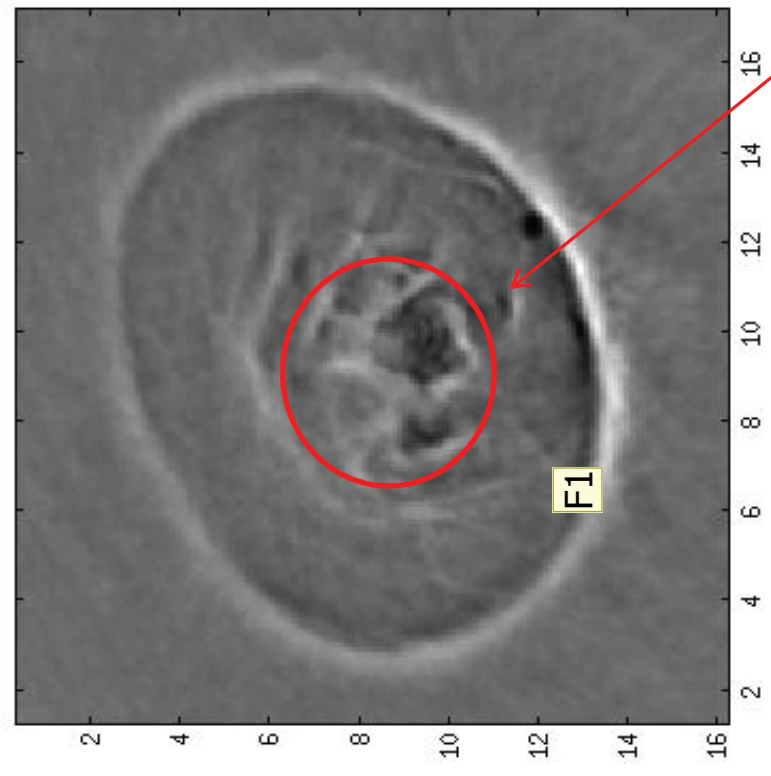
- 2 implants
- 4 cancers
- Also present:
  - Papillom
  - Fibroadenom
  - Mastopathie
  - Cyts

