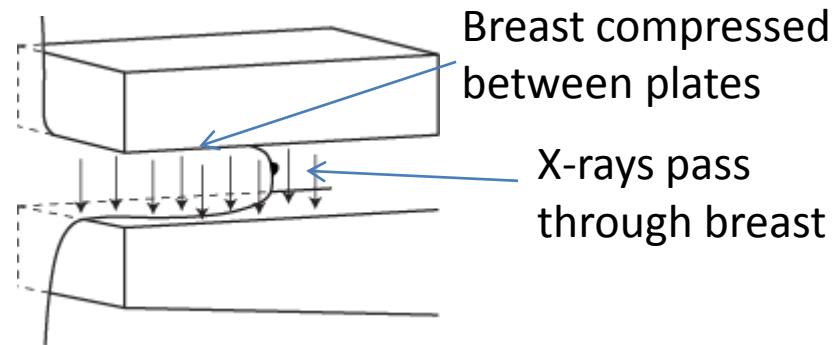


A practical, robust approach to high
resolution breast ultrasound
tomography
(HARBUT)

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Department of Mechanical Engineering,
Imperial College London, UK

Breast cancer imaging

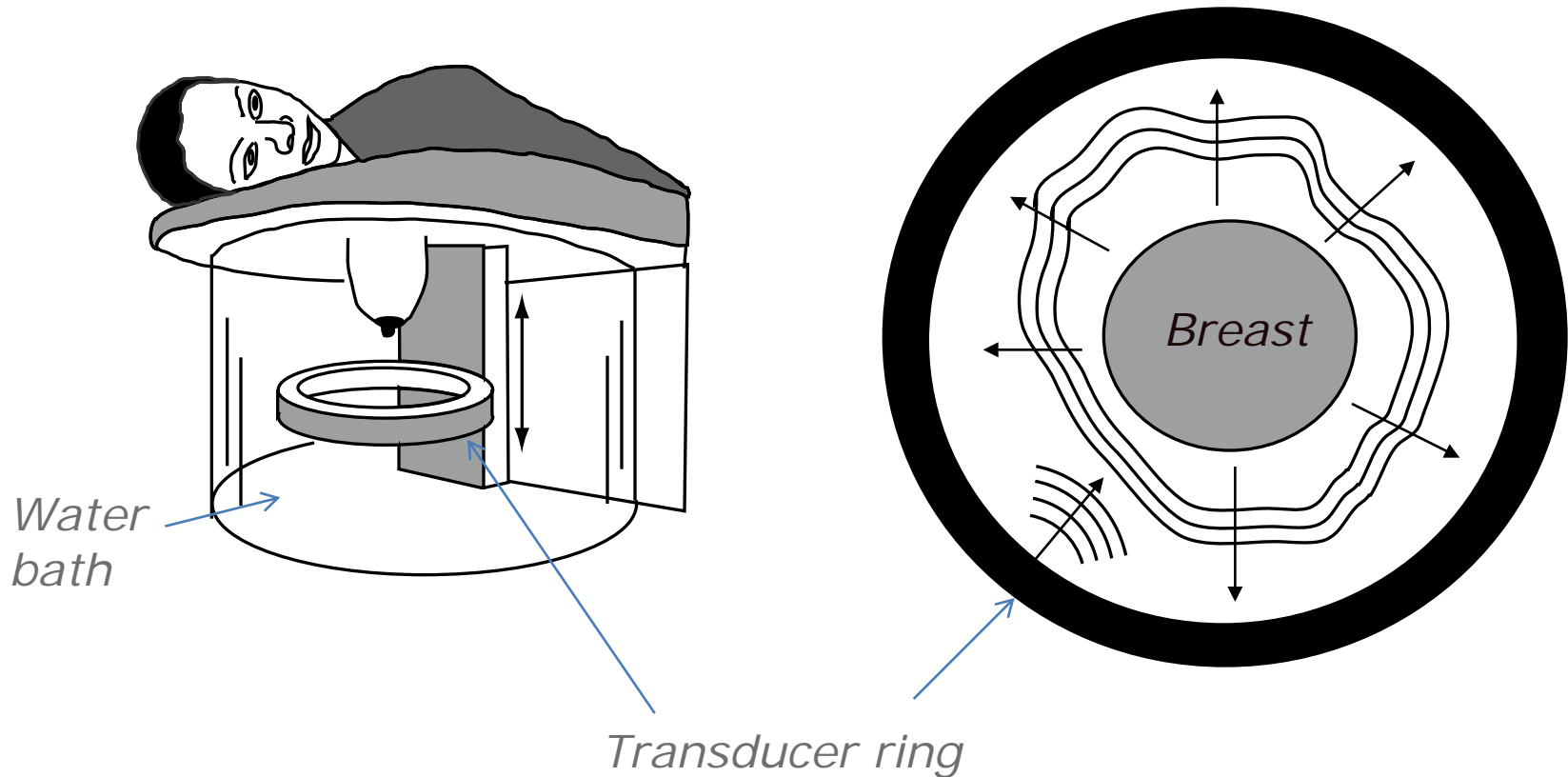
- 410 000 deaths per year from breast cancer
- Early detection important to survival
- Current 'gold standard' is mammography



