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Electrical Impedance Tomography for Perfusion Imaging and Monitoring

Thesis Defence Presentation

Symon Stowe

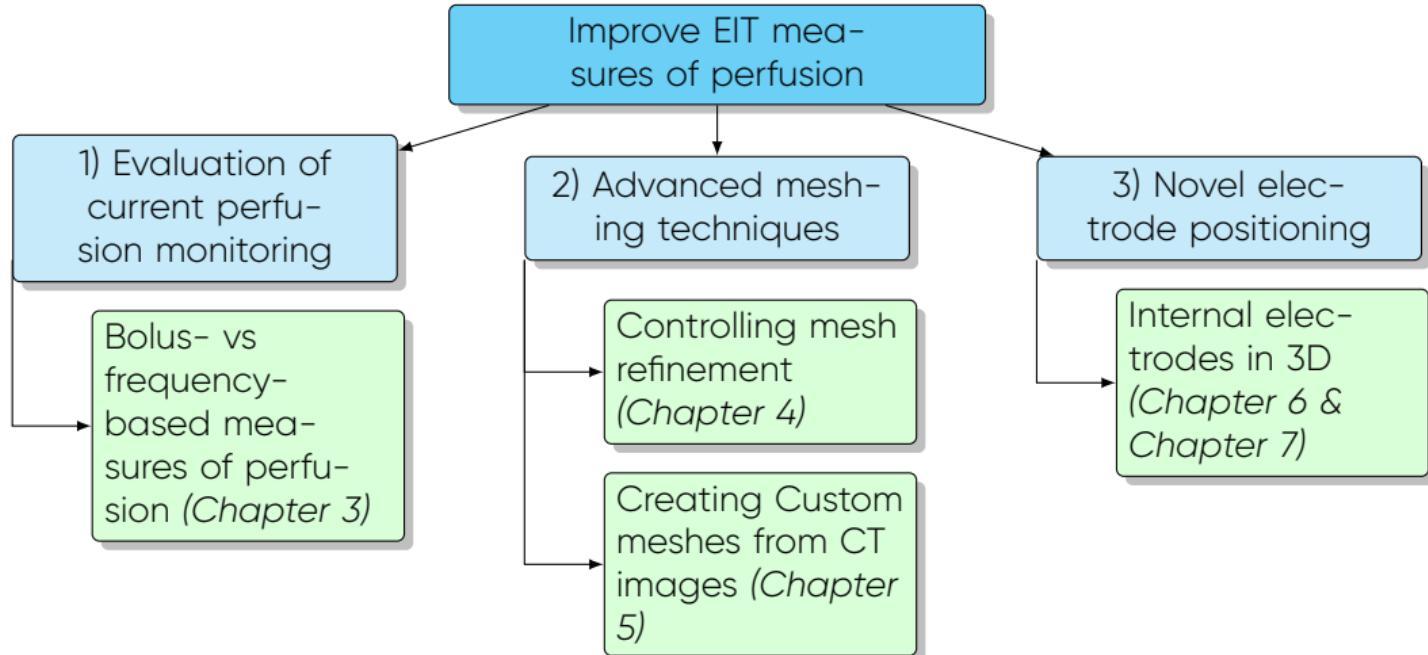
symonstowe@sce.carleton.ca

September 7, 2021

Overview

- ① Thesis Goals
- ② Contributions
- ③ Background
- ④ Methods and Results
- ⑤ Conclusions
- ⑥ Future Work

Thesis Goals





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Contributions



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Background

ARDS - Acute Respiratory Distress Syndrome

- Widespread inflammation in the lungs
- Reduces the lungs' ability to exchange oxygen and carbon dioxide
- Can be diagnosed with chest x-ray
- Treated with mechanical ventilation

