001 **HOW DOES ULTRAFAST IMAGING AFFECT SHEAR WAVE VISUALIZATION?**

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Background: In Shear Wave Elastography (SWE), acoustically excited shear waves are only accurately captured at high frame rates (~ kHz). This is nowadays possible due to dedicated single or compounded plane wave imaging but it is unclear whether this scanning influences SW visualization, especially when complex wave phenomena such as dispersion occur.

Aims: We investigated whether ultrafast imaging affected SW visualization and characterization in a left ventricular (LV) phantom, via SWE-experiments and multiphysics modeling. This multiphysics approach allows us to generate virtual SWE images with the true biomechanics behind the image fully known.

Methods: For the experiments, SW's were excited in the LV phantom (cfr. fig. A) with a frequency of 8 MHz and voltage of 50 V, using the Aixplorer system. Next, SW's were imaged using ultrafast scanning without (0°) and with (-2°, 0°, 2°) plane wave compounding, as shown in fig. C. The phantom's stiffness was determined via uniaxial tensile tests.
For the simulations, the SW propagation of the experiment was mimicked in the finite element software Abaqus (fig. D) [1]-[3]. Next, the ultrafast scanning was modeled in Field II, where the LV phantom was represented by point scatterers upon which ultrasound waves reflect, propagated during the scan according to the modeled tissue displacements (fig. E).

Results: Wave dispersion is obviously present for the experimental and simulated SW (left panels of fig. C and F), imaged without wave compounding. Here, we see clearly two downward velocity wave fronts (red zones) surrounding the tissue relaxation (blue). Compound imaging conceals dispersion in model and measurement, cfr. right panels of fig. C and F. In practice, different SWE-based material characterization algorithms are applied for dispersive and non-dispersive regimes: time-of-flight method vs. phase speed analysis. This leads to shear moduli of 16.5 kPa for compounding (~ no dispersion) and 26.2 kPa for non-compounding (~ dispersion), even though both images have the same mechanical ground truth (24.3 kPa).

Conclusions: The multiphysics simulations confirm that the applied imaging set-up might affect the observed SW patterns. Therefore, caution is advised when choosing a tissue characterization method based on visualized SW physics, as this might give an erroneous stiffness estimate.

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