



Center for Subsurface Sensing and Imaging Systems (CenSSIS)

# Measuring acoustic properties of tissue mimicking phantoms using pulse-echo ultrasound

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# Outline

- What are tissue phantoms?
- Research goals
- Methods
  - Experimental setup
  - Experiments 1 and 2
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- Results
  - Experiment 1
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  - Experiment 4
- Conclusions



# Tissue Phantoms

- Chemical mixture that mimics acoustic properties of human tissue

<u>Property</u>	<u>Agar Phantom</u>	<u>Human Tissue</u>
Density ( $\text{kg/m}^3$ )	1045	1000-1100
Sound Speed (m/s)	1551	1450-1640
Attenuation ( $\text{Np/m/MHz}$ )	10.17	4.03-17.27



# Tissue Phantoms

- Base phantom recipe

<u>Component</u>	<u>Amount</u>
Distilled Water	600mL
Agar	18g
Methyl Paraben	0.75g
Graphite Powder	54g
1-Propanol	50mL





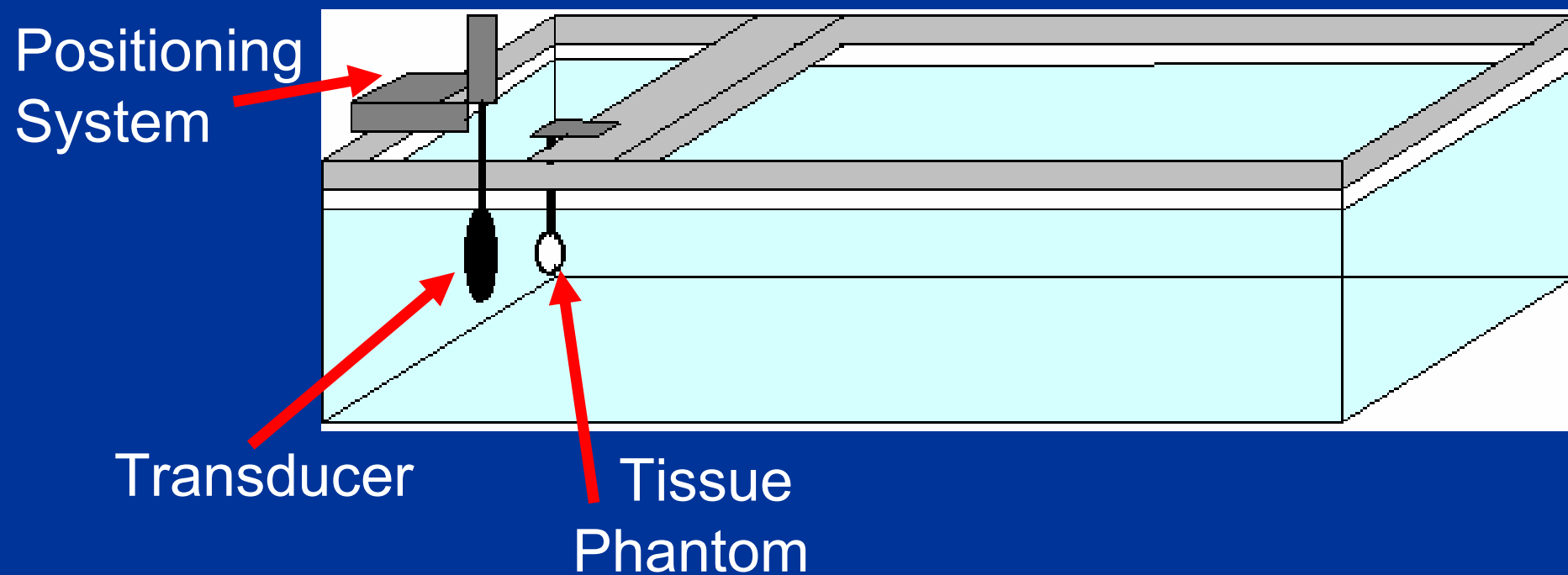
# Research Goals

- Determine optimum placement of phantom and transducer for most accurate results
- Discover how acoustic properties of phantoms change with variations in recipe