ARDS Treatment



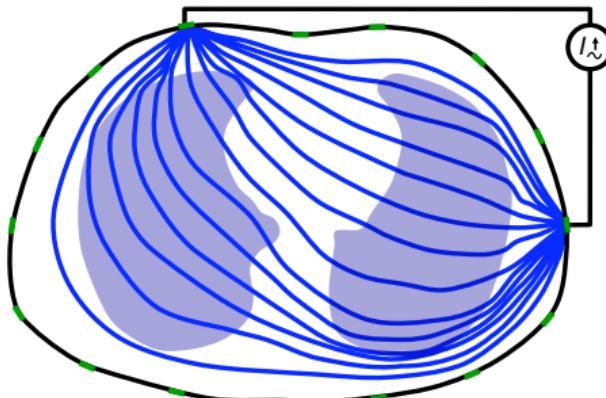
- Mechanical ventilation
- Challenging to monitor and adapt in real-time
- Can be continuously monitored with EIT...

EIT - Electrical Impedance Tomography



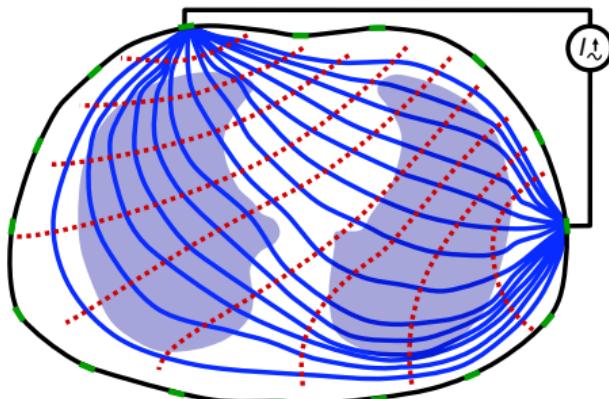
- used as a tool to monitor and guide mechanical ventilation
- non-invasive
- continuous
- low-cost
- safe

EIT - A brief overview



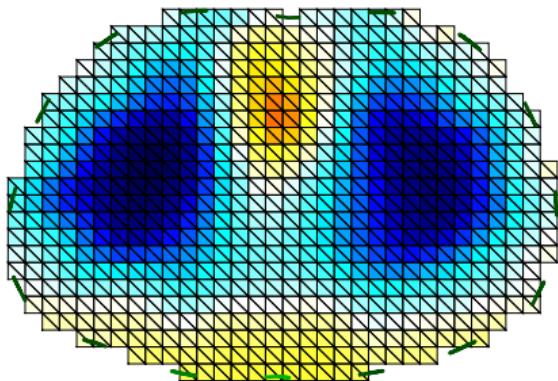
- current (blue) is injected between electrodes
- voltage is measured at the body surface
- voltages are reconstructed into images

EIT - A brief overview



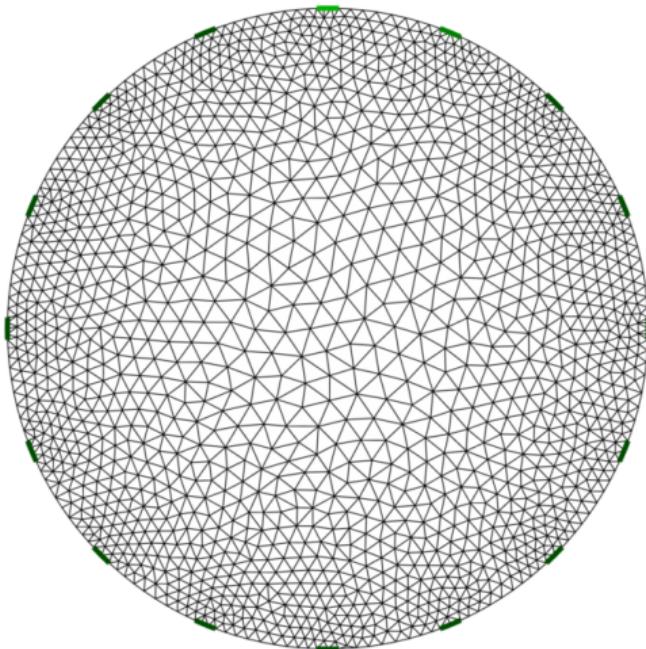
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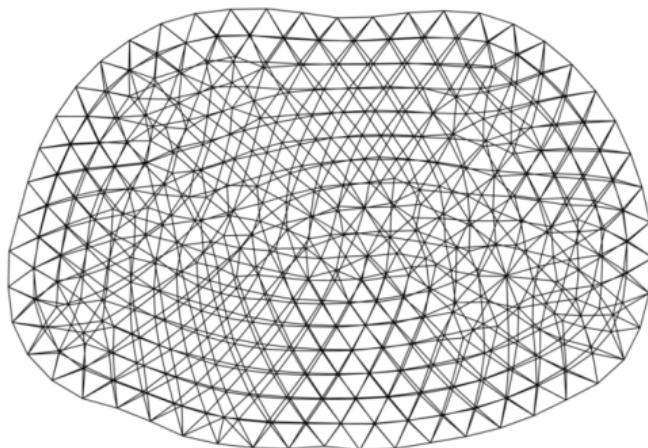
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Finitie Element Models (FEMs) in EIT



