RESEARCH & DEVELOPMENT

A New System for Superimposing Dual-Frequency Microbubble Signals on Clinical Ultrasound Images

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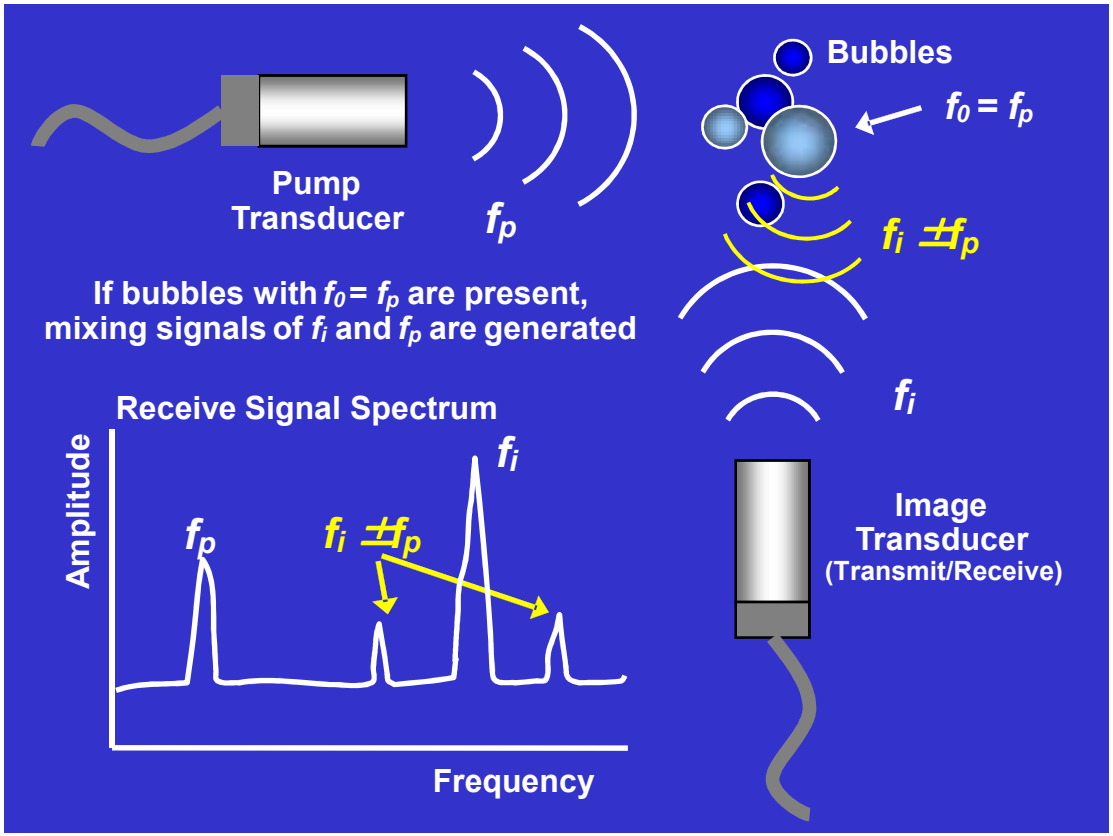
Microbubbles and DCS

- We have previously demonstrated that exercise can produce microbubbles in tissue
- These microbubbles may provide a nucleation site where bubbles form during decompression
- The location and size distribution of these microbubbles is unknown
- In addition to detection, the ability to ***localize*** microbubbles would help to understand the role microbubbles may play in decompression sickness
- May also be useful for diagnosis

Dual-Frequency Ultrasound



Current system: Pump frequency optimized for 2 to 5 μm bubbles

*Newhouse, V.L. and Shankar, P.M., "Bubble Size Measurements Using the Nonlinear Mixing of Two Frequencies," *Journal Acoustical Soc Am.*, Vol. 75, 1984, pp. 1473–1477.

