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Osseous and Digital Subtraction Angiography Image Fusion via various Enhancement Schemes and Laplacian Pyramid Transformations

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Abstract: Image fusion is a significant medical imaging tool which integrates the complimentary information from various sources into a single frame for enhanced visual perception. The fusion of osseous and vascular information is used for the localization of various medical abnormalities. The emergence of gradient reversal artefacts and halo effects in the fused image are of major concern for the researchers. In this paper we propose an image fusion technique to mitigate the artefact issues in case of bone and vessel image fusion. An ideal image fusion rule transfers maximum information from source images to fused image with least amount of distortion or loss. In this regard we have transformed the source images with the help of KL transformations and Ripplet transform. The artefacts are controlled via anisotropic diffusion filtering. The Laplacian pyramidal based fusion is employed to fuse the mask and DSA images. For the validation of our proposed methodology conventional as well gradient based metrics along with human visual perception are employed. The proposed methodology outperforms eight other state-of-the-art image fusion techniques with far better visual results. The entire algorithm is implemented in MATLAB 2012 with core i5 processor.

Keywords: Osseous, Vascular, Digital Subtraction Angiography, Image Fusion, KL transform, anisotropic diffusion, Laplacian pyramid

1 .Introduction

Medical image fusion incorporates a wide range of methods for fusion of information which addresses medical issues reflected via images of human body organs and cells. This field of technology serves an extensive range of applications in medical diagnostics, analysis and historical documentation [1]. Image fusion aims at combining the information contained in two individual images in a single composite image. The computer vision method helps in providing the quantitative assessment of the images under evaluation which assist in planning surgical procedures [2,3]. This computer aided tool (CAD) helps medical practitioners in deriving an accurate and unbiased decision in a shorter interval of time. Furthermore, the use of multi-sensor image sources can provide a greater diversity of features which are quite useful for medical analysis applications [4-6]. This additional information obtained from multiple sensors can be fused together in a single image for precise localization of abnormalities.

In medical image fusion, images of multiple modalities can be integrated together in a single fused image to obtain a more precise, comprehensive and reliable diagnosis. The main modalities which serve as primary inputs to medical image fusion studies are: CT (Computed Tomography), MRI (Magnetic Resonance Imaging), PET (Positron Emission Tomography), SPECT (Single photon Emission Computed Tomography), Ultrasound and DSA (Digital Subtraction Angiography). These medical modalities enable the assessment and precise diagnosis of medical ailments affecting brain, lungs, breast, intestines, soft tissues, bones etc. when fused together [2,7,8]. For