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Shuqiong Wu, Megumi Nakao, Tetsuya Matsuda

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Continuous Lung Region Segmentation from Endoscopic Images for Intra-operative Navigation

Shuqiong Wu · Megumi Nakao · Tetsuya Matsuda

Abstract Although preoperative Computed tomography images are widely used in intraoperative navigation, they can not provide precise information for organs such as the lungs, which deform severely during surgery because of deflation. By segmenting lung regions using intraoperative endoscopic images, a more accurate navigation can be obtained because endoscopic images directly provide real-time organ descriptions. However, satisfactory segmentation is rarely achieved with the algorithms in the literature due to the high deformability of the lungs and similarity between the background and object. This article addresses these problems by describing a novel approach for lung region segmentation based on endoscopic images. The proposed method leverages both GrabCut and optical flow for continuous segmentation. It also introduces a novel technique for quick user interaction, in which users are required to quickly provide a rough curve that shows the possible area of the boundary, and then a much more precise segmentation is deduced based on the rough curve. The effectiveness of the proposed approach was demonstrated by comparing it with conventional algorithms. The results show that the average F-measure of the proposed method is more than 97%. The position, size, and boundary of the lungs obtained by the proposed method can provide useful intraoperative navigation for lung resection surgeries.

Keywords Endoscopic image segmentation, GrabCut, Optical flow, Thoracoscopic surgery, Lung

1 Introduction

In recent decades, computer-based intraoperative navigation has played an increasingly important role in minimally invasive surgeries. However, intraoperative

Shuqiong Wu · Megumi Nakao · Tetsuya Matsuda
Graduate School of Informatics, Kyoto University, Yoshidahonmachi, Sakyo Ward, Kyoto 606-8501, Japan.
Tel.: +81-75-7533375
Fax: +81-75-7533375
E-mail: qq19850916@gmail.com (Shuqiong Wu)