MAFE-Net: A Multi-Level Attention Feature Extraction Network for Pancreas Segmentation

Jiawei Chen[1], Wenjie Chen[1], Zhipeng Zhu[1], and Qi Ye* [1]

[1]School of Mathematical Sciences, South China Normal University, Guangzhou 510631, China.

Abstract. Accurate and automatic segmentation of the pancreas from abdominal computed tomography (CT) scans is crucial for diagnosing and treating pancreatic diseases. However, the pancreas is a tiny target abdominal organ with high anatomical variability and low tissue contrast in CT scans, making segmentation tasks challenging. To address this challenge, we propose a multilevel attention feature extraction network to segment the pancreas in abdominal CT images. Specifically, a multi-field attention convolution module (MFAC) and a connection feature fusion module (CFF) are added to the encoding and decoding structure to improve the extraction of pancreatic features. To further enhance the segmentation network's extraction of pancreatic edge features, we propose a decoding feature recall module (DFC), which can be migrated to other encoding and decoding structures and pruned to capture pancreatic edge information better. We compared the performance of our method with that of the most advanced method on the NIH pancreatic segmentation dataset and the challenging pancreatic cancer CT image dataset collected by the Zhujiang Hospital of Southern Medical University. The experimental results show that the DSC of our method on NIH dataset and pancreatic cancer dataset is 84.69% and 78.18% respectively, which is superior to the existing methods.

1 Introduction

In recent years, pancreatic cancer has become an increasingly serious public health problem worldwide. Its early detection is very difficult, and the choice of treatment options is also very limited [26]. By 2030, pancreatic cancer will become the second leading cause of cancer deaths worldwide [12]. Pancreatic cancer is still the tumor with the lowest survival rate at present, the five-year survival rate is between 5% and 15% [1]. Computed tomography images are the main means for doctors to obtain information about pancreas and pancreatic cancer. We can segment the pancreas through CT images to better assist doctors in diagnosing and treating pancreatic cancer.

The pancreas is a retroperitoneal organ. Due to the influence of surrounding organs such as stomach and duodenum, as well as the invasive growth characteristics of pancreatic cancer, it is difficult to obtain the typical features of pancreatic cancer in the early stage by CT and magnetic resonance imaging (MRI) [18]. Therefore, pancreatic segmentation is one of the most representative tasks in the field of medical image segmentation, for the following reasons:

---

*Corresponding author. `yeqi@m.scnu.edu.cn`

- The pancreas is closely related to surrounding organs and has a high degree of similarity to surrounding tissues and organs, and its edge position is difficult to distinguish.

- Targets vary greatly in shape, size, and location [5]. The proportion of the pancreas in the entire abdomen is less than 0.5%. In Fig. 1.1, we can better understand information about the pancreas.
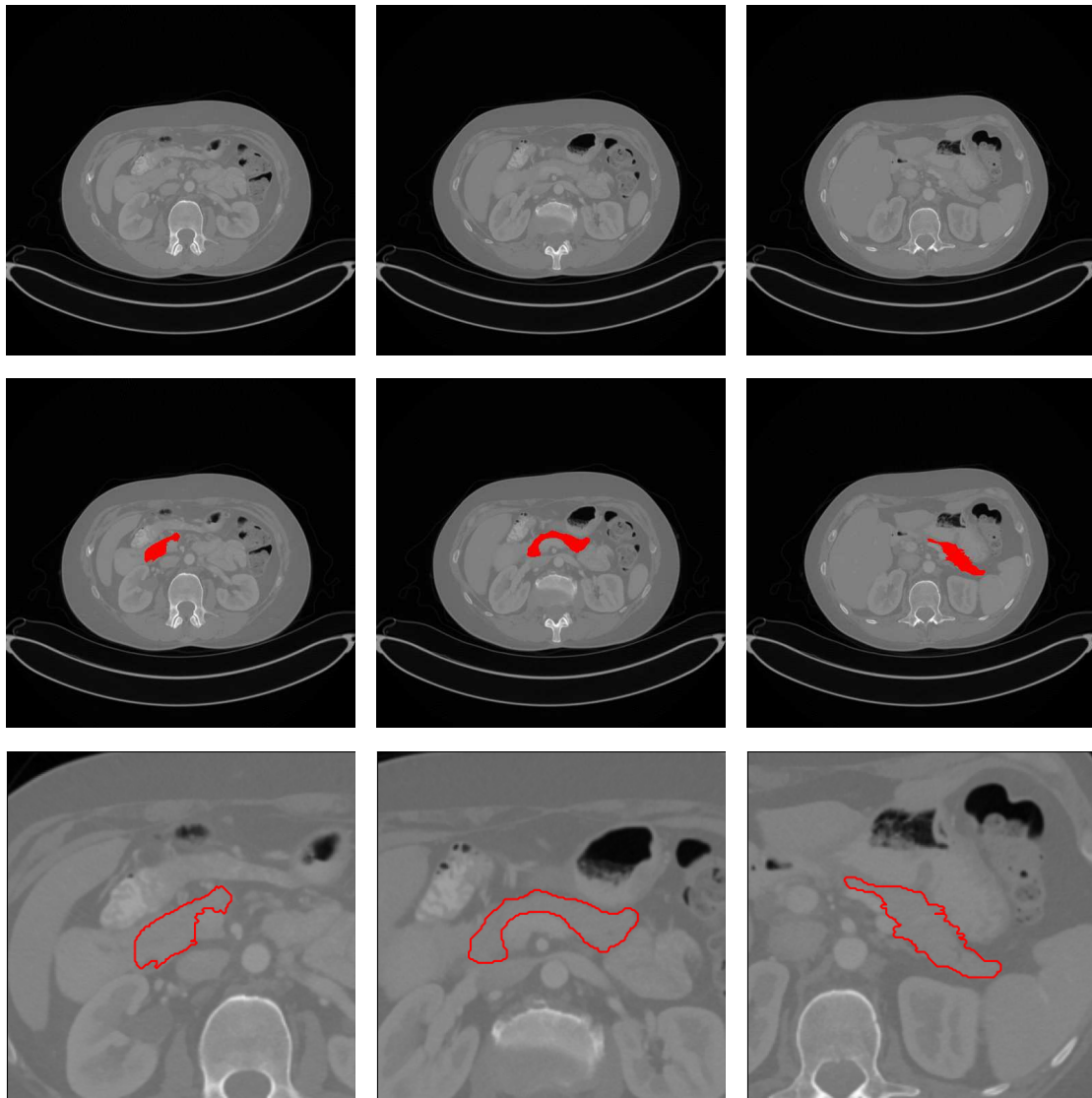

Figure 1.1: Here are three CT images from one case. The first row is the original CT image. The second row is a CT section of the pancreas labeled in red. The third row is a CT image cut based on the position of the pancreas, with the red color indicating the edge of the pancreas.