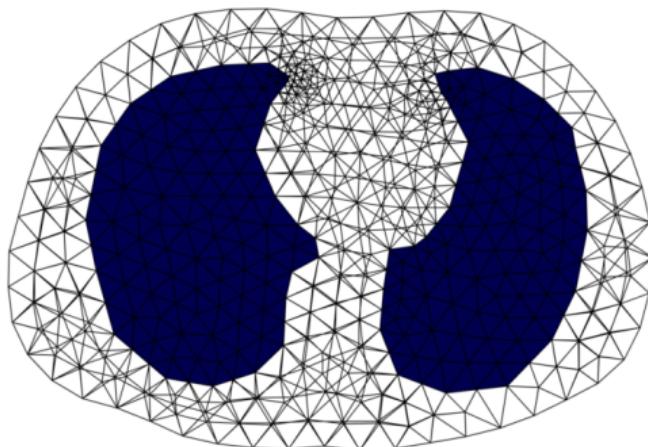
- finite element model is required to reconstruct voltages into images
- The more accurate the FEM the better the reconstruction
- More prior information regarding the body conductivity is better

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Motivation

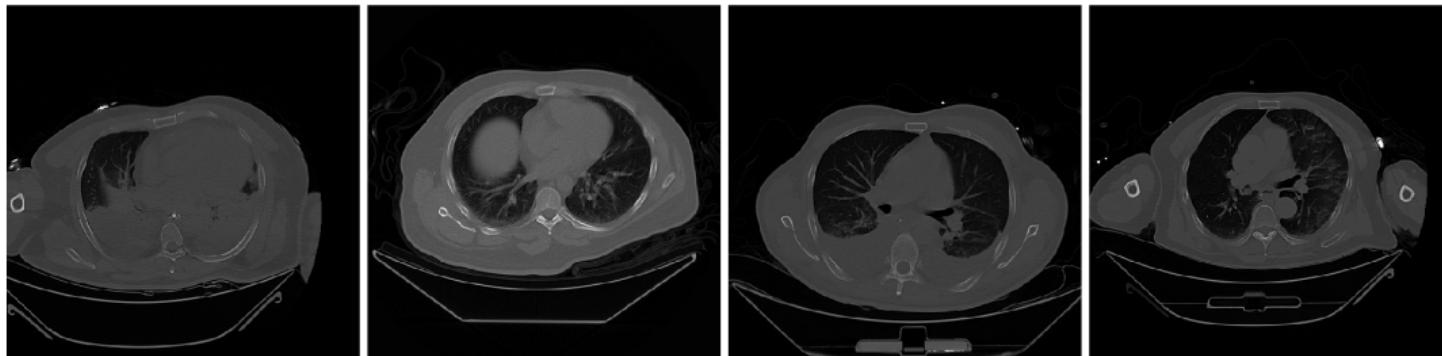
- Often a generic model is used for reconstructions
- True electrode locations and internal geometry is unknown
- With ARDS patients we have information from diagnostic CT images
- More prior information

Can we use this to improve EIT image reconstruction and monitoring of patients?

