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Contrast Ultrasound Imaging (CUSI) is an imaging modality involving the injection of Ultrasound Contrast Agent (UCA) i.e. gas-filled microbubbles into the biological media; It is one of the major innovations of the last ten years due to the successive improvement and safety of its contrast agents. CUSI requires instrumentation in which all the technical aspects (from excitation to measurement) are frequently improved such as the use of coded-excitations (Chirp Excitations) for solving the tradeoff between resolution and penetration that form the primary criterion for image quality along with the contrast. In order to follow this improvement of instrumentation, Chirp processing must also be fully optimized for extracting information related to improving the contrast. In the present study, we propose two algorithms, Second harmonic algorithm (SHA) and Pulse Inversion algorithm (PIA) to empirically optimize the frequency parameters of chirps as well as investigate their use for enhancing the contrast in a medium of contrast agent.

Simulations reveal particular values for which the frequency modulation indices of Chirp Excitations, its energy and indirectly the contrast are optimum. These methods can extract suitable variables related to the properties of non-symmetries and/or symmetries of the UCA. Furthermore, these changes of variables can be optimized by determining *a priori* conditions on the excitation signals such as the choice of its central frequency. We also depict that during the nonlinear response of microbubbles the Chirp's modulation indices are no longer symmetrical and evidence using SHA the strong impact of the resonant frequency on the energy outcomes of Chirps and thus on the contrast. We finally note that, parabolic chirp insonation using PIA is the optimal choice for contrast enhancement and we select optimal frequency parameters manually.

Keywords: Contrast Ultrasound Imaging (CUSI), Ultrasound Contrast Agent (UCA), Microbubbles, Chirp Excitations, Second Harmonic Algorithm (SHA), Pulse Inversion Algorithm (PIA).