# Some Impressions

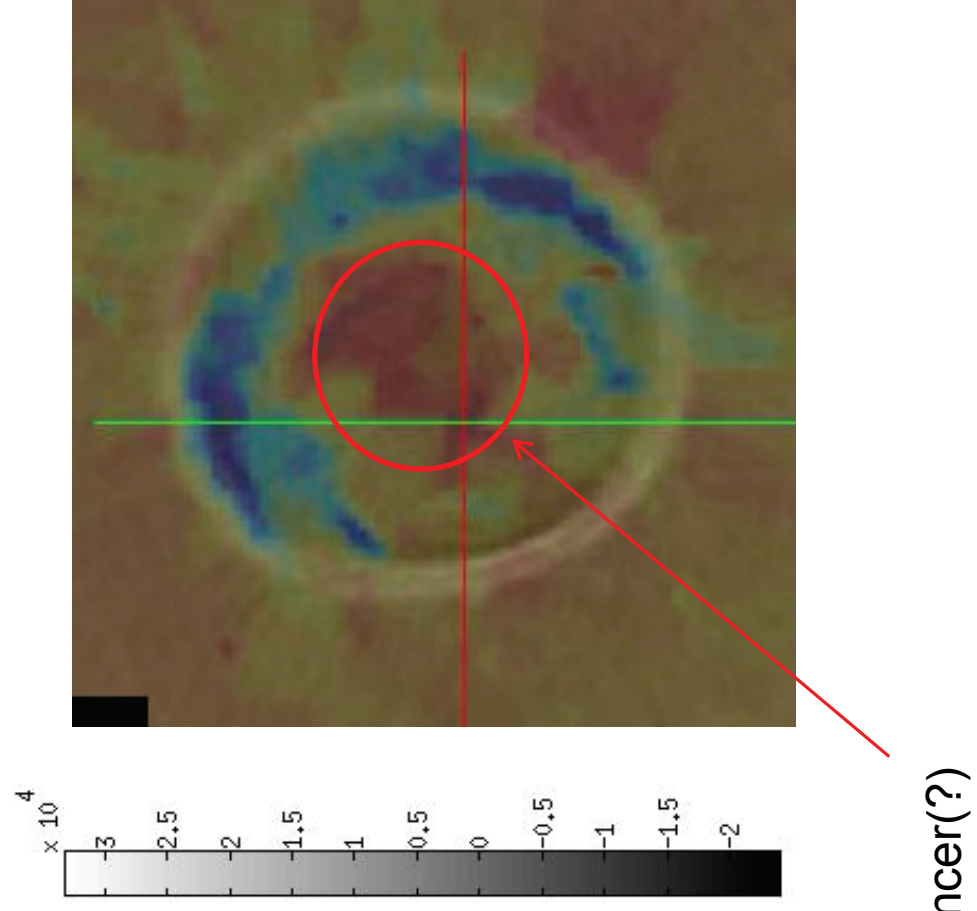


# Preliminary results: Cancer cases

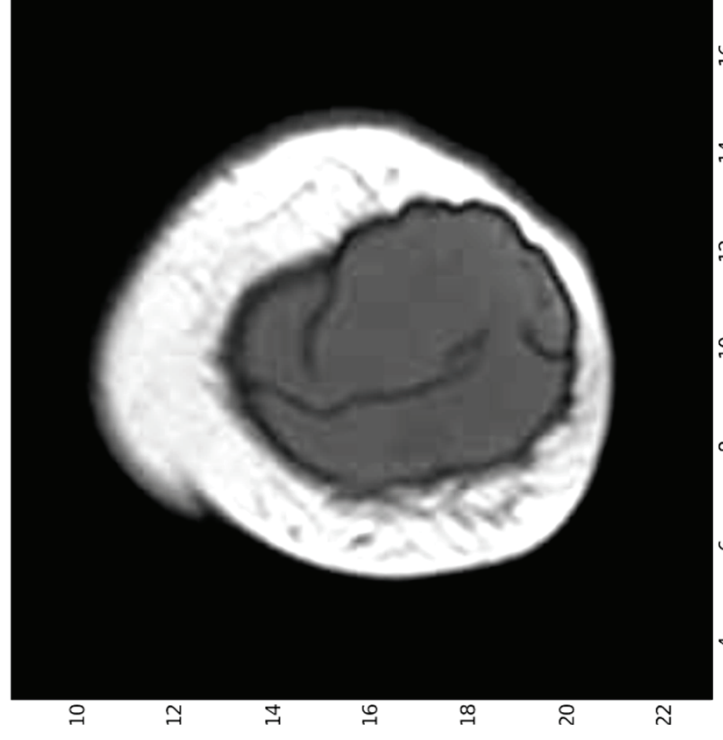
Reflectivity (P12)



Fused SOS and reflectivity (P15)

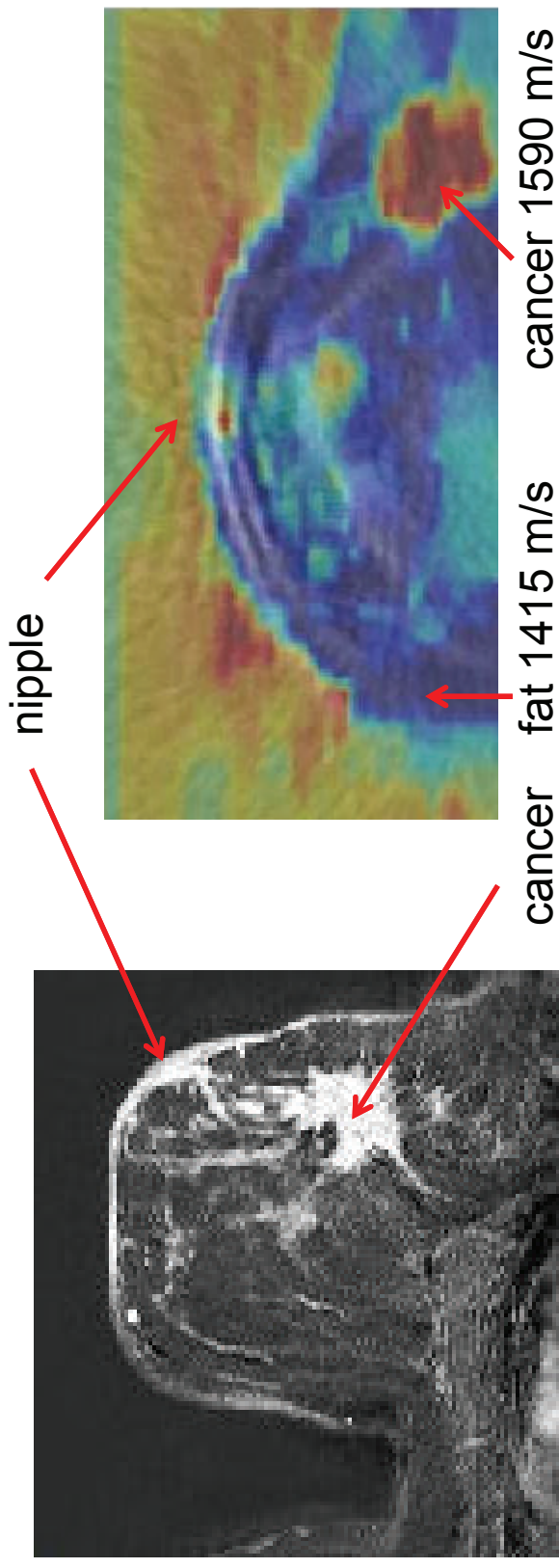


# Patient with an intact Implant



## A very strong cancer case

- P16, 64 years, left lateral  $5 \times 3 \times 4$  cm<sup>3</sup> tumor with “satellites”



