

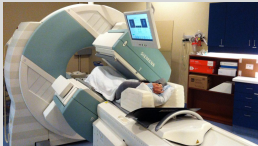
Image Processing and optimization of SPECT CT ventilation 3D images

Introduction

- Chronic Lung Allograft Dysfunction (CLAD) is a condition defined by a progressive and permanent loss of lung allograft function due to non-acute transplant rejection.
- Technegas™ Vent SPECT/CT imaging. A combination of SPECT scan (radiation detection) and CT scan (multi-layered x-ray).



CT Scan



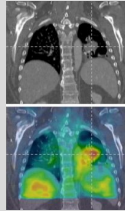
SPECT Scan

Problem

- Assessment of CLAD using SPECT/CT is currently qualitative.

Goal

- Making assessment of CLAD more quantitative through image processing on MATLAB.
- Execute sensitivity analysis on the quantified lung ventilation, and then assess reliability.

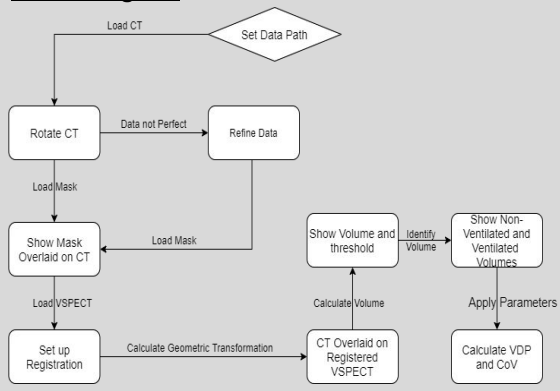


SPECT/CT Image

Design Process

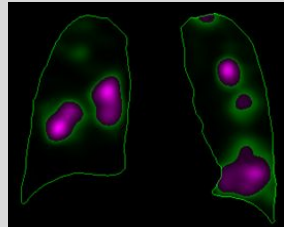
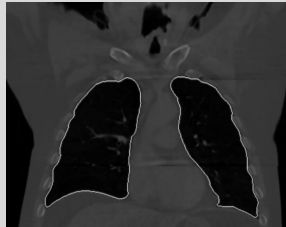
- Show mask and register images
- Show volume and threshold
- Quantify VDP and CoV

Block Diagram



Details of Design

- After acquiring both CT and SPECT images from various CLAD patients. 3D slicer was used, the images were registered, and mask was applied.
- Below are some of the images acquired when executed using MATLAB.



CT image (image at the left) showing the boundaries between tissue (gray) and air (black) in the lungs. VSPECT (image at the right) in two colors: Low intensity in green, and high intensity in purple. Black represents no ventilation.

Ventilation in Lungs shown in Matlab 3D Viewer

- The CT and VSPECT images would then be used to run the 3D viewer to display the ventilation in lungs, visually.

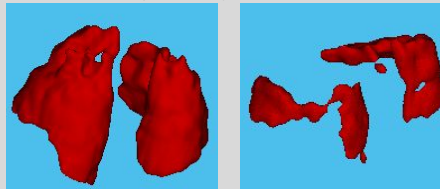


Image on the left shows the parts of the lungs with proper ventilation. Image on the right shows the parts of the lungs with no or poor ventilation.

- However, the decisions of what the boundary is between low ventilation and no ventilation was challenging. This is because depending on what threshold factor value we used, which influences the sensitivity of the ventilation analysis, could result in different VDP and CoV values.

- Lower the ratio of standard deviation to mean of each VDP, better the reliability.

Sensitivity Analysis on VDP values

	<i>(factor*median)</i>			<i>(factor*mean)</i>		
	factor = 0.1	factor = 0.15	factor = 0.2	factor = 0.1	factor = 0.15	factor = 0.2
STD / mean	0.4	1.03	0.89	1.79	1.45	1.22

Verification

- Compared the mean and median approaches to quantify ventilation.
- Obtained histogram for the patients.
- Displayed the ratio of STD and mean for sensitivity.
- Verified the reliability of the algorithm rigorously.
- Applied learnings from former students and verified the software on trachea removal, threshold selection and the sensitivity in resulting outcome.

Conclusion

- Obtained results primarily on the VDP and CoV values
- Assessed the reliability of the software.
- Examined two different approaches by using median and mean.
- Executed sensitivity analysis by calculation ratio of STD to mean for each threshold value of VDP.

References

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