Overview

- ① Obtain CT images
- ② Automatically identify lung regions
- ③ Present in a GUI for correction by doctors or technicians
- ④ Generate a FEM based on the corrected segmentation
- ⑤ Reconstruct EIT data

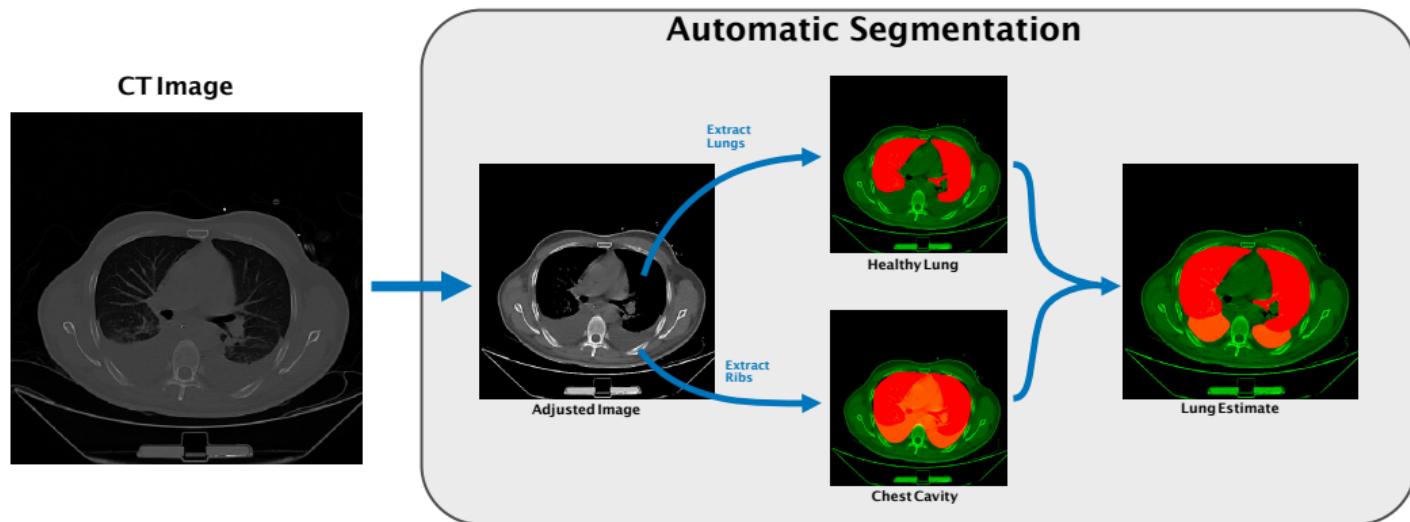
CT images



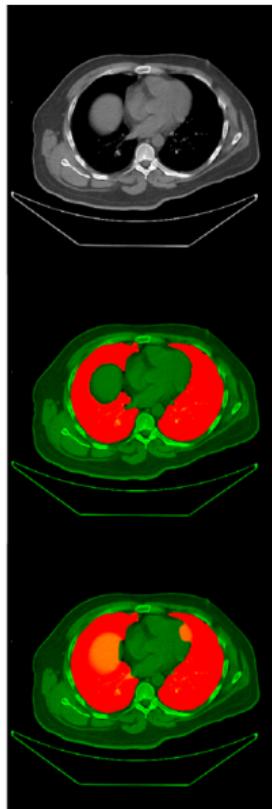
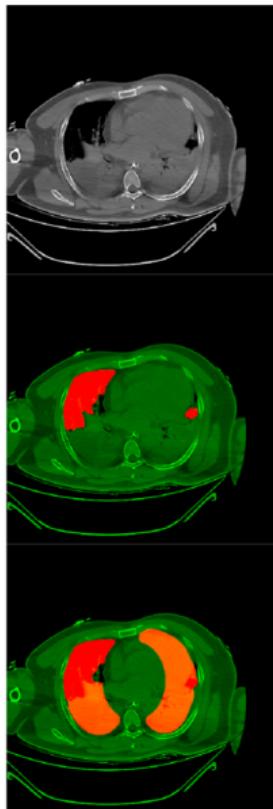
Example images taken from the 4th intercostal space for each subject