# Methods

- Experimental setup





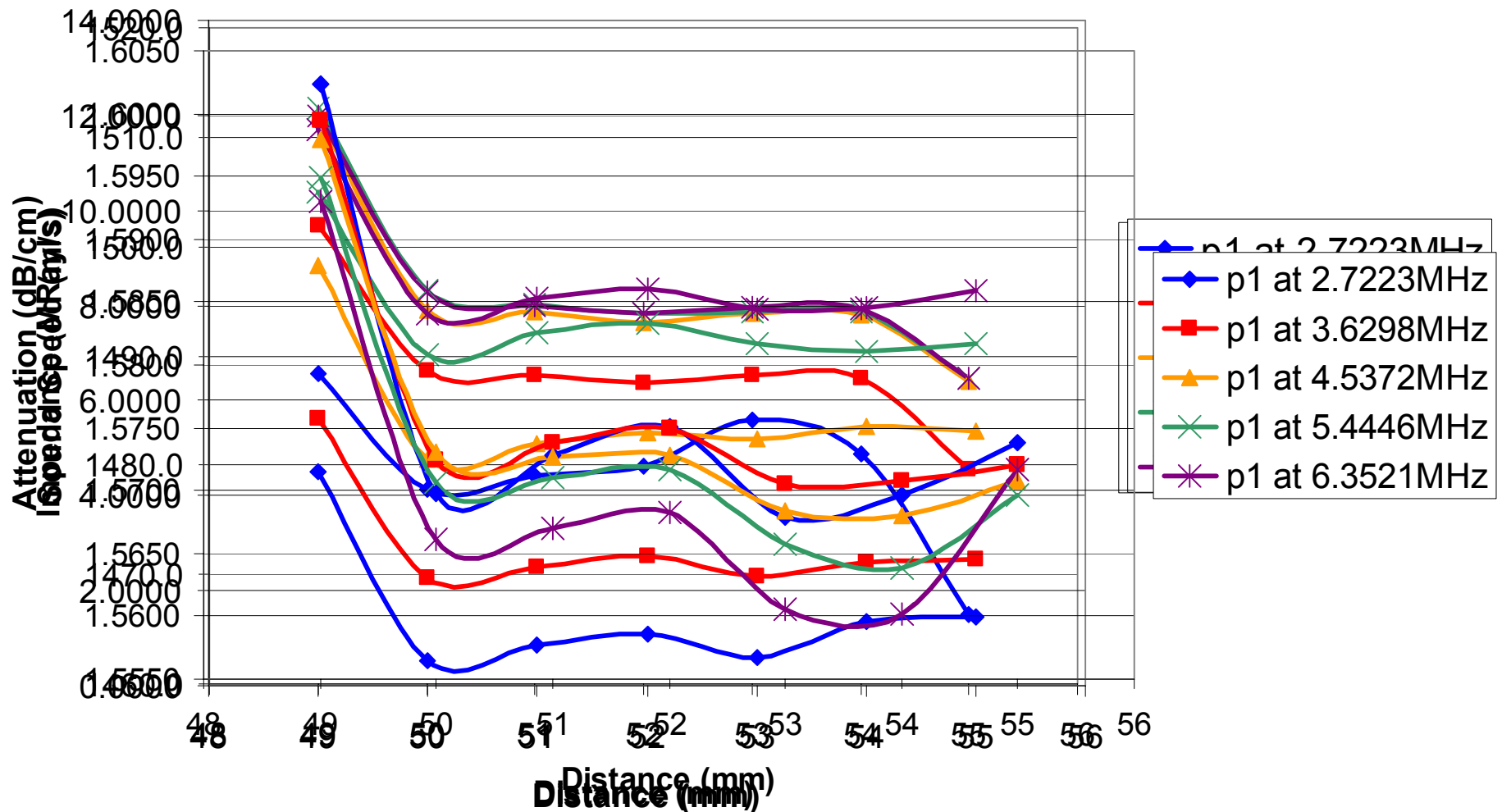
# Methods

- Experiment 1
  - Base phantom recipe
  - Position sample at 49, 50, 51, 52, 53, 54, and 55mm from transducer
- Experiment 2
  - Base phantom recipe
  - Position sample at 51mm from transducer and rotate from  $-15^{\circ}$  through  $15^{\circ}$  with respect to normal incidence



