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A Survey on “Combination Strategies in Abdominal Multi-Atlas Image Segmentation”

Shashipriya H. Sharma¹, Vijay B. Baru², Swati Deshmukh³

¹PG Student, Dept. of Electronics and telecommunication, Sinhgad College of Engineering, Savitribai Phule Pune University, Pune India

²Associate Professor, Dept. of Electronics and telecommunication, Sinhgad College of Engineering, Savitribai Phule Pune University, Pune India

ABSTRACT-The segmentation of organs like the liver, pancreas, and kidneys on abdominal computed tomography (CT) scans can form an input to computer aided diagnosis (CAD) frameworks and laparoscopic surgery help. We show a typical, completely computerized procedure for multi-organ division of stomach figured tomography (CT) checks. Many existing techniques are particular to the segmentation of individual organs and fight to deal with the inconstancy of the shape and position of stomach organs. The strategy depends on level set registration, a system broadly utilized in brain imaging. The acquired probabilistic atlases are used in a graph-cuts based model to obtain a final segmentation of a structure of interest that incorporates high-level spatial requirements.

Technical Keyword: Abdominal computed tomography (CT), level set segmentation.

I. INTRODUCTION

The principles of level set method have been successfully applied to a wide variety of image modalities and segmentation tasks. This approach has a major advantage when compared to other segmentation algorithms, such as watersheds. Namely, it allows introducing a prior knowledge about the shape and the distribution of the segmented structures in a simple way, by using a pre-segmented image as a reference that guides the segmentation. The segmentation of organs like the liver, pancreas, and kidneys on abdominal computed tomography (CT) scans can form an input to computer aided diagnosis (CAD) systems and laparoscopic surgery assistance. Further applications include radiotherapy planning as well as cancer detection and staging. Most previous work on automated abdominal segmentation is based on statistical shape models or probabilistic level set methods. Usually, statistical models are learned on a training set and applied in combination with post processing steps that are often specialized to a particular organ. Population-based models in the form of statistical shape models or probabilistic level set methods represent the variation in a given population. However, the generality of such models may hamper the segmentation of a specific subject in the case of high inter-subject variability. In brain segmentation, a similar observation led to move away from single level set methods to multi-level set method approaches. Such techniques have been shown to outperform methods using only single (probabilistic) level set methods by generating a target-specific model. By definition, such methods are particularly powerful in cases where registered level set methods are similar to the target image. Applying multi-level set method registration methods to structures that show a higher variability in global appearance than the brain, shows some inherent challenges: identifying suitable level set method plays

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an increasingly important role in order to avoid the level set method-target registration process to be trapped in potential local minima for an unsuitable level set method-target combination. In this, a multi-level set method registration framework that is specifically designed to address the challenges found in abdominal scans. To address the high variability in subject-specific appearance as well as the variability in field-of-view, a hierarchical model for level set method generation is described. This approach is general to the organ and is able to capture the anatomical variability's in the available level set method database. Based on a database with manual labels, a target-specific probabilistic level set method is generated for a new subject. To capture inter-subject variability, level set methods are refined on three levels: on the global level, on the organ level and on the voxel level. Based on the defined probabilistic level set method, the final segmentation is obtained by applying a model based on graph-cuts, incorporating high-level information in the form of smoothness constraints. Generating a subject-specific level set method model has several advantages over approaches that use a general, population-wide statistical model: the model can be expected to be more general both towards global subject appearance as well as organ-location and -appearance. These advantages follow from only using the prior knowledge in the model that is considered helpful at the different level set method-generation levels and for the specific target subject. A preliminary version of the presented level set method learning method has been published in conference proceedings. Here, a more advanced method to estimate the final segmentation from the defined probabilistic level set method is presented together with a more detailed evaluation on a larger cohort.

II. MOTIVATION

A robust automated segmentation of abdominal organs can be crucial for computer aided diagnosis and laparoscopic surgery assistance. Many existing methods are specialized to the segmentation of individual organs and struggle to deal with the variability of the shape and position of abdominal organs. We present a general, fully-automated method for multi-organ segmentation of abdominal computed tomography (CT) scans. The main motivation of this project is that Abdominal CT scan are used when a doctor suspects that something might be wrong in the abdominal area and an abdominal CT is a relatively safe procedure.

