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Current & Future Orientation of Anatomical & Functional Imaging Modality Fusion

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ABSTRACT

The need of image fusion stems from the inherent inability of several imaging modalities to provide the complete diagnostic information about the ailment under study. The radiographic scanning provides a wide range of divergent information. The evolution in the interfacing of the signal analysis theory and technological advancements has made it possible to device highly efficient image fusion techniques. In this manuscript the fundamentals of multisensory image fusion are discussed briefly. The various key factors related to the future exertion of medical image fusion have also been presented.

Keywords: Modality fusion, Image, Future orientation.

INTRODUCTION

Biology, nuclear medicine and radiology are witnessing an enormous amount of data acquisition provided by instrumental technology of high precision. It is apparent in the radiographic scanning that different imaging modalities provide a wide range of heterogeneous information[1]. Due to the inherent inability of a single imaging modality to provide the holistic information about the diseased tissue, the integration of different imaging modality is requisite for the higher comprehension of the true ailment in the human body[2]. For instance, the conventional MRI does not enable the extended visualization of the gliomatus tissue after therapeutic procedures. Anatomical and functional imaging modalities have served as a paradigm in planning surgical procedures for brain tumour treatment. It is evident that the fusion of co-registered PET/MRI can significantly improve the specificity for the precise evaluation recurrent tumour and its treatment. Also for precise localization of the abnormal vascularisation in ankylosing spondylitis patients, US and CT scan are fused to evaluate the inflammation severity of the sacroiliac joints[3-8].

The main objective of the image fusion is to substantiate the joint analysis of the imagery data using various sensors for the same patient. Image fusion generates a single fused image which provides a more reliable and accurate information in which intracranial features are more distinguishable. For example to direct neuro-surgical resection of epileptogenic lesions or to segment cerebral iron deposits T1 weighted and T2 weighted MRI images have been fused together. Image fusion

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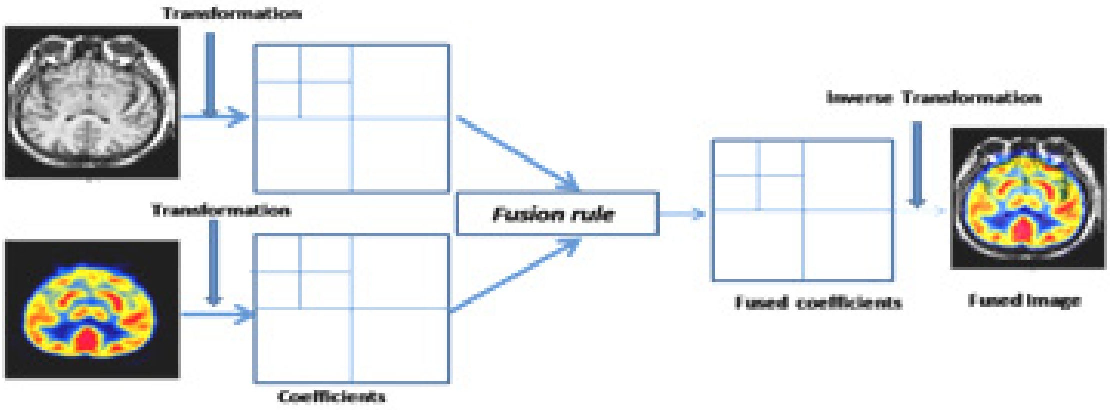

Fig. 1: T1 Weighted MRI and PET Fusion

has also demonstrated its advantages in detection and localization of lesions in patients with neuro-endocrine tumours. The fusion of images has rather incurred as a phenomena that is subconsciously practised by radiologist to compare and identify abnormalities, even if not performed explicitly using a CAD system[9]. The interfacing of the signal analysis theory and technological advancements in the hardware implementation has materialized the blending of the pixel values of multi-modal images to integrate information while preserving the contrast. The predicament of the image fusion technology pertains to the relentless effort of the researcher for the increased information transfer rate so to generate a relatively ideal case of image fusion. Nonetheless, along with higher information rate in 2-D image fusion, the focus of researchers is altering towards the triple modality fusion[10-24]. There is a constricted hardware as well as software implementation practise of the tri-modality fusion technology. The development of new tri-modality image fusion method which can display all the image sets together in one operation is the milestone in medical imaging technology. Recently for better localisation of gross tumour volume delineation in patients with brain tumour, a tri-modality fusion scheme (MRI/PET/CT) has been proposed[25]. This technology holds colossal potential usability for radiotherapy treatment planning of various brain tumours.

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