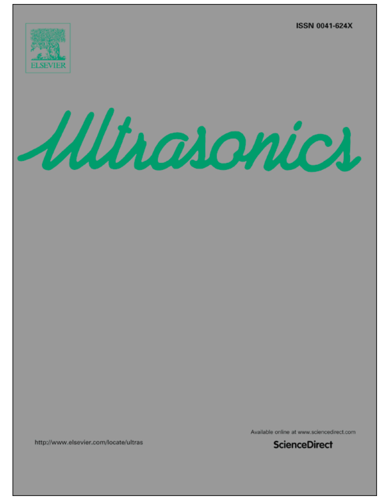
Accepted Manuscript



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PII: S0041-624X(17)31026-0
DOI: https://doi.org/10.1016/j.ultras.2018.07.012
Reference: ULTRAS 5788

To appear in: *Ultrasonics*

Received Date: 12 December 2017
Revised Date: 26 April 2018
Accepted Date: 20 July 2018

Two-dimensional affine model-based estimators for principal strain vascular ultrasound elastography with compound plane wave and transverse oscillation beamforming

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Abstract

Polar strain (radial and circumferential) estimations can suffer from artifacts because the center of a nonsymmetrical carotid atherosclerotic artery, defining the coordinate system in cross-sectional view, can be misregistered. Principal strains are able to remove coordinate dependency to visualize vascular strain components (*i.e.*, axial and lateral strains and shears). This paper presents two affine model-based estimators, the affine phase-based estimator (APBE) developed in the framework of transverse oscillation (TO) beamforming, and the Lagrangian speckle model estimator (LSME). These estimators solve simultaneously the translation (axial and lateral displacements) and deformation (axial and lateral strains and shears) components that were then used to compute principal strains. To improve performance, the implemented APBE was also tested by introducing a time-ensemble estimation approach. Both APBE and LSME were tested with and without the plane strain incompressibility assumption. These algorithms were evaluated on coherent plane wave compounded (CPWC) images considering TO. LSME without TO but implemented with the time-ensemble and incompressibility constraint (Porée *et al.*, IEEE Trans. Med. Imag. 2015) served as benchmark comparisons. The APBE provided better principal strain estimations with the time-ensemble and incompressibility constraint, for both simulations and *in vitro* experiments. With a few exceptions, TO did not improve principal strain estimates for the LSME. With simulations, the smallest errors compared with ground true measures were obtained with the LSME considering time-ensemble and the incompressibility constraint. This latter