III. LITERATURE SURVEY

They observed that the effectiveness of object recognition depends on the number and distribution of objects considered in the model assembly. Recognition accuracy improves with increasing number of objects. The evaluated results indicate the following. 1) High recognition accuracy can be achieved by including a large number of objects which are spread out in the body region. 2) Incorporating local object scale information improves the recognition in a way that there is no need to do search for scaling, orientation, and translation parameters. That is the pose of objects can be estimated in one shot without search or optimization. 3) The appearance information incorporated via ball-scale has a strong effect on the computation of the PA system, and on the relationship function. 4) The incorporation of shape prior into the framework by embedding proper scale, orientation, and translation information is feasible. 5) Intensity variation among scenes in an ensemble degrades recognition performance, because it affects the relationship functions between shape and intensity structure systems. Specifically, the spread of the pose parameters increases considerably when scenes have intensity nonstandardness [1]. In this paper, they have proposed a 3-D automatic anatomy segmentation method. The method effectively combines the AAM, LW, and GC ideas to exploit their complementary strengths. It consists of three main parts: model building, initialization, and delineation. For the initialization (recognition) part, we employ a pseudo-3-D strategy and segment the organs slice by slice via the MOAAM method, which synergistically combines the AAM and LW methods. For the delineation part, an iterative GC-OAMM method is proposed, which integrates the shape information gathered from initialization with a GC algorithm. The method was tested on a clinical CT data set from 20 patients for segmenting the liver, kidneys, and spleen. The experimental results suggested that an overall segmentation accuracy of TPVF >94.3% and FPVF <0.2% can be achieved [2]. This paper presented an automated pancreas segmentation algorithm from contrast-

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enhanced multiphase CT volumes. They introduced three unique ideas in the algorithm. First, they employed a two-stage segmentation strategy with a spatial standardization of the pancreas based on the three vessels that run along the pancreas so as to reduce variations in the pancreas shape and location. Second, we developed a patient-specific probabilistic atlas-guided segmentation to cope with the remaining variability in shape and location. Finally, a classifier ensemble was incorporated to refine the rough segmentation results [3]. A framework for organ delineation in radiotherapy planning is presented, including automated 3D model-based segmentation, as well as tools for interactive corrections. We demonstrated that the proposed approach is significantly more efficient than manual contouring in two-dimensional slices [4]. They have successfully constructed a full vector-valued probabilistic atlas by registering 31 patient data sets onto a single patient. The value of probabilistic atlases increases inversely with their variance. In general, the variances of TPS-based atlas construction are on the order of four to eight times better than the affine atlas construction. The structure that is a notable exception to this generalization is the left lobe of the liver. Here, the similarity in variance between the two methods may reflect more on the anatomical variation, i.e., presence or absence of this structure across patients. In order to reduce the effects of such variation at least two approaches are possible. One is to use a few subcategories of atlases with or without the missing structure, and the other is to use many DOF in the registration method [5]. Robotic technology is enhancing surgery through improved precision, stability, and dexterity. In image-guided procedures, robots use magnetic resonance and computed tomography image data to guide instruments to the treatment site. This requires new algorithms and user interfaces for planning procedures; it also requires sensors for registering the patient's anatomy with the preoperative image data. Minimally invasive procedures use remotely controlled robots that allow the surgeon to work inside the patient's body without making large incisions. Specialized mechanical designs and sensing technologies are needed to maximize dexterity under these access constraints. Robots have applications in many surgical specialties. In neurosurgery, image-guided robots can biopsy brain lesions with minimal damage to adjacent tissue. In orthopedic surgery, robots are routinely used to shape the femur to precisely fit prosthetic hip joint replacements. Robotic systems are also under development for closed-chest heart bypass, for microsurgical procedures in ophthalmology, and for surgical training and simulation. Although results from initial clinical experience are positive, issues of clinician acceptance, high capital costs, performance validation, and safety remain to be addressed [6].

IV. SYSTEM OVERVIEW

The principles of atlas-based segmentation have been effectively connected to a wide assortment of picture modalities and segmentation tasks. This approach has a noteworthy advantage when compared to other segmentation algorithms, such as atlas-generation or watersheds. In particular, it permits presenting a priori knowledge about the shape and the distribution of the segmented structures essentially, by utilizing a pre-segmented picture as a source of perspective that aids the segmentation. We show a level set registration system that is particularly intended to address the difficulties found in stomach checks. To address the high variability in subject-specific appearance as well as the variability in field-of-view, a hierarchical model for atlas generation is described.

