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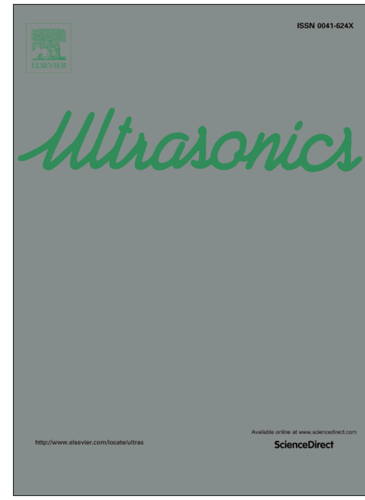

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Towards clinical computed ultrasound tomography in echo-mode: Dynamic range artefact reduction

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Computed ultrasound tomography in echo-mode (CUTE) allows imaging the speed of sound inside tissue using hand-held pulse-echo ultrasound. This technique is based on measuring the changing local phase of beamformed echoes when changing the transmit beam steering angle. Phantom results have shown a spatial resolution and contrast that could qualify CUTE as a promising novel diagnostic modality in combination with B-mode ultrasound. Unfortunately, the large intensity range of several tens of dB that is encountered in clinical images poses difficulties to echo phase tracking and results in severe artefacts. In this paper we propose a modification to the original technique by which more robust echo tracking can be achieved, and we demonstrate in phantom experiments that dynamic range artefacts are largely eliminated. Dynamic range artefact reduction also allowed for the first time a clinical implementation of CUTE with sufficient contrast to reproducibly distinguish the different speed of sound in different tissue layers of the abdominal wall and the neck.

Keywords: Diagnostic, multimodal, reflection mode, sound speed, tissue characterisation

1 Introduction

Ultrasound (US) offers flexible probe guidance, real-time display, comparably low cost, and portability for bed-side and emergency use. In order to pair these advantages with outstanding diagnostic power, much effort has been put in complementing classical grey-scale B-mode US with multimodal structural and functional information. This includes Doppler flow imaging, but also novel techniques such as ultrasound elastography [1, 2] or optoacoustic imaging [3, 4]. A further promising modality is speed of sound imaging. Speed of sound varies significantly depending on tissue type [5, 6] and thus its local magnitude can reveal disease-related changes in tissue composition [7, 8]. Ultrasound computed