NONLINEAR ACOUSTIC IMAGING OF ISOECHOGENIC OBJECTS AND FLOWS USING ULTRASOUND WAVE PHASE CONJUGATION

Pernod, Philippe; Preobrazhensky Vladimir, Pyl’nov, Yuri; Krutyansky, Leonid
LEMAC / IEMN - WRC Cite scientifique 59652 Villeneuve d'Ascq Cedex preobr@newmail.ru
vladimir.preobrajenski@iemn.univ-lille1.fr

ABSTRACT
The results of theoretical and experimental studies of application of parametric wave phase conjugation (WPC) for ultrasonic velocimetry of flows and nonlinear detection of isoechogenic phantoms are reported. 3D-simulation of propagation of phase conjugate waves (PCW) in heterogeneously nonlinear and moving media is developed. Break of time reversal invariance of WPC in moving media is proposed as a principle of detection and velocimetry of flows. The results of experimental linear and harmonic imaging of flows in water are presented in comparison with theoretical description. Experimental WPC harmonic imaging of isoechogenic phantoms in water was demonstrated on an example of cell filled with a mixture of water and methyl alcohol. Variation of methanol concentration allows obtaining some mixtures with varied nonlinear parameters while their linear acoustic impedance remains close to the water’s one. Analysis of harmonics of PCW in automatically con-focal WPC-system provides reliable detection of the phantoms. According to the theoretical predictions the contrasts of images are comparable with, or even stronger, than the ratio of nonlinear parameters of a phantom and its surrounding medium.