QIBA Ultrasound SWS System Dependencies Task Force Meeting
November 4, 2016
Call Summary

In attendance

Keith Wear, PhD (Co-Chair)
Mark Palmeri, MD, PhD (Co-Chair)
S. Kaisar Alam, PhD
Michael Andrè, PhD
Manish Dhyani, MD
Todd Erpelding, PhD, MSE
Al Gee
Tim Hall, PhD
Mike MacDonald, PhD
Andy Milkowski, MS
Kathy Nightingale, PhD
Nancy Obuchowski, PhD
Stephen Rosenzweig, PhD
Michael Wang, PhD

RSNA

Joe Koudelik
Julie Lisiecki

Notes provided by Keith Wear, PhD

1. The RSNA/QIBA poster was reviewed. It contains 4 sections:
   a. Organization & QIBA Profile
   b. Ultrasound vs. Magnetic Resonance Elastography Study
   c. Temperature Dependence of SWS Study
   d. Effects of Phase Aberration and Ultrasound Attenuation on SWS Measurements

2. There was a discussion of differences in profiles for SWS elastography and MRE elastography. The MRE profile contains a longitudinal claim, based on change in SWS. They want to include a confidence interval for the true change. Linearity is required to make the confidence interval calculation. Therefore, the Ultrasound SWS profile should also consider linearity, which has not been a point of emphasis of the ultrasound biomarker committee so far.

3. There was a discussion of the latest plot comparing Phase II (and I) phantom data to human data. This plot shows SWS from displacement data vs. SWS from velocity data for human data and phantoms. The two SWS parameters are highly correlated, but SWS values derived from velocity are a little higher. For elastic phantoms, there was little dispersion, so displacement-based and velocity-based values are nearly identical. But for viscoelastic phantoms, the velocity-based values are a little higher. The velocity-based data has higher frequency content than the displacement-based data because of the high-pass filter effect of the velocity operator. The viscoelastic phantom data is very consistent with the human data. The plot supports the relevance of Phase II viscoelastic phantoms to human data. The plan is to include this plot in the manuscript.

4. There was a discussion of a publication submitted to IEEE Transactions on Ultrasonics, Ferroelectrics, and Frequency Control by Mark Palmeri from Duke University and Bo Qiang, Shigao Chen, and Matthew Urban from the Mayo Clinic titled "Finite Element Modeling of Acoustic Radiation Force-Induced Shear Wave Propagation in Tissue-Mimicking Media." This work was funded by QIBA.

   Abstract: Ultrasound shear wave elastography is emerging as an important imaging modality for evaluating tissue material properties. In its practice there has been observed some systematic biases associated with ultrasound frequencies, focal depths and configuration, transducer types (linear versus curvilinear), along with displacement estimation and shear wave speed estimation algorithms. Added to that, soft tissues are not purely elastic, so shear waves will travel at different speeds depending on their spectral content, which can be modulated by the acoustic radiation force excitation focusing, duration and the frequency-dependent stiffness of the tissue. To understand how these different acquisition and material property parameters may affect measurements of shear wave velocity, simulations of the propagation of shear waves generated by acoustic radiation force excitations in viscoelastic media are a very important tool. This article serves to provide an indepth description of how these simulations are performed. The general scheme is broken into three components: (1) simulation of the three-dimensional acoustic radiation force push beam, (2) applying that force distribution to a finite element model, and (3) extraction of the motion data for post-processing. All three components will be described in detail and combined to create a simulation platform that is powerful for developing and testing algorithms for academic and industrial researchers involved in making quantitative shear wave based measurements of tissue material properties.

5. There was a discussion of reference standards. There was a discussion of interest in a combined ultrasound-MRE phantom. There is a need for more standardization of the MRE measurement (e.g., specification of a particular field strength). There remains a lack of a gold standard for validating elasticity/shear wave speed measurements, especially at low stiffness values (e.g., near 1 kPa). We have more confidence in measurements at higher stiffness values (e.g., near 10 kPa).