MRI

USCT: overlaid reflection and SoS image

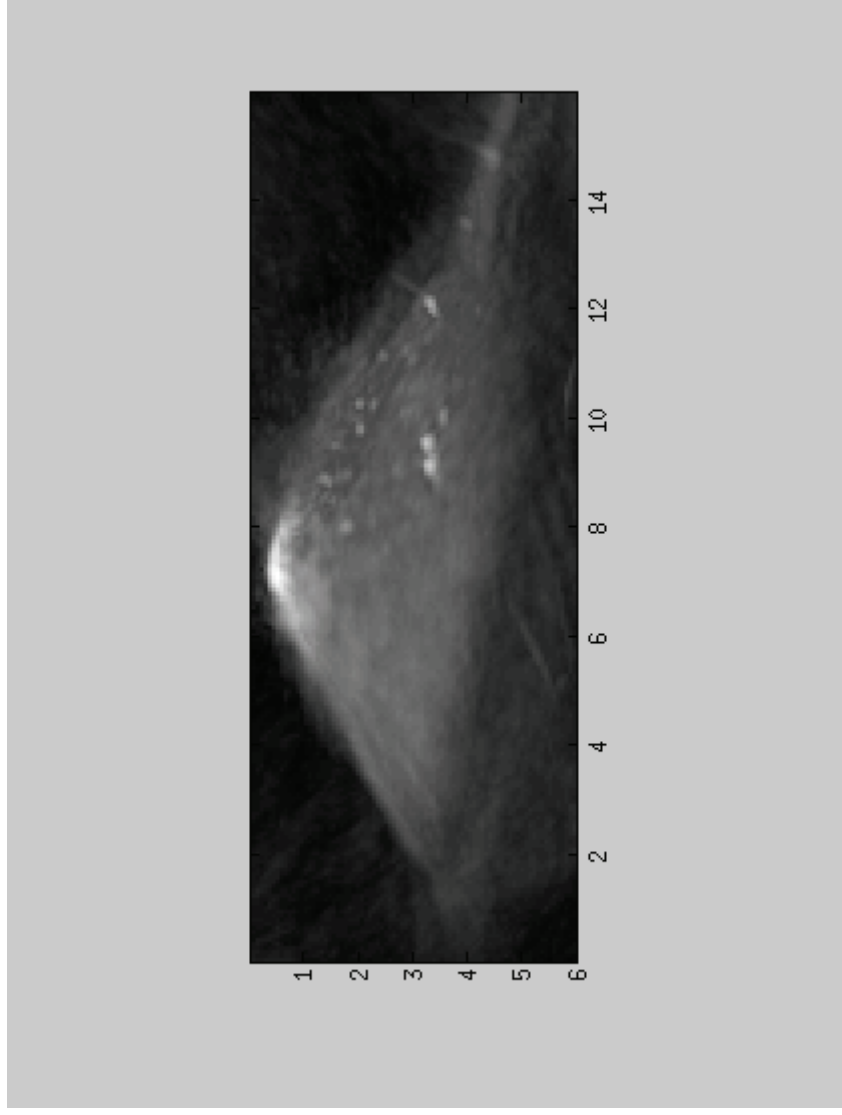
## Success!!!

- Main aim: Evaluate and optimize imaging protocols
- Pros:
  - Successful!
  - Data of all but one patient ok
  - Patient throughput ok
  - Low amount of macroscopic patient movements (at least less than 1 mm)
- Lessons learned:
  - Patient bed: uncomfortable and problems with imaging the breasts' onset
  - Contralateral breast needed in same image quality
  - More "simple" cases needed
  - Speed of sound seems to have most "hits"
- Currently:
  - Adapt image reconstruction to MDs expectations (should look more like MRI and / or B-Scans, contralateral breast for differential diagnosis, ...)
  - Reach higher resolution



# Thank you!

- Algorithms and Imaging  
**N. V. Ruiter, M. Zapf, R. Dapp, T. Hopp, H. Gemmeke, et. al.**
- HW Acceleration  
**M. Birk, M. Balzer, E. Kretzek, et. al.**
- Sensors  
**B. Kohout, et. al.**
- DAQ und Hardware  
**D. Tsherniakhovski, S. Menshikov, et. al.**
- Design and Mechanics  
**L. Berger, B. Osswald, T. Piller, W. Frank, et. al.**



P2: Maximum intensity projection (axes in [cm])