- Drawbacks:
 - Dense breast
 - Radiation
 - Painful compression
 - High false positive rate

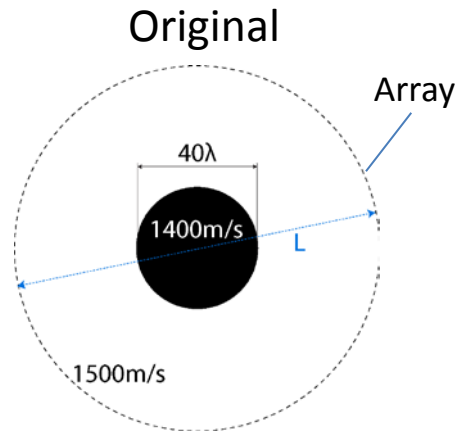


Breast Ultrasound Tomography

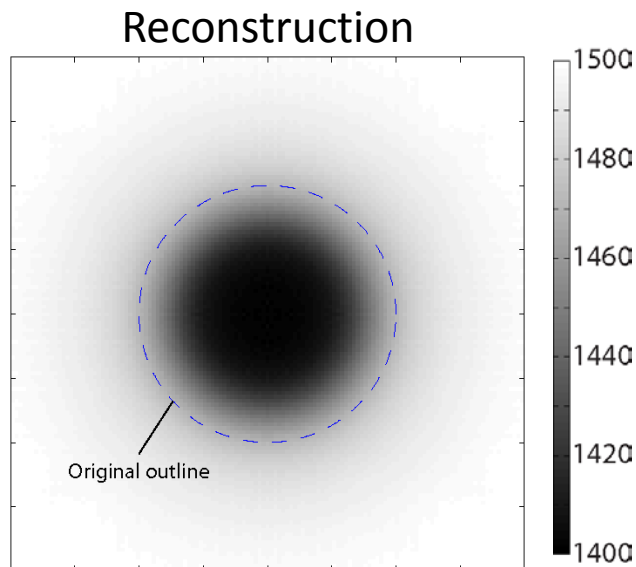


Time-of-Flight Tomography

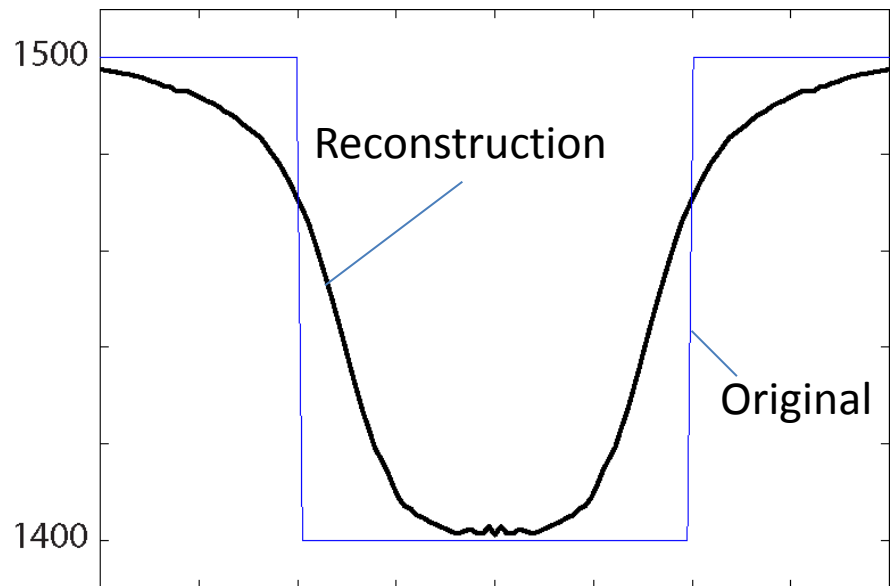
- Reconstruction based on the ray approximation



