Chapter 15
Image Fusion Techniques for Different Multimodality Medical Images Based on Various Conventional and Hybrid Algorithms for Disease Analysis

Rajalingam B.
Priyadarshini College of Engineering and Technology, India

Priya R.
Annamalai University, India

Bhavani R.
Annamalai University, India

Santhoshkumar R.
Annamalai University, India

ABSTRACT

Image fusion is the process of combining two or more images to form a single fused image, which can provide more reliable and accurate information. Over the last few decades, medical imaging plays an important role in a large number of healthcare applications including diagnosis, treatment, etc. The different modalities of medical images contain complementary information of human organs and tissues, which help the physicians to diagnose the diseases. The multimodality medical images can provide limited information. These multimodality medical images cannot provide comprehensive and accurate information. This chapter proposed and examines some of the hybrid multimodality medical image fusion methods and discusses the most essential advantages and disadvantages of these methods. The hybrid multimodal medical image fusion algorithms are used to improve the quality of fused multimodality medical image. An experimental result of proposed hybrid fusion techniques provides the fused multimodal medical images of highest quality, shortest processing time, and best visualization.

DOI: 10.4018/978-1-6684-7544-7.ch015

BACKGROUND AND MOTIVATION

Medical imaging, diagnostics, and treatment planning are in a transition phase. Modern medicine relies on information provided in the form of images. Transverse slices of the human body obtained from different modalities like Computed Tomography (CT), Magnetic Resonance Imaging (MRI), Positron Emission Tomography (PET), Single Photon Emission Computed Tomography (SPECT), etc are widely used for the evaluation of the patients' health status. Different imaging reveals different information about the same anatomy and hence provides complimentary information to the clinicians. Medical imaging technology has undergone tremendous improvement over the last decades. Many modalities are now able to provide three-dimensional and four-dimensional information (i.e.) 3D imaging over time. The ways the images are presented and interpreted are also being changed. Even though 3D- and 4D-visualization techniques are used for an increasing number of applications, the cross-sectional 2D slice images are still predominantly used in radiology.

For proper diagnosis, medical images need to provide two important and interrelated pieces of information to radiologists: exactly what is going on and precisely where in the body. Anatomic imaging technologies like MRI and CT clearly show the morphological features like size and shape, but no information on proliferation or inflammation are provided. Using CT image alone it is difficult to determine whether the suspicious mass is a malignant tumour or fibrosis. The functional imaging technologies like SPECT and PET use radio labeled glucose or monoclonal antibodies to give the necessary information on the cellular activity, but it they cannot provide the anatomical details needed for exact localization. From the functional information alone, it is difficult to locate exactly whether the metastatic hot spot is in the muscle or the nearby bone. Radiologists need both anatomic and functional data to make a definitive diagnosis. High-quality digital displays are emerging from radiology reading rooms into interventional settings and even into portable devices. Instead of looking at X-Ray films and side-by-side CT slice images on a back-lit panel in the operating room, surgeons can now visualise live interventional imaging. Gone are the days where the medical images provided by different modalities were considered as separate sources of information, integrated only in the minds of the physician. Accurate diagnosis and treatment planning is possible by integrating the medical images obtained using different imaging techniques. The recent advancement in the medical imaging technology and the development of image processing algorithms provide new means of visualisation. Merging of multiple imaging data of the same patient, acquired at different times and by different modalities, is termed as multimodal fusion. Bringing together anatomical and functional information with sensitivity and specificity gives the true value of multimodal fusion imaging. Merging together the images obtained from different modalities without any artefacts is the focus of this dissertation.

MEDICAL IMAGING MODALITIES

Medical imaging is the technique of creating visual representations of the interior of a body for clinical analysis and medical intervention. It seeks to reveal the internal structures hidden by the skin and bones, as well as to diagnose and treat disease. Medical images are acquired in various bands of the electromagnetic spectrum. The various modalities used in medical imaging are presented in this chapter. The basic principles of CT, MRI, PET and SPECT imaging are described. The background information of the various imaging systems, the physics behind it are presented.