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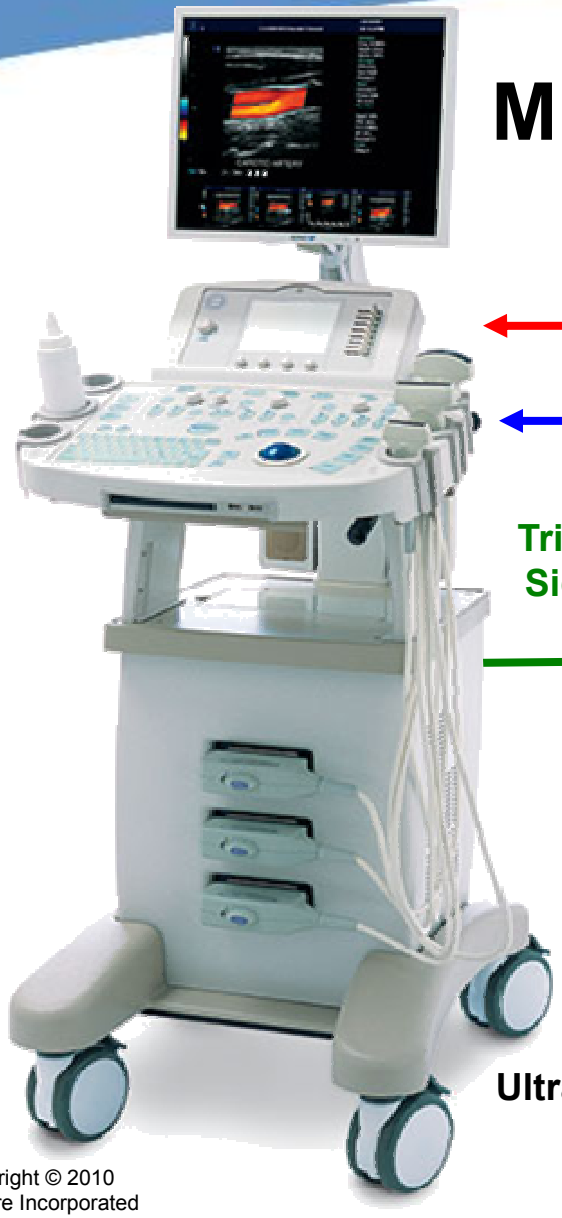
Microbubble Imaging System