Methods

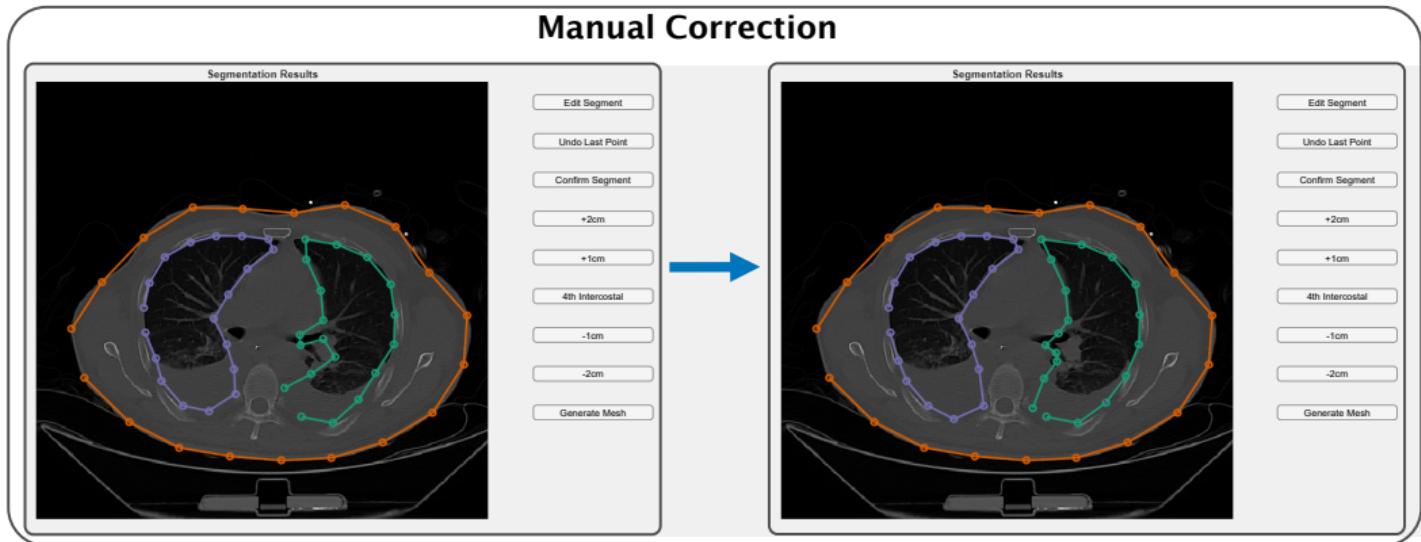


Segmentation Results



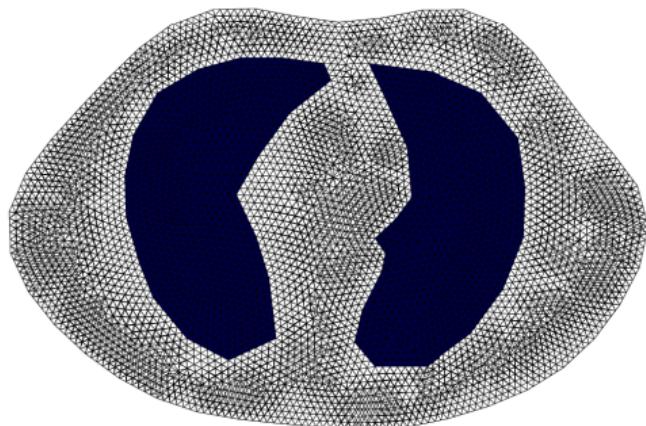
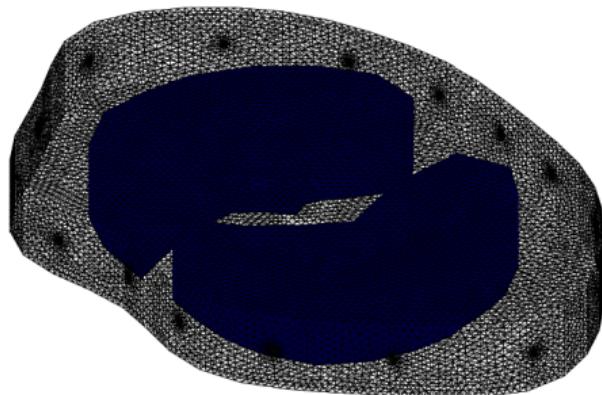
Methods

Manual Correction

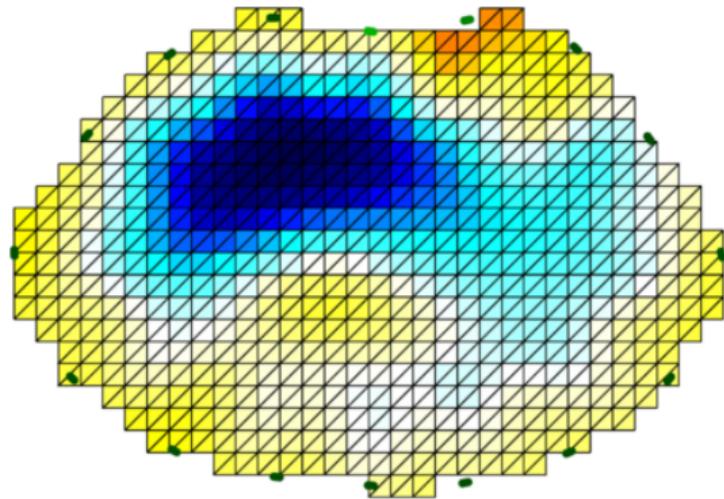
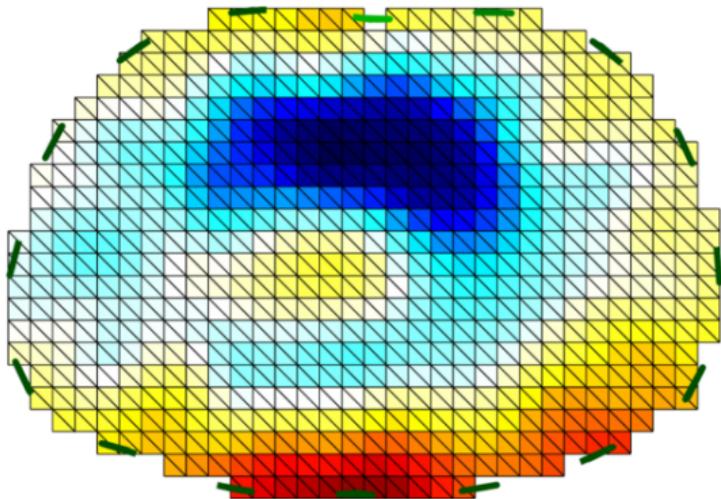


Methods

Mesh Generation



Preliminary Results



An average breath imaged for two FEMs

Current Work

Improvement

- Apply the segmentation to larger numbers of patients
- Create a more user friendly editing program to accelerate segmentation and meshing
- Create a database of meshes that can be applied to additional subjects

Validate the use of custom meshes for ARDS monitoring

Do patient specific meshes:

- improve on generic meshes for ARDS monitoring?
- give increased accuracy in measures of lung collapse and fluid movement?
- Improve detection of collapse and overdistention



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