$$\text{Resolution limit} = \sqrt{L\lambda}$$

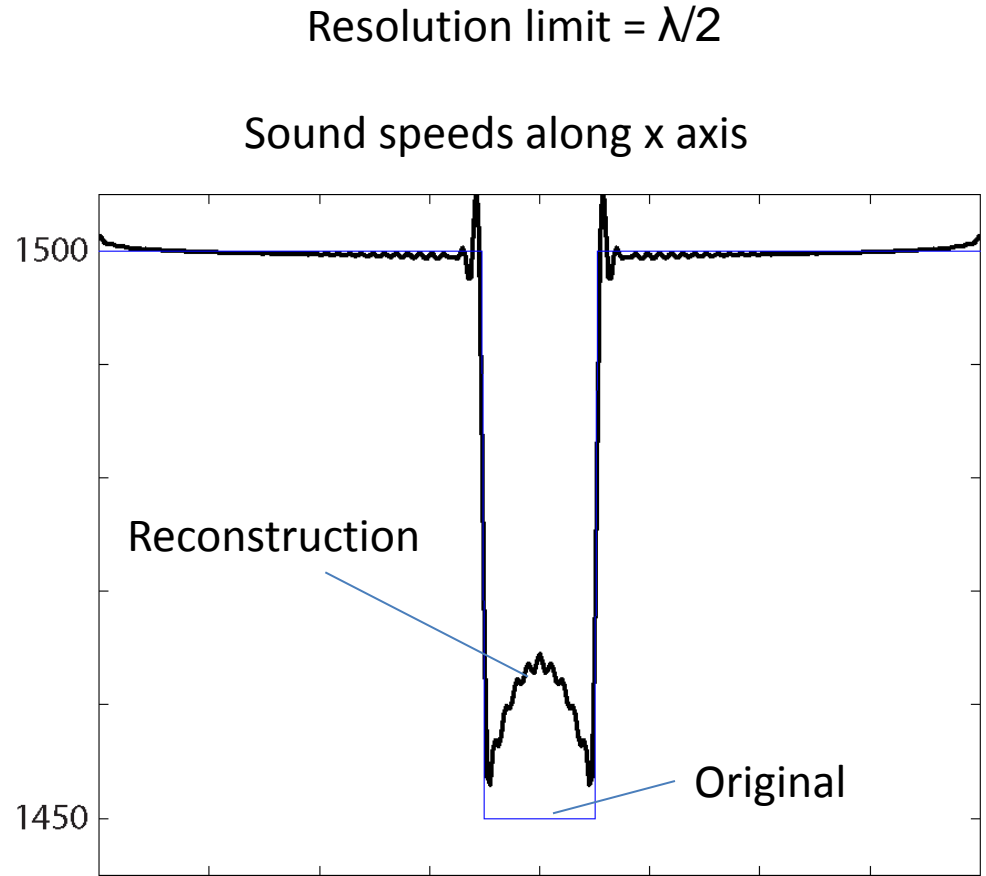
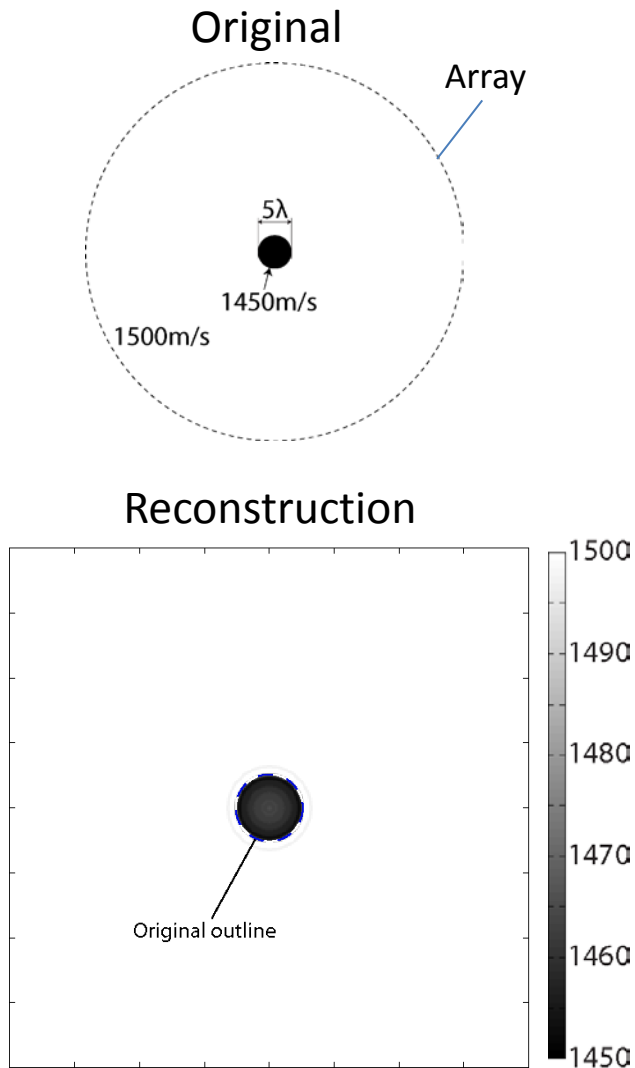