Ultrasonix® Sonix RP Ultrasound System

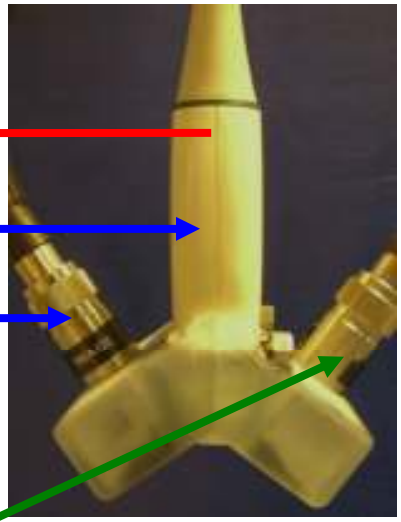
Bubble Signal

B Mode Image Signal

Trigger Signal

Function Generator & Amp

Bubble Image Signal



Transducers

Function Generator & Amp

Pump Signal

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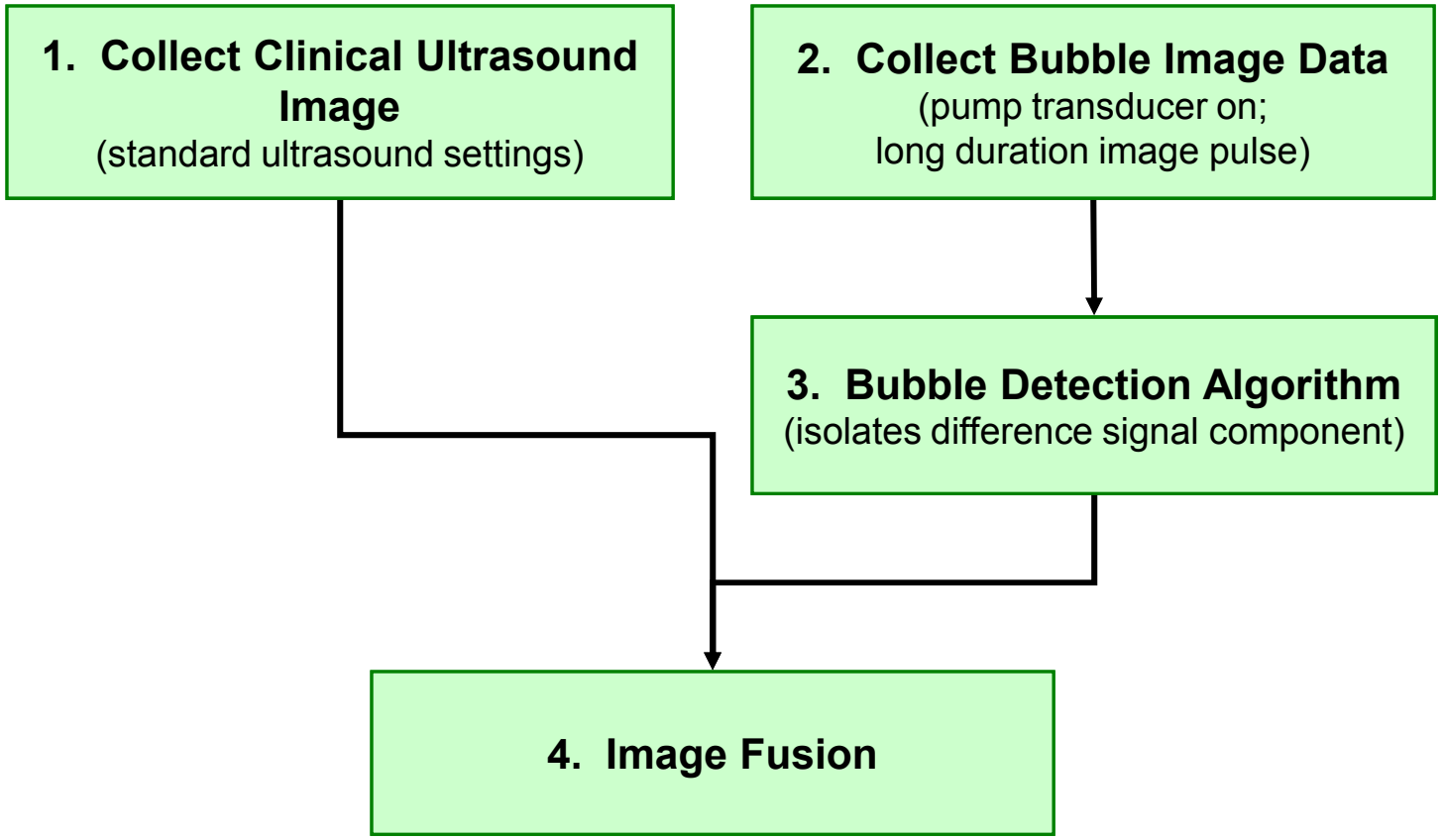
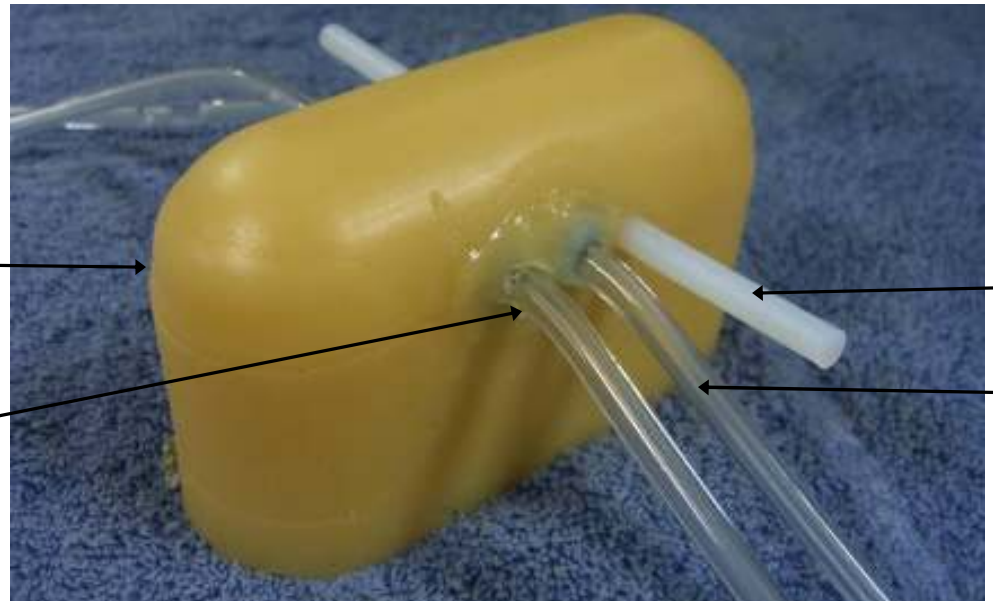
Data Processing

