Image reconstruction of ultrasonic pulse-echo mode using regularization method

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Abstract

This work deals with the modeling of ultrasonic signals generated by concave circular focused transducer, in pulse-echo mode, inspecting a predetermined region of interest (ROI). For this analysis, the model of the impulse response of a concave transducer was implemented using concentric rings as elements of the emitting area. The addition of several concentric rings moved along its axis allowed us to calculate the acoustic field generated by a concave opening and the echo reflected from each point in space. The impulse response of each ring represents the difference between the impulse responses calculated for a large circular transmitter and a small one. The model implemented for calculating the echo signals is used to scan a region, within a ROI, containing a set of points with different acoustic reflectivity. Simulations of the regions are made with these signals by applying the Tikhonov regularization method. An experiment is conducted using a planar circular transducer and a target (rod). The A-scans obtained are inserted in the theoretical model. To evaluate the quality of image reconstruction, the images are compared with the conventional B-mode images. Among the parameters of regularization to be evaluated, the L- curve and Generalized Cross-Validation (GCV) criteria were selected.

Keywords: Inverse problems, pulse-echo imaging, regularization, ultrasound imaging.