ACOUSTICS2008/2102
Variability of velocities provided by axial transmission due to irregular geometry of cortical bones

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Early predictions of the velocities of axially transmitted waves on cortical bones were based on waveguides such as plate and tube of regular geometry and uniform thickness. We investigate the role of the actual irregular geometry by means of numerical simulations comparing monodirectional and bidirectional multielement modalities. Propagation was simulated using a finite difference method in a set of human radii previously examined by a bidirectional device. Individual geometry of the samples was reconstructed from X Ray tomography (pixel=100mm). The material constituting the bone models was considered to be a transverse isotropic medium with chosen fixed elastic properties taken from literature. In addition simulations were performed on plate of either constant or variable thickness. Preliminary results perfomed on 9 samples show that bidirectional technique reduces the variability of the velocities of axially transmitted waves compared to monodirectional array when irregular geometries are involved. Whereas bidirectional velocity is significantly correlated to the velocity obtained in plates whose thickness is equal to the mean thickness of the specimen (r^2=0.77, p=0.0018, RMSE=29m/s), no significant correlation is found for monodirectional velocity. The effect is mainly attributed to the irregular external surface of real samples.