Sound speeds along x axis

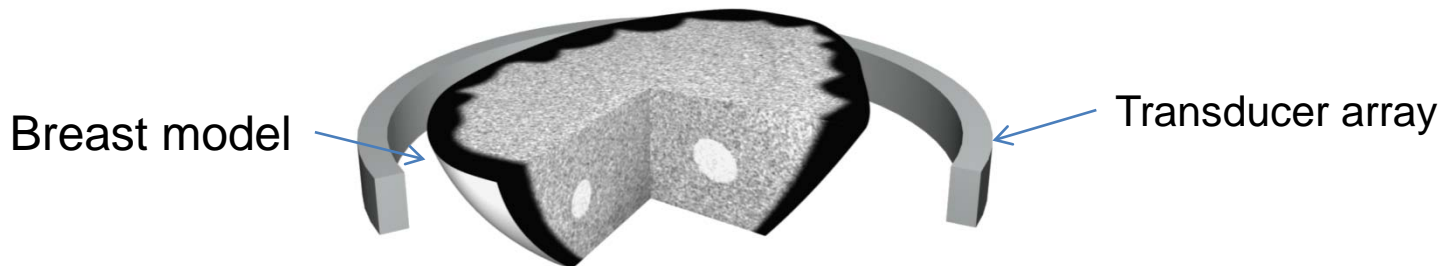
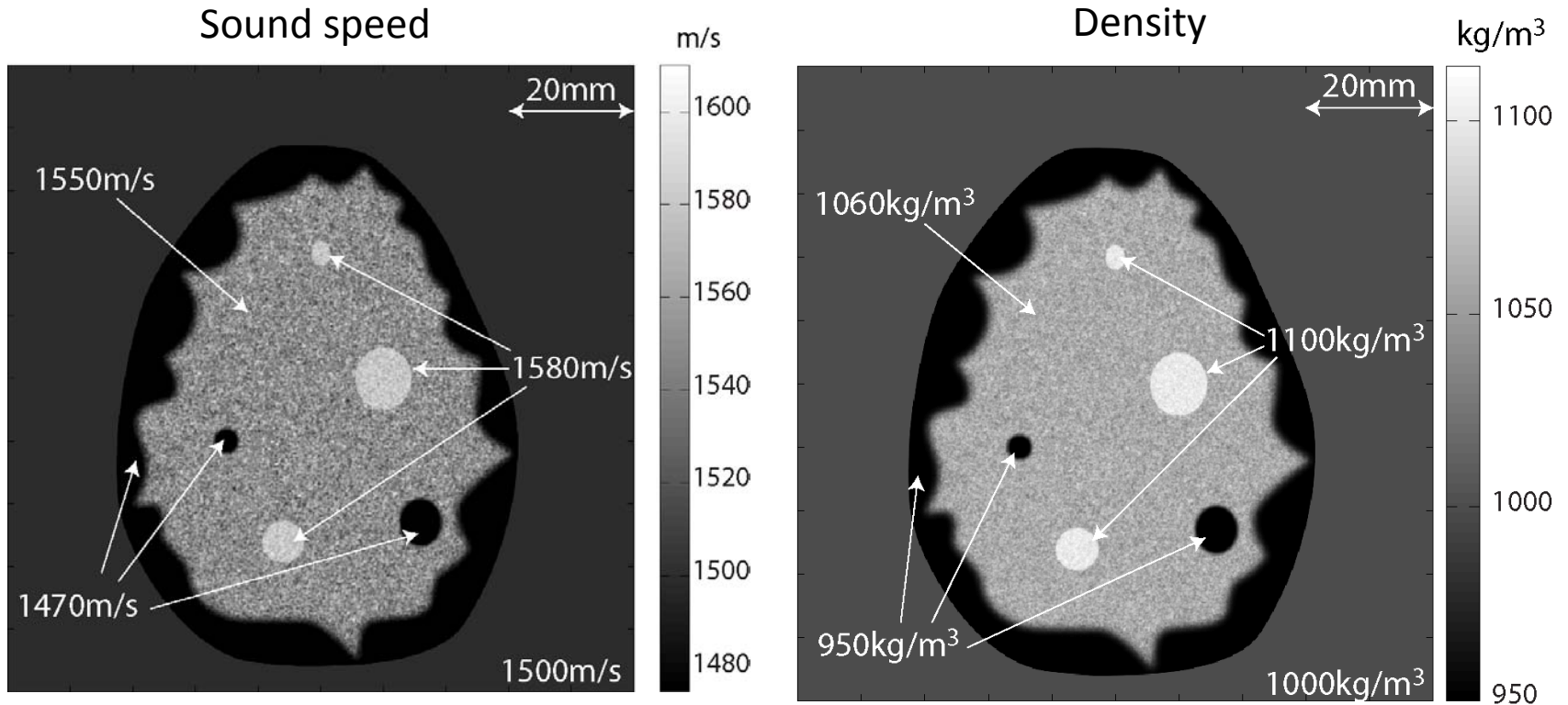