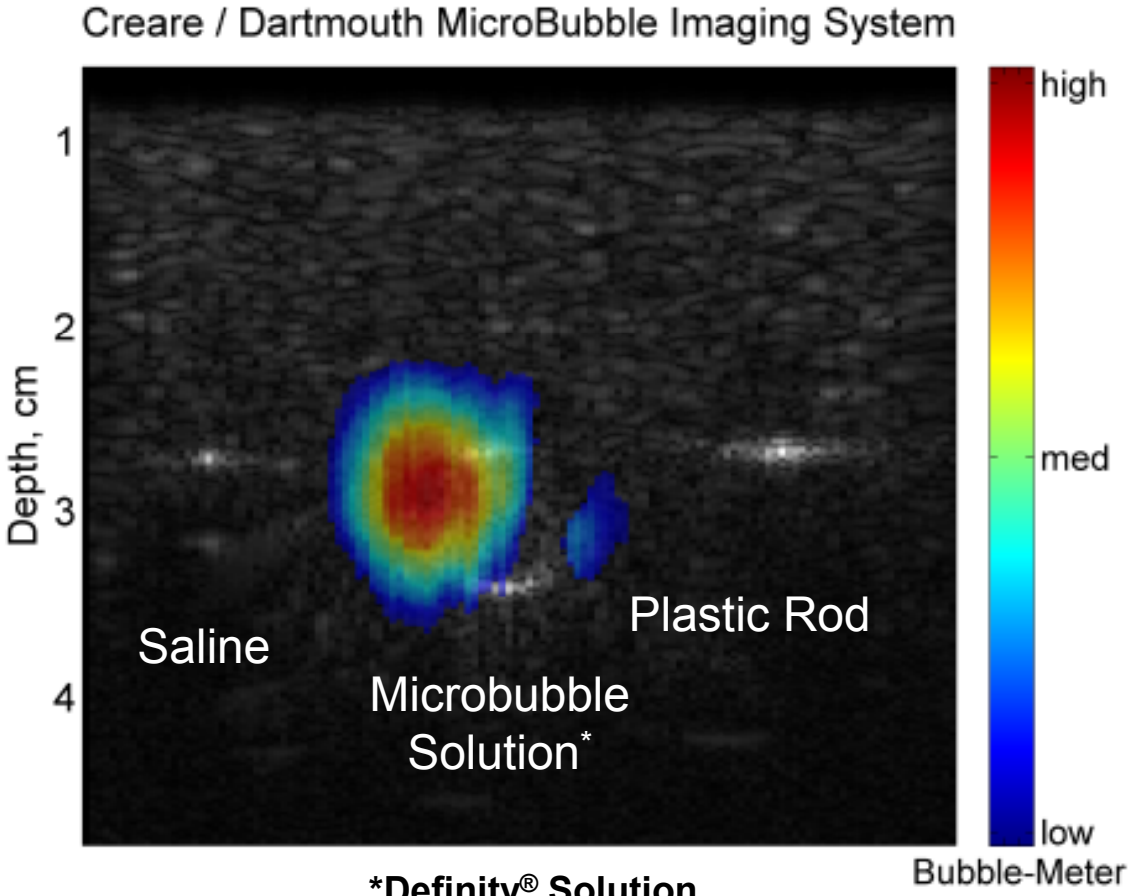


Urethane Phantom Construction

- Tissue mimicking phantom
- Three targets
  - Microbubble solution (center tube)
  - Two controls: saline filled tube and plastic rod



Urethane Phantom Results



***Definity® Solution**

Conclusions

- **Developing an instrument for detecting and *localizing* microbubbles**
- **System can detect microbubbles and superimpose the bubble image on a 2-D ultrasound image**

Future Work

- **System improvements**
  - **Developing integrated transducer**
  - **Optimizing bubble detection algorithms**
- **In-vivo testing (swine model)**
  - **Contrast agent injections into tissue**
  - **Decompression studies**
- **Human subject testing**
  - **Anatomic location of microbubble formation during exercise**
  - **Location of bubbles in decompression studies**