Specifications of a computed tomography dedicated to the breast with synchrotron radiation.

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SYRMA-CT setup

- Area detector for phase-contrast imaging
- Rotating and vertically translating bed
- X-ray laminar beam
- Pendant breast
- Compression plate for mammography
- Area detector for mammography
Project features

High resolution single photon counting X-ray detector

- 650 μm CdTe, hexagonal pixel
- 60-mm pitch
- Active Area $250 \times 25 \text{ mm}^2$
- Energy range 1-100 keV
Project features

Propagation-based phase contrast imaging

Attenuation Based Imaging

Propagation-based Phase-Contrast Imaging
Breast specimen – 5-mm thick

Phase CT slice
Voxel size = (120 μm)$^3$

Mammogram
Pixel size = (100 μm)$^2$
Edge Spread Function and Line Spread Function

**Edge profile across PMMA edge**
- Voxel size = (60 um)
- Projections = 720

**Phase effects**

**Phase-contrast**

**Phase retrieval**

**LSF across PMMA edge**
- Voxel size = (60 um)^3
- Projections = 720

**Phase effects**

**Phase-contrast**

**Phase retrieval**
Presampled PSF on W wire in attenuation imaging

![Graph showing Presampled LSF (mm⁻¹) vs Distance (mm).](image-url)
MTF curves over PMMA edge: attenuation imaging

MTF across PMMA edge
720 projections

Voxel size = (120 μm)³

Voxel size = (60 μm)³

Voxel size = (120 μm)³

MTF

Spatial frequency (mm⁻¹)

0 1 2 3 4 5 6 7 8

0.0
0.5
1.0
1.5
2.0
2.5

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Contrast to Noise Ratio

\[ \text{CNR} = \frac{A^{1/2} |S_g - S_f|}{\sqrt{\frac{\sigma_g^2}{2} + \frac{\sigma_f^2}{2}}} \]

ROIs

![Image of contrast to noise ratio graph with slice pixel size and air kerma values]
Microcalcifications visibility
Voxel size = 60x60x120 μm³; air kerma = 10mGy
Conclusions

Synchrotron radiation phase contrast CT of the breast

• Spatial resolution up to 7 mm\(^{-1}\) (phase contrast) or 2 mm\(^{-1}\) (phase retrieval);

• CNR one order of magnitude greater in phase imaging than in phase contrast imaging;

• Microcalcifications down to 0.13 mm detectable both in phase and in phase contrast imaging.
Thanks for your attention