平成25年度博士論文

題目：**Study on Image Segmentation Using Model-based Methods and its Application in Medical Fields**

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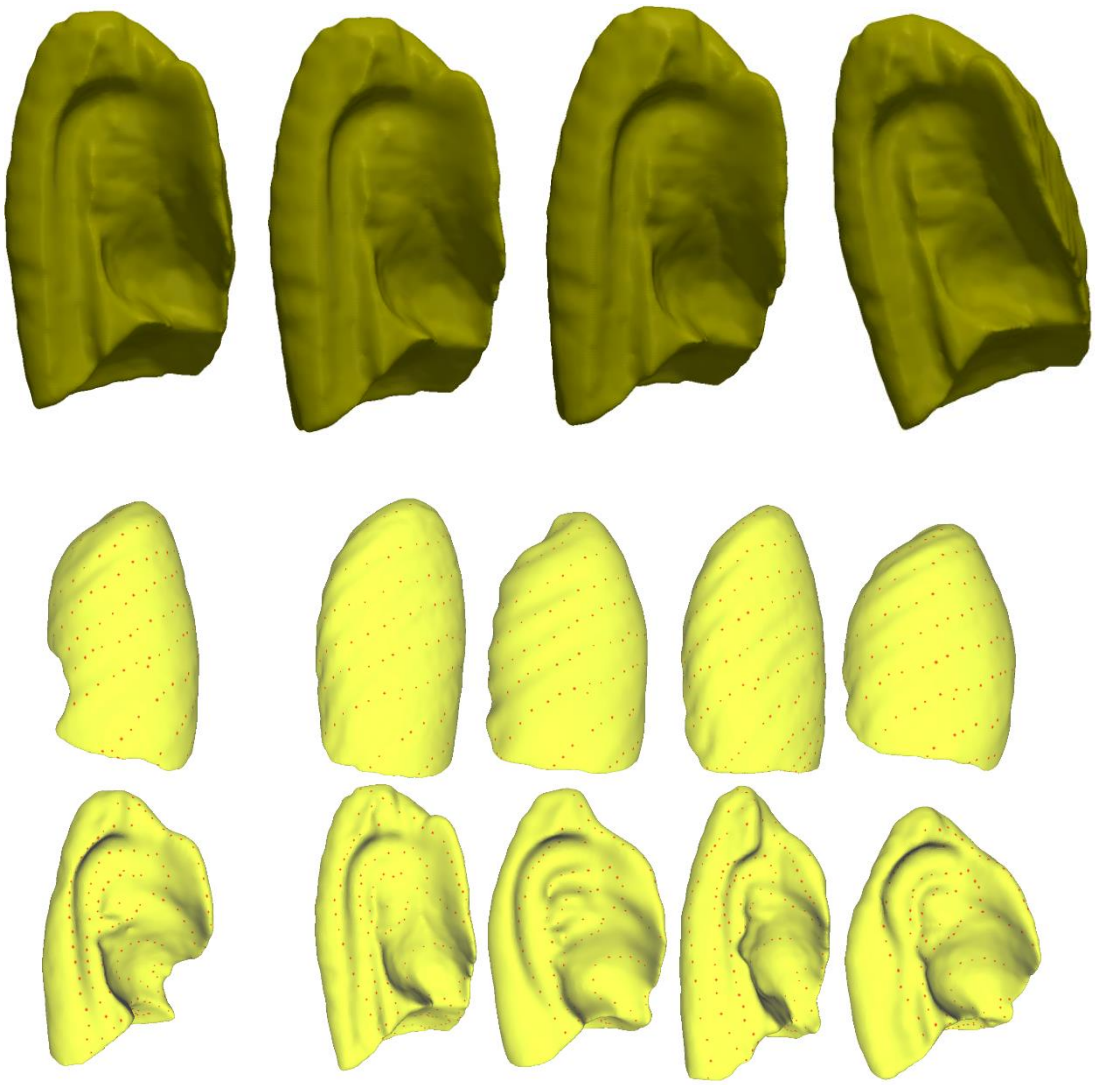
In image processing, segmentation is one of the critical tasks for diagnostic analysis and image interpretation. In the following thesis, we describe the investigation of three problems related to the segmentation algorithms for medical images: Active shape model algorithm, 3-dimensional (3-D) statistical shape model building and organic segmentation experiments. For the development of Active shape models, the constraints of statistical model reduced this algorithm to be difficult for various biological shapes. To overcome the coupling of parameters in the original algorithm, in this thesis, the genetic algorithm is introduced to relax the shape limitation.

How to construct a robust and effective 3-D point model is still a key step in statistical shape models. Generally the shape information is obtained from manually segmented voxel data. In this thesis, a two-step procedure for generating these models was designed. After transformed the voxel data to triangular polygonal data, in the first step, attitudes of these interesting objects are aligned according their surface features. We propose to reflect the surface orientations by means of their Gauss maps. As well the Gauss maps are mapped to a complex plane using stereographic projection approach. The experiment was run to align a set of lung lobe models. The second step is identifying the positions of landmarks on polygonal surfaces. This is solved by surface parameterization method. We proposed two simplex methods to correspond the landmarks. A semi-automatic method attempts to “copy” the phasic positions of pre-placed landmarks to all the surfaces, which have been mapped to the same parameterization domain. Another automatic corresponding method attempts to place the landmarks equidistantly. Finally, the goodness experiments were performed to measure the difference to manually corresponded results. And we also compared the affection to correspondence when using different surface mapping methods.

The third part of this thesis is applying the segmentation algorithms to solve clinical problems. We did not stick to the model-based methods but choose the suitable one or their complex according to the objects. In the experiment of lung regions segmentation which includes pulmonary nodules, we propose a complementary

region growing method to deal with the unpredictable variation of image densities of lesion regions. In the experiments of liver regions, instead of using region growing method in 3-D style, we turn into a slice-by-slice style in order to reduce the overflows. The image intensity of cardiac regions is distinguishable from lung regions in CT image. But as to the adjacent zone of heart and liver boundary are generally blurry. We utilized a shape model guided method to refine the segmentation results.

3-D segmentation techniques have been applied widely not only in medical imaging fields, but also in machine vision, computer graphic. At the last part of this thesis, we resume some interesting topics such as 3-D visualization for medical interpretation, human face recognition and object grasping robot etc.



実験結果