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Beam Coding with Orthogonal Complementary Golay Codes for Signal to Noise Ratio Improvement in Ultrasound Mammography

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Abstract : In this paper, we report the experimental results on using complementary Golay coded signals at 7.5 MHz to detect breast microcalcifications of 50 µm size. Simulations using complementary Golay coded signals show perfect consistence with the experimental results, confirming the improved signal to noise ratio for complementary Golay coded signals. For improving the success on detecting the microcalcifications, orthogonal complementary Golay sequences having cross-correlation for minimum interference are used as coded signals and compared to tone burst pulse of equal energy in terms of resolution under weak signal conditions. The measurements are conducted using an experimental ultrasound research scanner, Digital Phased Array System (DiPhAS) having 256 channels, a phased array transducer with 7.5 MHz center frequency and the results obtained through experiments are validated by Field-II simulation software. In addition, to investigate the superiority of coded signals in terms of resolution, multipurpose tissue equivalent phantom containing series of monofilament nylon targets, 240 µm in diameter, and cyst-like objects with attenuation of 0.5 dB/[MHz x cm] is used in the experiments. We obtained ultrasound images of monofilament nylon targets for the evaluation of resolution. Simulation and experimental results show that it is possible to differentiate closely positioned small targets with increased success by using coded excitation in very weak signal conditions.

Keywords : coded excitation, complementary golay codes, DiPhAS, medical ultrasound
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