Diffraction Tomography

- Reconstruction based on the Born approximation

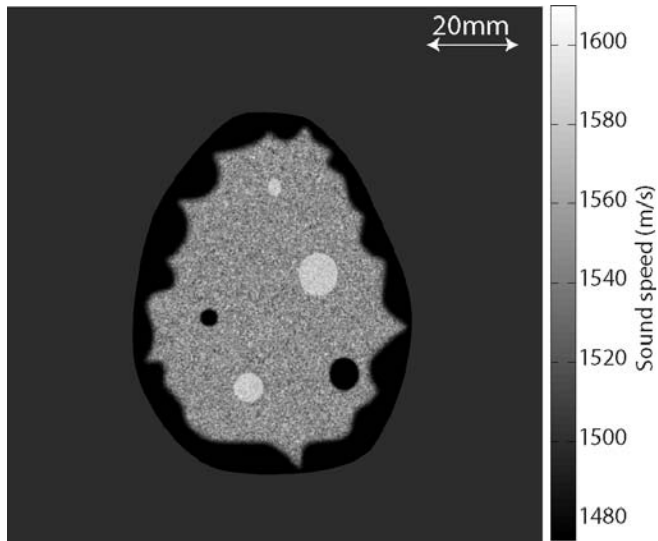


Numerical model

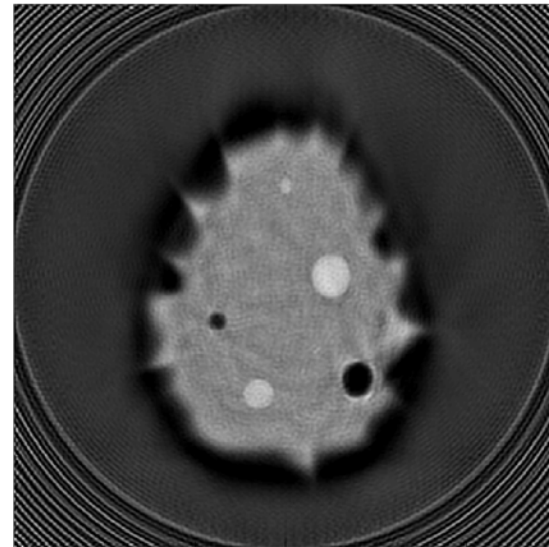


Application of TFT and DT to the breast