# Results: Experiment 1

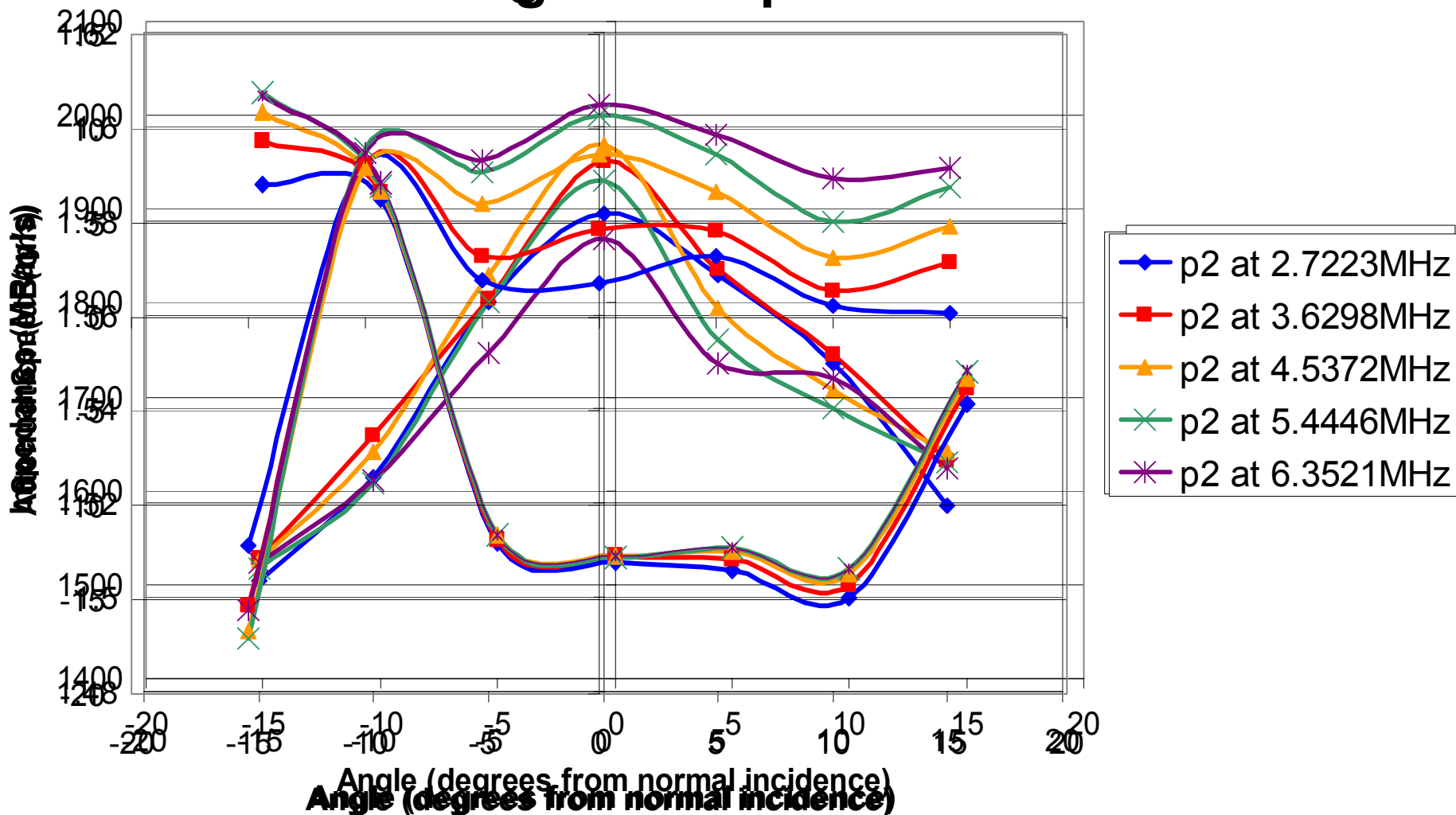
## Effect of Distance on Signal Speed





# Results: Experiment 2

## Effect of Angle on Impedance





# Methods

- Experiment 3
  - Less graphite than base phantom recipe
- Experiment 4
  - More 1-propanol than base recipe

<u>Component</u>	<u>Amount</u>
Distilled Water	600mL
Agar	18g
Methyl Paraben	0.75g
Graphite Powder	54g
1-Propanol	75mL







# Conclusions

- Optimum placement is 1.5mm front or back of focal point and within  $5^\circ$  of normal to transducer axis
- Less graphite = lower sound speed and higher attenuation
- More 1-propanol = higher sound speed and lower impedance
- Future research should test recipes with more graphite and less 1-propanol



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