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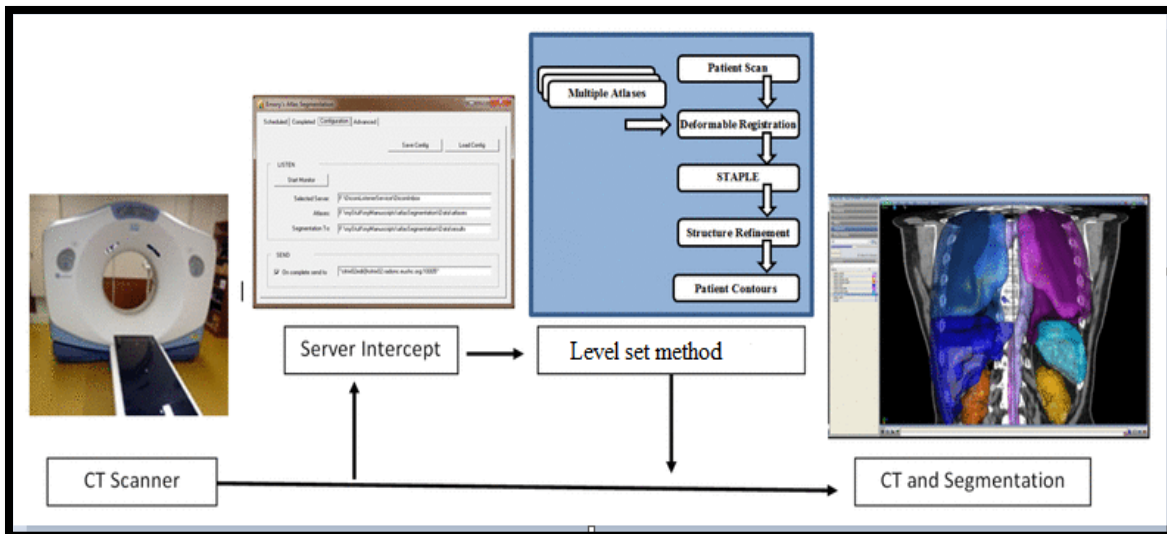


Fig. 1: Workflow of the automated level set method-segmentation approach.

The method consists of a hierarchical level set method generation step and a segmentation refinement step. Level set method labels are weighted on three scales: on the global level, the organ level and the voxel level. In the first step, the set of most suitable level set methods from a database is selected for a new subject by measuring global image appearance. After aligning all preselected level set methods with the target image, a local level set method weighting is carried out on an organ-by-organ basis. Finally, a patch-based segmentation refinement is applied to weight level set method labels at the voxel level. To incorporate neighborhood smoothness constraints and high-level topological information, the final segmentation of a given structure is obtained by applying a graph-cuts based refinement step with the hierarchical probabilistic level set method as a spatial prior.

V. CONCLUSION

An level set method-based technique for multi-organ abdominal segmentation is displayed in this paper. The positive point of this technique is to be applied consistently to multiple organs without specialization and individual parameter settings. The method is based on multi-level set method registration, a technique widely used in brain imaging. Abdominal CT scan are used when a doctor suspects that something might be wrong in the abdominal area. Obtain Segmentation of individual organs and to define the shape and position of abdominal organ.

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BIOGRAPHY

Shashipriya H. Sharma is a student in the Electronics and telecommunication Department, Sinhgad College of Engineering, Savitribai Phule Pune University. She received Bachelor of Engineering degree in Instrumentation Engineering in 2014 from SGBAU, Amravati, MS, India. Her research interests are Image processing, Signal processing and Biomedical Engineering.

Vijay B. Baruis Associate Professor in the Electronics and telecommunication Department, Sinhgad College of Engineering, Savitribai Phule Pune University. He has received Master of Engineering (M.E) degree in Electronics & Telecommunication Engineering from Government College of Engineering in 1996. He is a member of ISTE and IETE. His main areas of interest are Analog circuits and its applications, Electronic circuit and product design, Image and video processing and Multimedia techniques.

Mrs. Swati Deshmukhis Associate Professor in the Electronics and telecommunication Department, Marathwadamitramandal college of engineering, Savitribai Phule Pune University. She has received Master of Engineering (M.E) degree in Electronics Engineering from Government College of Engineering in 2004. She is a member of ISTE and IETE. Her main areas of interest are Medical imaging, Analog circuits and design, Electronic product design.