Title

Experimental observations of Scholte waves propagating in an incompressible soft solid

Abstract

Due to the heterogeneous structure of the soft biological tissue, such as the brain, surface waves might be important to elucidate the biomechanics of injury formation from impacts. In this context, surface waves generate a wavelength on the order of the centimeter with a typical penetration length of the same order. Therefore, investigating surface waves at depth is crucial for understanding their relationship with the physics of soft tissue injuries. Planar surface waves produce particle motion along two dimensions, the direction of propagation and the depth direction, making them more challenging to measure when compared to polarized shear waves that only produce motion in one direction. This study presents an experimental setup capable of generating Scholte wave propagating in a soft solid–liquid interface. In particular, we studied a tissue-mimicking phantom material, such as gelatin, under a layer of water. Ultrasound imaging techniques, operating at 8600 frames per second, and a one-dimensional cross-correlation algorithm were used to independently estimate the two components of the wave's particle displacement. We conducted experiments sweeping frequencies between 50 and 500 Hz for different gelatin stiffness, finding a surface wave speed of 0.86 times the shear wave speed and a penetration distance of 0.35 times the wavelength. These results agree with the theory of Scholte waves propagating in an incompressible semi-infinite elastic medium covered by an incompressible fluid.

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