Non-contact airborne ultrasound device for 2D sub-surface elasticity mapping

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Background, Motivation and Objective

Measurement of tissue elasticity on sensitive surfaces such as cornea or skin can be a major issue for medical staff. Non-contact probe would be an advantageous solution thanks to its hygienic approach easy to maintain. The 2D scanning non-contact airborne ultrasound surface vibrometer presented in this document should be a solution. It allows to monitor propagation of surface waves and subsequently to determine the wave velocities and local elasticities.

Statement of Contribution/Methods

The studied medium is either a thin layer of gel or silicone on top of a water tank. Both media are considered as semi-infinite media. The imaging system is placed above the studied medium, they are separated by a layer of the air. The system works at 300 kHz. A transducer is used in emission and a microphone in reception. The microphone is located in one of the two focal points of an elliptic acoustic mirror. The device is mounted on a two-axis motorized translator to allow to scan the surface of the studied medium. From each measurement point the received ultrasound signal is post-processed to determine the normal displacement velocity in function of time. Once the velocity measurement is made over the entire observation surface area of the studied medium the surface wave propagation is computed and the local elasticity is determined.

Results/Discussion

Surface wave is detected and tracked with airborne ultrasound. The 300 kHz device works at 8 kHz framerate and is capable to monitor the surface wave propagation of a few hundred hertz. The sub-surface elastic modulus of the medium is estimated from the propagation velocity of the monitored surface waves. The next step will be to characterize the elasticity of the cornea of a real eye like that of an ox. The results will then be transposed to that of a human to anticipate the results of measurement of another future device operating at 500 kHz.

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