Chapter 9

Segmentation of Liver From 3D Medical Imaging Dataset for Diagnosis and Treatment Planning of Liver Disorders

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ABSTRACT

CT- and MRI-based imaging modalities are non-invasive, fast, and accurate in the diagnosis of different anatomical and pathological disorders. As such, there is a pertinent requirement for segmentation of the large organs such as liver and lungs to give proper visual information on the extent of involvement of morphological and pathological changes. The aim of this chapter is to discuss and implement different liver segmentation techniques on the 3D medical data set to determine best feasible technique for the purpose. The localization and detection of liver tumor will be easier for a radiologist with the extraction of the liver margins from other adjoining organs and its localization within the anatomical segments. It is found that active contour technique provides satisfactory results and also the validation results are well outlined in the case of active contour techniques.

INTRODUCTION

The liver is the largest and heaviest internal organ and a gland in the human body and is usually located in the right side of upper abdominal cavity, related to the right hemi-diaphragm above, surrounded by lower right thoracic cage to protect from external trauma. One pint (13%) of the body’s blood supply at any given moment is hold by the Liver. Inferior surface comes in contact with the right kidney, gall
bladder, stomach and adjacent small and large intestines. It is a wedge shaped dark reddish-brown organ that weighs about 1.44-1.66 kilograms in a healthy adult (See Figure 1). The hepatic portal system is responsible for directing blood from parts of the gastrointestinal tract carrying nutrients from food to the liver. In the hepatic portal system, the liver receives a dual blood supply from the portal vein and hepatic arteries. Also, hepatic portal vein used to it supplies 75% of the liver’s blood and carries venous blood drained from the gastrointestinal tract, spleen and to the associated organs. The hepatic arteries supply arterial blood to the liver and account for the remainder 25% of its blood flow.

Lobes of Liver

The liver consists of two main lobes the right lobe (largest) and the left lobe along with two smaller quadrate (Part of left lobe) and the caudate lobe. Entire liver consist of eight (8) segments based on Couinaud’s classification that consist of 1,000 lobules (small lobes) as shown in Figure 2. Each lobule and subsequently a segment is an independent functional unit with its own portal vein, bile duct, hepatic artery in the center and a draining hepatic vein in the periphery. These lobules are connected to small bile ducts (tubes) that connects with larger ducts to ultimately form the common hepatic duct. The common hepatic duct transports the bile produced by the liver cells to be stored temporarily in the gallbladder finally draining to the duodenum (the first part of the small intestine) via the common bile duct along with pancreatic duct which joins at its distal end and drains via a common duct called ampulla of Vater which is routinely identified as a projection from inside the duodenum called Papilla during endoscopic retrograde cholangiopancreatography or ERCP.

*Figure 1. Location of liver*