Breast model

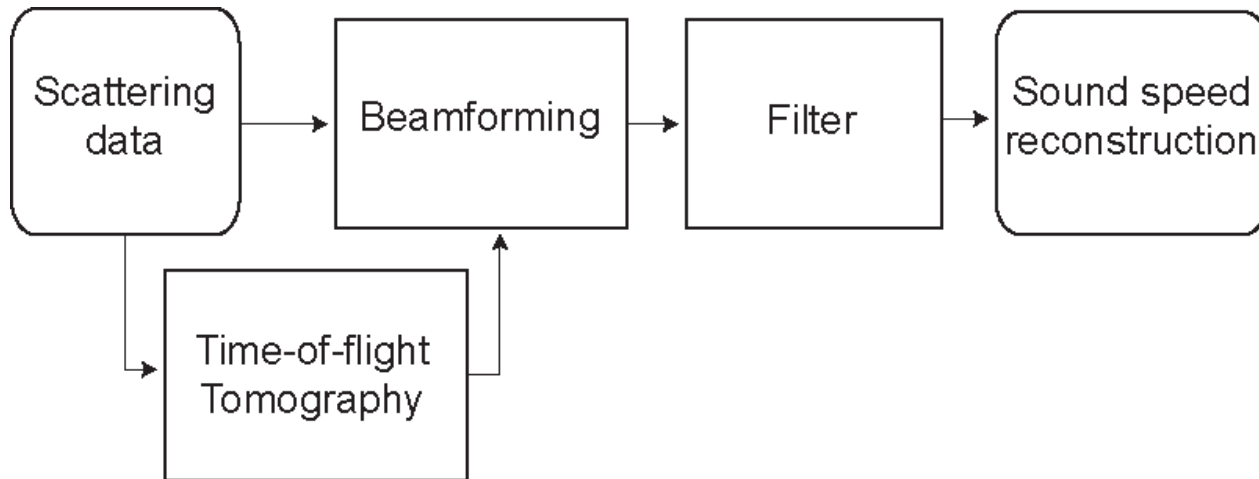


HARBUT

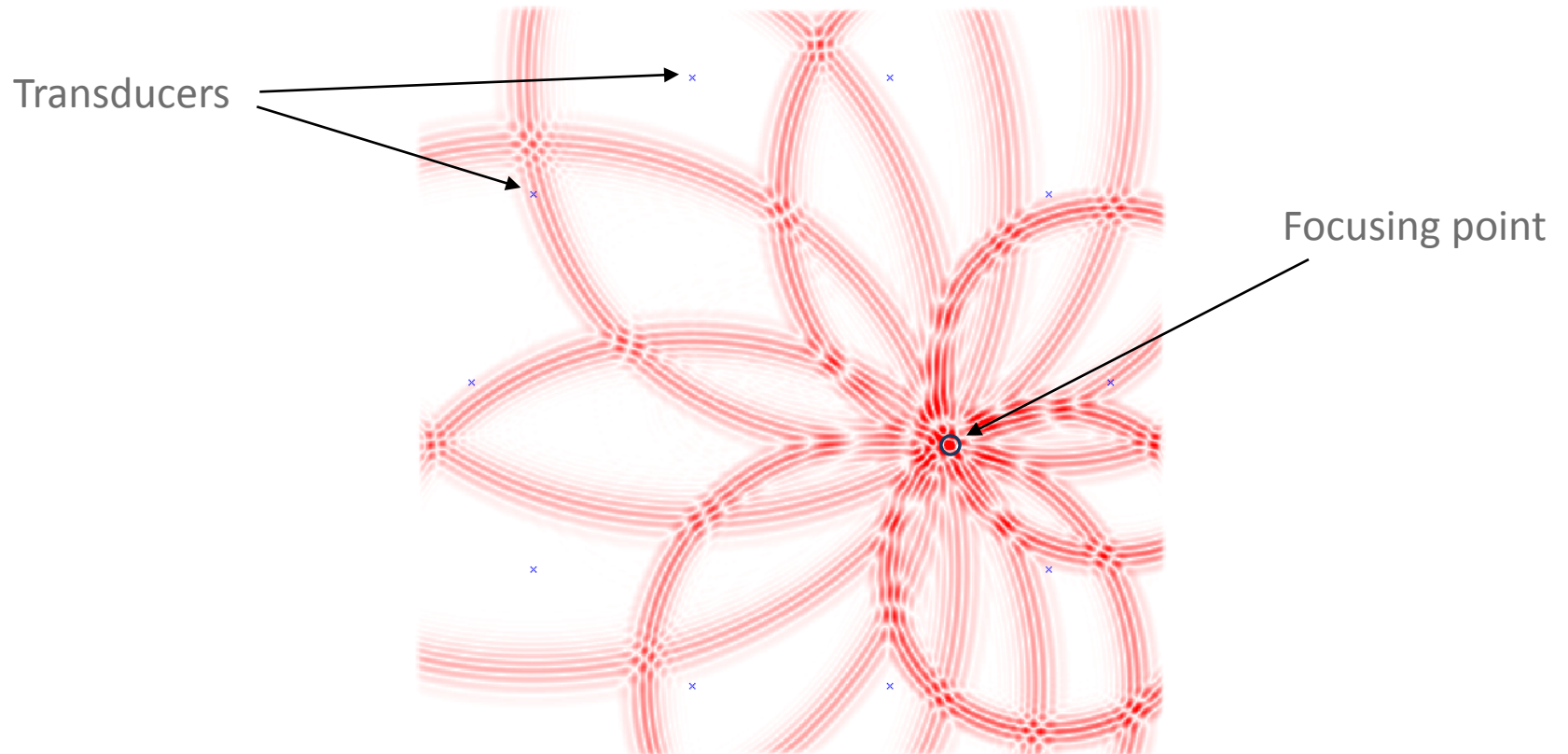


HARBUT

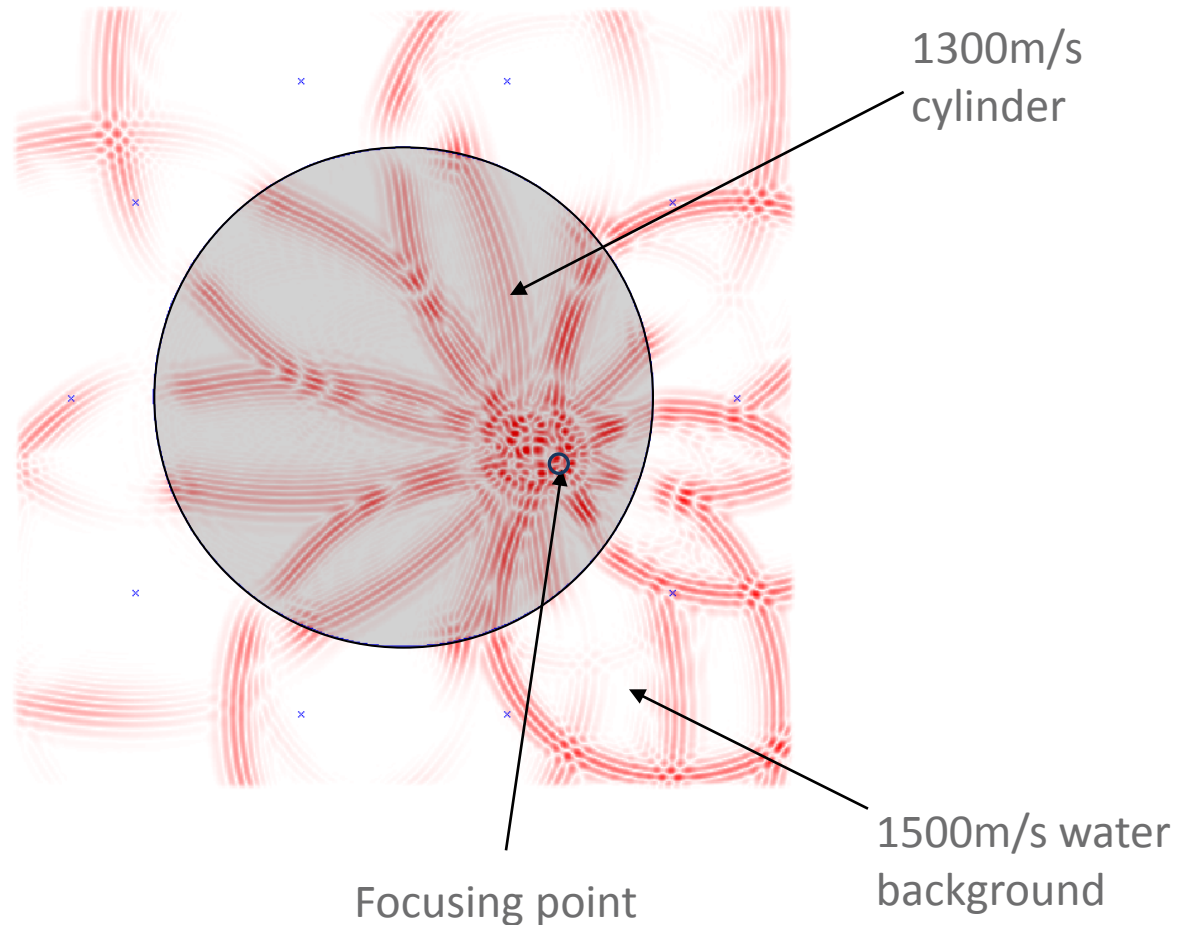
Hybrid Algorithm for Robust Breast Ultrasound Tomography



