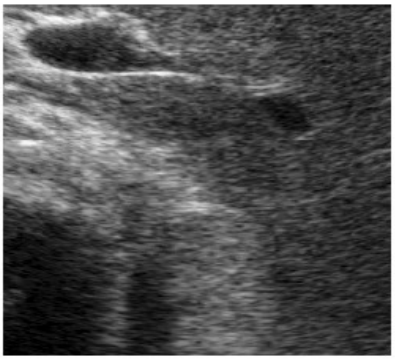
SUBJECT : JOINT DESPECKLING-DECONVOLUTION (JDD) OF ULTRASOUND DATA.

CONTEXT:

Clinical ultrasound images are often analyzed in in challenging conditions as one is confronted to speckle noise and blurring. Enhancing these images can help both help the practitioners for a better interpretation and be a pre-processing step for further tasks such as segmentation and registration.

Recently, in a series of works, [1][2], we proposed a method to called wavelet-fisz (WF) despeckling which aims at removing speckle from US images. This method has proved to be competitive with state-of-the-art methods and enjoys adaptability and easy-tuning. However, the obtained images (cf. Figure) are often still blurred. The aim of this project is to Improve the resolution of the WF algorithm results.

Original Image



Denoised Image (WF)

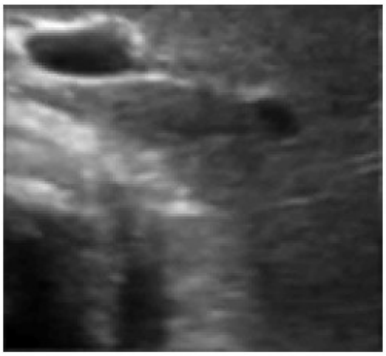


Figure : Denoising of an ultrasound liver image using the WF algorithm.

OBJECTIVE:

The purpose of this internship is to extend WF to perform jointly speckle removal and deconvolution. In particular, the student will explore the characteristics of the point-spread function (PSF) in the wavelet-domain [3] and propose a scheme that enables to solve the despeckling-deconvolution problem through wavelet-thresholding [4].

ROAD MAP:

1/ Understanding the wavelet-thresholding paradigm, the WF technique and the behavior of convolution operators in the wavelet-domain through the existing literature.

2/ Characterization of the PSF and its wavelet decomposition.

3/ Constructing a scheme for coupling despeckling and deconvolution.

4/ Validation of the algorithm on simulated and real data.

5/ Writing a scientific report on the results in English.

Skills

Potential applicants are required to have a strong knowledge in signal / image processing or/and applied mathematics. Basic knowledge on wavelet processing is likable but not necessary. The student is free to use any programming language (Matlab, Python, C++,...)

[1] Y. Farouj, J.M. Freyermuth, L. Navarro, M. Clausel, P. Delachartre, Hyperbolic Wavelet-Fisz denoising for a model arising in Ultrasound Imaging. *IEEE Trans. Comp. Imag. (2017)*

[2] Y. Farouj, J.M. Freyermuth, L. Navarro, M. Clausel, P. Delachartre, Ultrasound Spatio-temporal Despeckling via Kronecker Wavelet-Fisz Thresholding. Under review *(2017)*

[3] Yves Meyer, Ondelettes et opérateurs

[4] Donoho, D. L., & Johnstone, I. M. (1994). Ideal spatial adaptation by wavelet shrinkage. *biometrika*, 425-455.