QIBA Ultrasound Shear Wave Speed (SWS) Combined Call:
System Dependencies *and* Phantom-System Measurement Testing Subcommittees
Friday, February 21, 2014; 11 AM CT
Draft Call Summary
Notes provided by Dr. Wear

In attendance

Mark Palmeri, MD, PhD (Co-Chair)	Brian Garra, MD	Nicolas Rognin, MSc, PhD	**RSNA**
Keith Wear, PhD (Co-Chair)	Timothy J. Hall, PhD	Cedric Schmitt, PhD	Joe Koudelik
Michael Andre, PhD	Christopher Hazard, PhD	Daniel Sullivan, MD	Julie Lisiecki
Paul Carson, PhD	Ted Lynch, PhD	Matthew Urban, PhD	
Jun Chen, PhD	Stephen McAleavey, PhD	Michael Wang, PhD, MASc	
Shigao Chen, PhD	Kathy Nightingale, PhD	Hua Xie, PhD	

Moderator: Keith Wear, PhD

General Discussion:

- The call summary from 01-17-2014 combined (Phantom subcommittee) and (System Dependencies subcommittee) was approved.

Agenda:

1. Review of "DEVELOPMENT OF OIL-IN-GELATIN PHANTOMS FOR VISCOELASTICITY MEASUREMENT IN ULTRASOUND SHEARWAVE ELASTOGRAPHY" *Ultrasound in Med. & Biol*., vol. 40, No. 1, pp. 168-176, 2014 by Hua Xie *et al*., (Xie).

The authors constructed a set of phantoms with gelatin concentrations ranging from 3-7%, castor oil concentration ranging from 0-40%, 2% graphite, and 7% n-Propanol. They used a Philips iU22 with a C5-1 curvilinear transducer. They tracked at a depth of 4 cm and lateral positions of 1.4, 2.7, 4.0, 5.3, and 6.6 mm. They used push pulses with a pulse repetition frequency of 70 Hz, which resulted in shear waves with a fundamental at 70 Hz and harmonics at 140, 210, and 280 Hz. They found that shear modulus and viscosity could be controlled by adjusting concentrations of gelatin and castor oil.

The authors also characterized phantoms using the slope of shear wave phase velocity as a function of frequency. They hypothesized that this parameter may be a better measure of shear wave dispersion than shear viscosity derived for Voigt model.

There was a comment about stability issues associated with gelatin-based phantoms.

2. Tests of CIRS Phase II phantom samples (Nightingale).

Scientists at Mayo, Duke University, U. Wisconsin, and CIRS are working together to identify viscoelastic (VE) phantom recipes that mimic shear wave stiffness and dispersion in humans.

Tasks:

1. Develop recipes for VE phantoms and fabricate test samples (CIRS, U. Wisconsin).
2. Quantify dispersion in VE phantoms and compare with human data (Duke, Mayo, Rheolution).
3. Iterate until phantom recipes spanning human range of stiffness and dispersion are obtained.

The Voigt model can be used to model dispersion. In principle, you can measure shear wave velocity over a band of frequencies and use a Voigt model fit to get μ_1 and μ_2. However, extrapolating Voigt-model dispersion curves outside the measurement band of frequencies can give inconsistent results. Therefore, it might be better to use midband fit (c_0) and dispersion slope (dc/df) to characterize phantoms,

$$c(f) = c_0 + (dc/df)\, f.$$

Scientists at Duke and Mayo can continue to do initial phantom testing. However, eventually, it will become important to verify phantom measurements at multiple sites. Two CIRS samples (#7 and #8) appear promising for modeling low dispersion. However, samples with higher dispersion are also needed. CIRS will make another set of phantoms. U. Wisconsin has also constructed some phantoms and will send them to Duke for testing. There are challenges with acoustic attenuation. Rheolution is also characterizing phantom recipes from CIRS and U. Wisconsin. We are not ready to commit to a recipe yet.

Schedule for March:

Date	*Time (CT)*	*Day*	*Committee/ Subcommittee*	*Moderator*
03/07/2014	11:00 am CT	Friday	COMBINED: System Dependencies / Phantom Subcommittees Call	Dr. Wear
03/14/2014	11:00 am CT	Friday	US SWS Technical Committee (guest speaker, Dr. Rubin)	Mr. Milkowski
03/21/2014	11:00 am CT	Friday	COMBINED: System Dependencies / Phantom Subcommittees Call	Dr. Palmeri
03/28/2014	11:00 am CT	Friday	US SWS Clinical Applications Subcommittee	Dr. Samir

Conferences for Ultrasound on QIBA Wiki

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