The Homogeneous Beamforming Algorithm

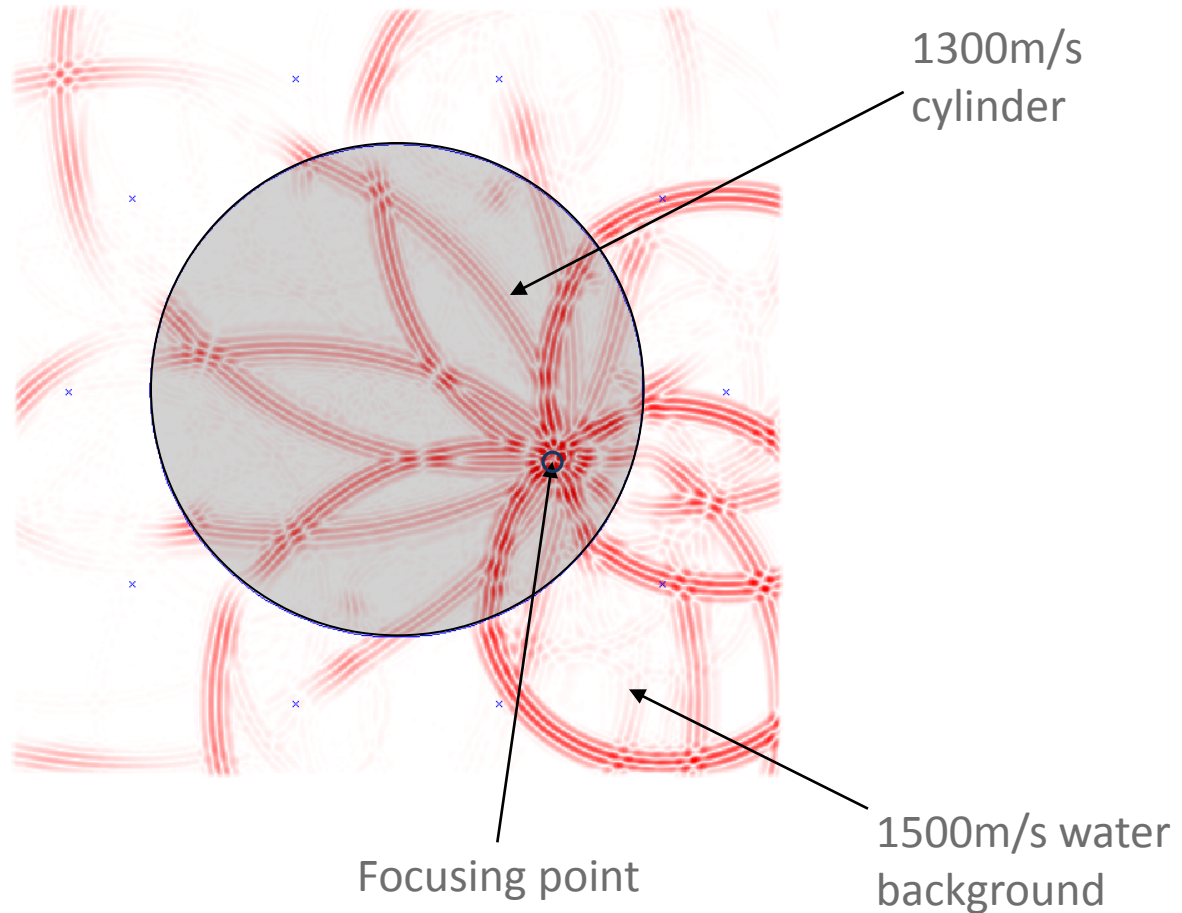


Beamforming with an inhomogeneous background



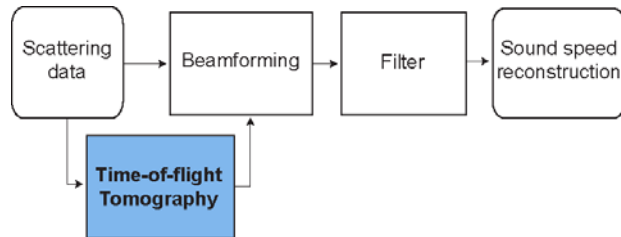
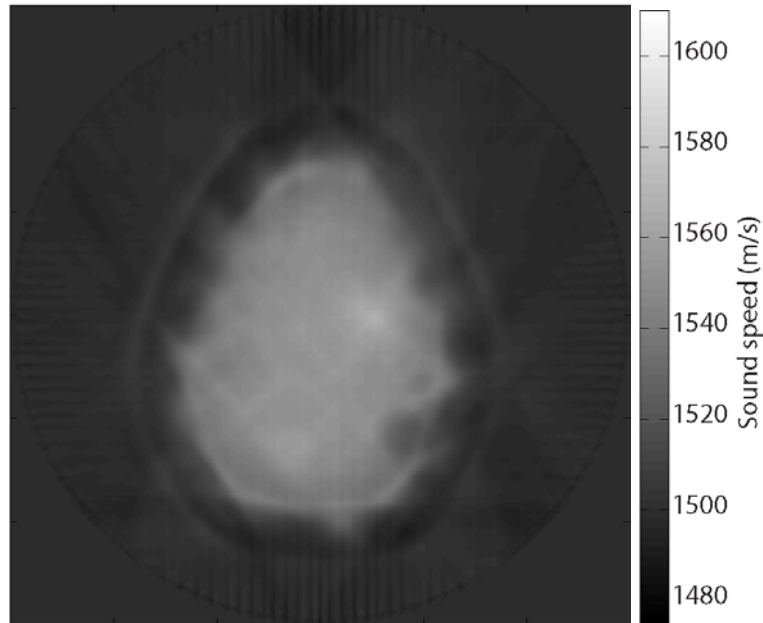
Beamforming with an inhomogeneous background

