Using Breast Density as an Indicator of the Side Effects and Change Induced by Tamoxifen and Radiation Treatment for Ductal Carcinoma in Situ

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What is Ductal Carcinoma In Situ?

• DCIS is the *precursor* lesion for most invasive breast cancer
• $\frac{1}{4}$ of DCIS will lead to Breast Cancer
Radiation Side Effects

- Breast Appearance
- Skin
- Fatigue
- Fibrosis
- Edema
Breast Imaging

- MRI
- Mammography
- UST

In mammography, each breast is compressed horizontally, then obliquely and an x-ray is taken of each position.
Breast MRI

• Pros:
  – Tissue Contrast
  – Resolution
  – Safety
  – Not affected by density

• Cons:
  – Cost
  – Time
Mammography

• Pros:
  – Low Cost
  – Low Radiation
  – “Gold Standard”

• A Few Problems
  – Subjective
  – Ionizing Radiation
  – Too many false positives
Consequences of False Positives

- Unnecessary biopsies lead to
  - Wasted Time
  - Wasted Money
  - Unnecessary anxiety
Ultrasound Tomography

• Pros:
  – Short scan time
  – Great resolution / tissue contrast
  – Low cost
  – No ionizing radiation

• Cons:
  – ...?
UST vs. MRI Comparison
Breast Density

• Why does breast density matter?
  – Breast density is strongly associated with an increased risk in breast cancer
  – Mammography is more difficult with dense breasts
Does Breast Density Change During Treatment?

- Tamoxifen
- Radiation?
  - Recall: Edema, Fibrosis, etc...
Results

- One Patient’s Experience:
Sound Speed Percentage vs Time by Patient on Tamoxifen

- 331_L (Post Rad, TAM)
- 331_R (TAM)
Conclusion

• Need more data!
• We *can* detect changes in breast density in the time it takes to treat the patient
• Results look promising
Sound Speed -> Breast Density

- \( c = \sqrt{C/\rho} \)
- \( C \propto \rho^3 \)
- Combining equations...
  - \( c \propto \rho \)