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Medical Images Assignment

Topic 4

Edge detection and segmentation of lungs in CT images

GROUP 18

Prof. Giuseppe Baselli

Ing. Augusto Bonilauri

Daniela Eraso Casas

Giulia Ghiazza

Leonardo Franco

Teodoro Crapolicchio

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Introduction

Accurate 3D lung segmentation from CT scans is crucial for clinical assessment and volumetric analysis. In this study, we use axial and coronal sections from a single patient's CT dataset to isolate lung structures and estimate their volumes. The proposed pipeline aims to evaluate its robustness against various noise conditions.

Material and Methods

Starting from an axial slice that best represents the lungs, the region of interest was cropped, then the selected slice was binarized, inverted, thresholded, and processed (getpts(), bwselect(), imfill()) to identify lung regions. Pixel spacing from DICOM metadata enabled conversion of the binary mask into a cross-area measurement. The procedure was iterated across multiple slices, and extended to coronal views, using bwareafilt() to retain the two largest lung components, and obtain a volumetric estimation. Various levels of Gaussian, Salt & Pepper, and Periodic noise were introduced. Average, median filters (5×5) and frequency-domain noise suppression were employed to mitigate artifacts.
Dice coefficient evaluations was employed to quantify the accuracy of lungs segmentation.

Results

With low-to-moderate Gaussian noise, area measurements deviated by less than 2%, but volume estimations were more sensitive, especially with moderate Gaussian noise. The pipeline remained robust against even high-level Salt & Pepper noise, with area and volume deviations under 4%. Periodic noise severely impacted both area and volume despite filtering attempts.
Dice coefficient confirmed that the proposed pipeline achieved adequate segmentation quality.

Discussion

The proposed approach is stable under low-to-moderate Gaussian and high-level Salt & Pepper noise, yet remains sensitive to periodic patterns and moderate Gaussian noise when estimating volumes. Further refinement in filtering and preprocessing strategies is recommended to enhance reliability under challenging noise conditions.