SAR DESPECKLING FILTERS IN ULTRASOUND IMAGING

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Abstract— **Ultrasonics is a widely used technique in medical imaging, due to its non-invasive nature and its capability of forming real-time portraits of hidden targets. In this technique, pulse-echo ultrasonic waves are sent to the investigated medium and the backscattered waves provide the information for image formation. However, the coherent nature of the waves results in the appearance of speckle noise. This phenomenon is common to laser, sonar and synthetic aperture radar (SAR) imagery, and is the result of interference between the scattered waves. Many filters have been proposed for alleviating this noise, especially in remote sensing applications. Some of these filters (Mean, Median, Lee, Frost and Gaussian MAP) are reviewed and applied to ultrasound B-scan images, along with a non-linear technique based on computing the median on the binary slices of the data. The performance of these techniques is assessed both quantitatively (regarding noise suppression and radiometric preservation) and qualitatively (through perceptual contrast and edge preservation).**

Keywords— **Image processing, Speckle, Ultrasound.**

I. INTRODUCTION

The importance of ultrasound imaging in medicine and other fields of application is enormous. It is estimated that more than one out of every four medical diagnostic imaging studies in the world involves ultrasonic techniques. B-scan images have good spatial resolution (better than a millimeter in abdominal scanning), good tissue contrast and can be formed in real-time. One of the disadvantages of these images is the presence of speckle noise, which is caused by the interference between the backscattered ultrasonic waves in soft tissues. This noise is present in laser, sonar and synthetic aperture radar (SAR) imagery. Speckle pattern reduces the target detectability in B-scan images. It does not affect contrast resolution though it does reduce the useful spatial resolution. The reduction affects the human ability to identify normal and pathological tissues.

Speckle noise has been widely studied, mainly with an stochastic approach within the framework of statistical optics (Goodman, 1985) due to its non-deterministic nature. Many filters have been proposed using the statistical nature of this noise. Deterministic or model-free filters have also been tried, with limited success so far (WFUMB, 1997).

Most speckle filters have been proposed and assessed in remote sensing applications (Oliver and Quegan, 1998). These filters can be classified into linear and non-linear depending on the operations they use, or according to the framework they employ (local, global, adaptive, robust (Frery *et al.*, 1997b), maximum a posteriori etc.). A comprehensive survey of speckle filters for remote sensing applications can be found in Lee *et al.* (1994).

Speckle suppression in ultrasonic imaging is usually done by adding uncorrelated images of the scan plane (a technique called *multilook* by the remote sensing community), by adaptive filtering in the spatial domain (Bamber and Draft, 1986), or by processing in the wavelet domain (Rakotomamonjy *et al.*, 2000).

Though there is no consensus in the definition of "good" filters, it is clear that the application at hand requires procedures that, simultaneously, reduce the noise and retain the main features of the images. Me-