Accounting for cylinder



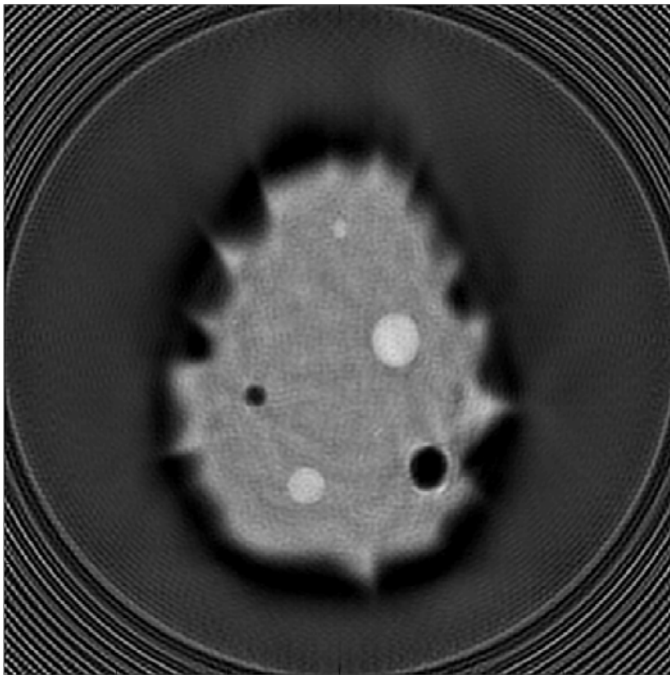
Applying inhomogeneous beamforming

Time-of-flight tomography

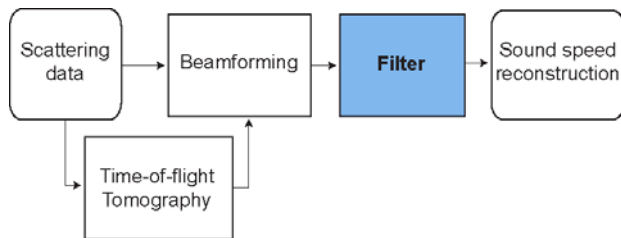
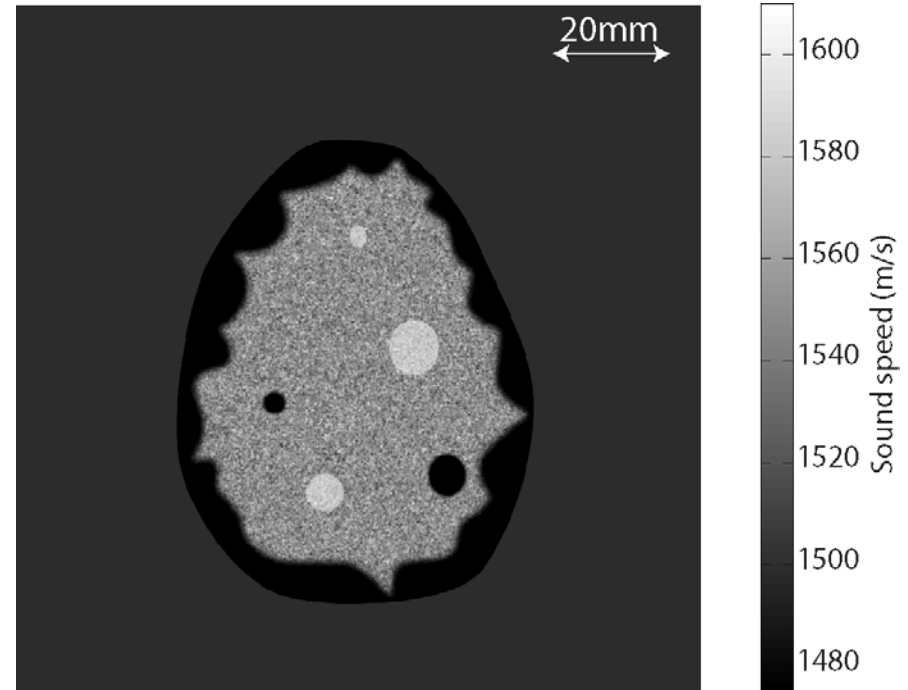


HARBUT Step 3: Filter BF to get DT sound speed reconstruction

Final Reconstruction



Original model



Conclusions

- We have introduced HARBUT, a novel method of combining TFT and DT
 - BF can be modified for an inhomogeneous background
 - TFT can provide this background
- HARBUT shown to work for a representative model of the breast