Iterated Conditional Modes Algorithm for Medical Image Denoising

MS Defense by
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Abstract: In the context of medical imaging, there are three distinct needs for image processing: removal of any noise in the image, better visualization of anomalies, such as tumors, and fast completion so that real time image processing is possible.

Noise in an image can be understood as a stochastic function which is the result of all undesired external disturbances that interfere with the analysis of the signal of interest. Often times, noise is generated by the imaging method itself, making it necessary to filter an image after it is recorded. Besides the denoising, identification of suspected early stages tumors require enhancing the visibility of different structures. Existence of a tumor creates inhomogeneity with respect to boundary tissues, and thus subtle structural differences in the homogeneous structure of organs and tissues. The goal of this thesis is to utilize the iterated conditional modes (ICM) algorithm with appropriate modifications so that it is suitable for denoising and enhancing medical images – ultrasound and magnetic resonance images in particular.

The ICM algorithm’s strength lies in distinguishing subtle structural changes while also removing noise. The biggest challenge in using this algorithm is identifying appropriate variations for different regions of the human body. This thesis provides theoretical and numerical investigations for several variations of the ICM algorithm, which are analyzed, tested, and compared by means of visual improvement, error norms, and computation time.

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