QIBA Ultrasound Shear Wave Speed (SWS): System Dependencies Subcommittee

Friday, April 19, 2012; 11 AM CT

Call Summary

Notes provided by Dr. Wear

In attendance

Keith Wear, PhD (Co-Chair)	David Cosgrove, MD	Ned Rouze, PhD	**RSNA**
Paul L. Carson, PhD	Timothy J. Hall, PhD	Daniel C. Sullivan, MD	Joe Koudelik
Shigao Chen, PhD	Kathy Nightingale, PhD	Hua Xie, PhD	Julie Lisiecki
Claude Cohen-Bacrie, MS	Nicolas Rognin, MSc, PhD		

Moderator: Keith Wear, PhD

1. AIUM Technical Standards Committee effort for explore costs/benefits for allowance of Transient Increased Output (TIO) for ARFI in the liver – Kathy Nightingale

   The goal of TIO subcommittee is to evaluate potential clinical benefit vs. risk of elevating output above current FDA guidelines. This is important at low frequency (near 2 MHz). The MI limit of 1.9 is difficult for measurements deep in the liver (> 7 cm). Another possible clinical area for benefit might be harmonic imaging. The TIO subcommittee has performed a bioeffects literature review. They are preparing a White Paper.

   Duke Study. 15 patients. Verasonics platform, C52 curvilinear array. Push Frequency = 2.36 MHz. MI = 1.5 – 3.0. Duration – 960 cycles, 407 microsec. Uncertainty in SWS measurements decreases as MI is increased. In particular, MI greater than or equal to 2.4 leads to significantly better results. If MI is increased beyond 1.9, the percent "inliers" increases. For subjects with valid data, body wall thickness was 2.5 ± 1 cm. For subjects with no shear wave, body wall thickness was 3.8 ± 1.2 cm. So body wall thickness was a limiting factor for measuring shear waves. In the heart, measurements are limited by clutter, so higher MI's would not necessarily help. Possible solution is using a different derating system to accommodate thicker body walls.

2. Effects of Preprocessing on Reconstructed Shear Wave Speeds in Human Liver *In Vivo* (presentation at AIUM conference in New York City) – Ned Rouze

   Duke Study. Motion correction is necessary in liver. Traditionally, they used quadratic motion corrections. Now they are trying high pass filters (HPF) since motion is expected to have low frequency content. They have also used differentiation (which is effectively a high pass filter). In 172 patients, SWS shows a significant dependence on HPF cutoff frequency. At 150 Hz, SWS measurements are 15% higher than with 25 Hz. Differentiation yields SWS measurements that are 18% higher than quadratic filter.

   Conclusion: Pre-processing methods can introduce differences in measured group velocities on the order of 15 – 18%.

3. Future Direction for SWS System Dependencies Subcommittee – Keith Wear

   The subcommittee's goal is to contribute to a profile for shear wave speed measurements in liver that allow measurements made with different machines to have comparable values. The SWS System Dependencies

Subcommittee should move forward with the goal of seeing how it can best complement the current and future inter-laboratory comparison studies.

A parallel inter-laboratory comparison, using laboratory systems rather than commercial systems, study might be considered to complement ongoing studies based on commercial systems.

- Laboratory systems could address a wider range of confounders since they would not be as constrained by proprietary considerations.
- Laboratory systems offer more flexibility for parameter adjustments.
- Phantom sets produced by CIRS would be a great resource for this.

This table shows a list of system (as opposed to biological) confounders, with most likely systems and targets that could be used for investigating them. The subcommittee should identify areas where we could best complement ongoing efforts by other subcommittees. The table is only a draft and corrections and suggestions are welcome.

System Confounder	**Most Likely System(s)**	**Most Likely Target(s)**
Shear Wave Excitation Spectrum[1,2]	COM, LAB, SIM, THE, LIT	EH, LH
Shear Wave Spatial Extent	LAB, SIM, THE	EH, LH
Shear Wave SNR	LAB, SIM?, THE	EH, LH
TI, MI[1,2]	COM, LAB, SIM?, THE	EH, LH
Diffraction[1,2]	COM, LAB, SIM, THE, LIT	EH, LH,
Operator Variability[1,2]	COM, (LAB), LIT	EH, LH, HU, AN
Reflection Filter	LAB, SIM?, THE	EI, LI
Motion Filter	LAB, THE	MP, HU
Tracking Spatial Sampling Rate	LAB, DSIM, THE	EH, LH, HU, AN
Tracking Pulse Center Frequency	LAB, DSIM, THE	EH, LH, HU, AN
Tracking Pulse Bandwidth	LAB, DSIM, THE	EH, LH, HU, AN
Tracking Pulse Repetition Frequency	LAB, DSIM, THE	EH, LH, HU, AN
Tracking Averaging	LAB, DSIM, THE	EH, LH, HU, AN
Phase Velocity vs. Group Velocity	LAB, DSIM, THE	LH, HU, AN
Lateral Range of Analysis	LAB, DSIM, THE	EH, LH, HU, AN

1: addressed by current inter-laboratory-comparison phantom study on elastic phantom
2: addressed by future inter-laboratory-comparison phantom study on lossy phantom

Systems:
Commercial (*e.g.* EchoSens, GE, Philips, Siemens, SSI) (COM)
Laboratory (*e.g.* Verasonics, commercial system w/ access to raw data) (LAB)
Simulation (Duke, U. Rochester?) (SIM)
Theory (THE)
Literature search (LIT)

Targets:
Elastic Homogeneous Phantom (EH)
Lossy Homogeneous Phantom (LH)
Elastic Inhomogeneous (*i.e.,* with inclusions) Phantom (EI)
Lossy Inhomogeneous (*i.e.,* with inclusions) Phantom (LI)
Moving Phantom (MP)
Animals (AN)
Humans (HU)

Next steps:
Participants are all encouraged to send suggestions for the QIBA annual meeting discussion to the co-chairs: following: (Brian.Garra@fda.hhs.gov; tjhall@wisc.edu; andy.milkowski@siemens.com)

Next QIBA US SWS calls:

- QIBA US SWS Technical Committee, **5/6/2013**, Monday, 1 pm CT (Dr. Garra)
- QIBA US SWS System Dependencies Subcommittee, **5/17/2013**, Friday, 11 am CT (Dr. Palmeri)
- QIBA US SWS Clinical Applications & Biological Targets Subcommittee, **5/20/2013**, Monday, 1 pm CT (Dr. Cosgrove)

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