Abstract

Resolution of ultrasound images is inherently limited by the imaging system features. Harmonic imaging (in case of ultrasound image) has been prescribed as one of the solutions to this problem. Tissue harmonic imaging (THI) and Contrast harmonic imaging (CHI) are used to improve the quality of the ultrasound image. Tissue harmonic imaging suffers from some disadvantages such as it fails to provide high-resolution image at higher depth due to its rapid attenuation along the way. Due to the attenuation the signal to noise ratio (SNR) becomes poor. Frequency bandwidth of the fundamental and the harmonic components often overlap. The spectral overlap causes degradation of spatial resolution and the undesirable artifact. It also requires a major change in the system hardware and increases the cost of the system. Contrast harmonic imaging is applicable only for those conduits, which are not usually visible clearly in US image. These can be imaged by injecting micro-bubble. Hardware based solution such as increasing ultrasound frequency and number of arrays in transducer probe techniques is not always feasible to solve the problem of ultrasound image resolution. Increase of frequency decreases the depth of penetration and increase of the number of array elements in transducer probe increases cost and complexity of the system. Software based super-resolution reconstruction techniques may be considered as a good solution to this problem. In super-resolution technique multiple sub-pixel shifted image frames are fused together to form a high resolution image. First part of our work it to develop a software based super-resolution technique which is applicable to the scan data of the ultrasound imaging system. The proposed super-resolution technique improves the over-all quality of the ultrasound image. It also improves the image quality at the higher depth of penetration and increases the detectibility of small objects from the reconstructed image. The proposed technique is also robust to noisy scan data.

In the case of ultrasound image it is required to protect the edges during speckle reduction. Linear filters are not suitable for this purpose. Non-linear filters are frequently used to protect the edges at the time of filtering. Most of the non-linear filter proposed in the literatures does not pay the attention for enhancing both positive and negative slope edges. We propose an adaptive weighted median filter admitting negative weights which enhances both the positive and negative slope edges during filtering and also improves the smoothing in homogeneous region of the image.

Keywords: Ultrasound image enhancement; resolution; super-resolution; scan conversion; Low resolution images; registration parameters; linear filters; non-linear filters; speckle reduction filters;