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Achieving Shear Wave Elastography by a Three-element Probe for Wearable Human-machine Interface

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Abstract : Shear elastic modulus of skeletal muscles can be obtained by shear wave elastography (SWE) and has been linearly related to muscle force. However, SWE is currently implemented using array probes. Price and volumes of these probes and their driving equipment prevent SWE from being used in wearable human-machine interfaces (HMI). Moreover, beamforming processing for array probes reduces the real-time performance. To achieve SWE by wearable HMIs, a customized three-element probe is adopted in this work, with one element for acoustic radiation force generation and the others for shear wave tracking. In-phase quadrature demodulation and 2D autocorrelation are adopted to estimate velocities of tissues on the sound beams of the latter two elements. Shear wave speeds are calculated by phase shift between the tissue velocities. Three agar phantoms with different elasticities were made by changing the weights of agar. Values of the shear elastic modulus of the phantoms were measured as 8.98, 23.06 and 36.74 kPa at a depth of 7.5 mm respectively. This work verifies the feasibility of measuring shear elastic modulus by wearable devices.

Keywords : shear elastic modulus, skeletal muscle, ultrasound, wearable human-machine interface
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