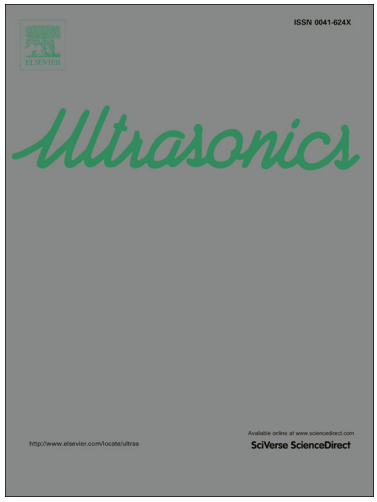

Ultrasound propagation in trabecular bone: a numerical study of the influence of microcracks

Samuel Callé, Hélène Moreschi, Guillaume Renaud, Marielle Defontaine

PII: S0041-624X(13)00225-4
DOI: http://dx.doi.org/10.1016/j.ultras.2013.08.003
Reference: ULTRAS 4651

To appear in: *Ultrasonics*

Please cite this article as: S. Callé, H. Moreschi, G. Renaud, M. Defontaine, Ultrasound propagation in trabecular bone: a numerical study of the influence of microcracks, *Ultrasonics* (2013), doi: http://dx.doi.org/10.1016/j.ultras.2013.08.003

Ultrasound propagation in trabecular bone: a numerical study of the influence of microcracks

Samuel Callé [1], Hélène Moreschi [1], Guillaume Renaud [2], Marielle Defontaine [1]

[1] Université François-Rabelais de Tours, UMR INSERM U930, 10 boulevard Tonnellé, 37032 Tours Cedex, France.

[2] Department of Biomedical Engineering, Thoraxcenter, Erasmus MC, P.O. Box 2040, 3000 CA Rotterdam, The Netherlands

Abstract: The accumulation of microdamage in trabecular bone tissue is suspected of being a predictive indicator of osteoporosis diagnosis. To quantify this microdamage, the Dynamic AcoustoElastic Testing (DAET) method measures the time of flight (TOF) and amplitude variations of transmitted ultrasound (US) pulses, while the bone sample is submitted to a low frequency sinusoidal hydrostatic pressure (opening/closing of microcracks). However, DAET is both sensitive to viscoelastic properties changes and microcracks density. To verify the microcracks density contribution on DAET results, a numerical approach is proposed. Multliple configurations of microdamaged trabecular bone-tissue-like mesh have been simulated. A 2D pseudo-spectral time domain numerical model was then developed to simulate linear wave propagation in heterogeneous solids. The influence of the microcracks number and orientation on the US TOF was particularly investigated. Results are discussed and compared with experimental data obtained from DAET measurements in trabecular bone samples.

Keywords: pseudo-spectral time-domain (PSTD) method; trabecular bone; dynamic acoustoelasticity; microcracks.