

# EIT with a wrapped-around electrode belt

Andy Adler<sup>1</sup> and Joaquin Araos<sup>2</sup>

<sup>1</sup>Systems and Computer Engineering, Carleton University, Ottawa, Canada, [adler@sce.carleton.ca](mailto:adler@sce.carleton.ca)

<sup>2</sup>College of Veterinary Medicine, Cornell University, Ithaca, NY, USA

**Abstract:** Can we create EIT images when the electrode belt wraps around? Yes.

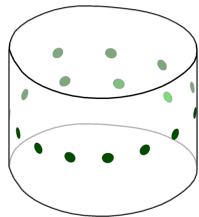
## 1 Introduction

EIT belts are sometimes not available in the right size. In that case, the belt is sometimes wrapped around the subject. This means that electrodes are in the wrong position for the original reconstruction algorithm, and that there is a vertical extent where the electrodes are overlapped.

We show that images can be reconstructed from such an electrode placement, by: 1) 3D Modelling of the body and electrode positions; 2) Reconstructing with a 3D algorithm; and 3) Taking a centre slice at the desired location

## 2 Methods: Data

As part of EIT data collection in brachycephalic beagles, EIT data were acquired with a Dräger Pulmovista 500. Since available belts were too small, the belt was wrapped around the thorax. Detailed photos of each animal were taken and a electrode positions noted so that an appropriate FEM (fig 1) could be modelled.



**Fig. 1:** FEM model with wrapped around electrodes

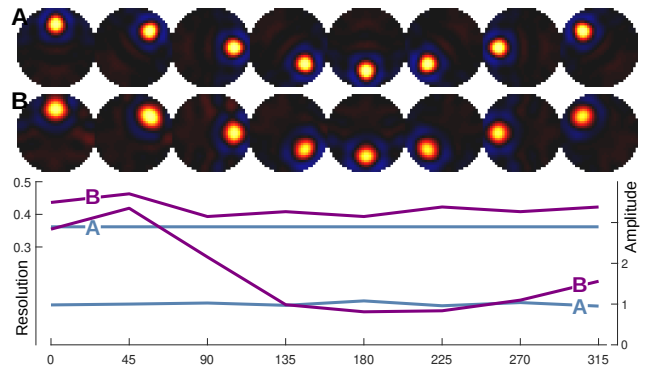
Brachycephalic dogs have shortened skull bones giving the face and nose a pushed-in appearance. These animals can have obstructive airways disease and often require surgical correction [2]. We conducted this study to define how different helmet CPAP levels alter cardiopulmonary mechanics in sedated dogs, providing physiologic evidence to inform more effective and safer clinical CPAP use.

## 3 Methods: Image Reconstruction

Using the custom FEM, an EIT forward model was created of the adjacent stimulation and measurement patterns. This model was used with 3D GREIT [1] to reconstruct images across multiple planes. Finally, the image in the centre plane (through the centre of the electrodes) was retained.

Data (available at DOI: 10.5281/zenodo.17829975) are shown in fig 3 during a transition of CPAP from 8–12 cmH<sub>2</sub>O. We see an increase in EELI, a longer expiratory time, and a small ventral redistribution of ventilation.

To understand the effect, we compare images from regular and helical placement (fig 2). An offset in resolution and image amplitude is seen near the electrode overlap.

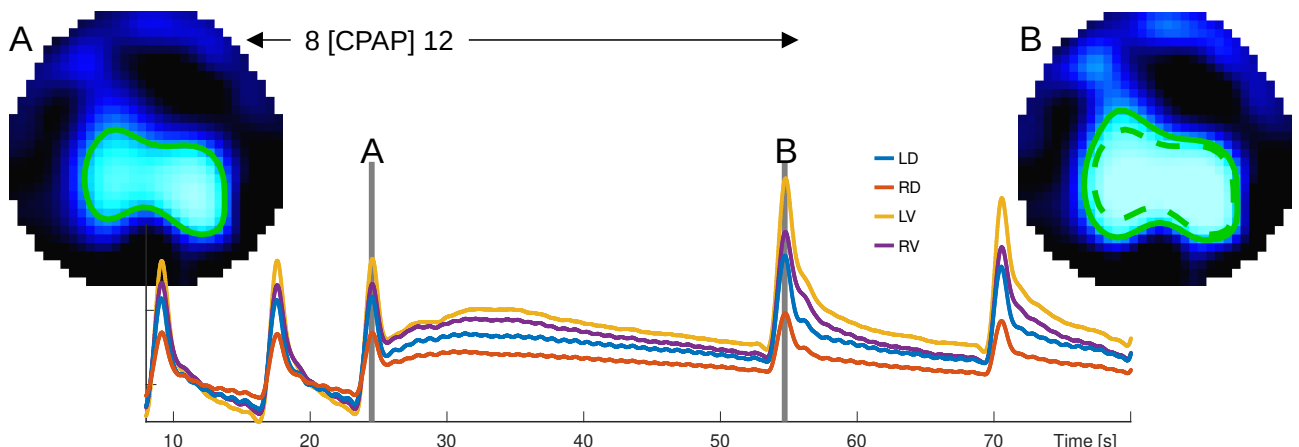


**Fig. 2:** Images from simulated data for (A) regular- and (B) helical-placement. Bottom right: amplitude,  $\frac{\sum \text{image}}{\sum A}$  normalized to  $\sum A = 1$ ; left: image resolution,  $\sqrt{\text{Area} > \frac{1}{2} \text{max}}$ .

In summary, EIT images can be reconstructed if a too-large electrode belt has been wrapped; however, the resulting images have some distortions.

## References

- [1] B Grychtol, B Müller, A Adler (2016) “3D EIT image reconstruction with GREIT” *Physiol Meas* 37:785
- [2] D Krainer, G Dupré (2023). “Brachycephalic Airway Syndrome”. *Small Animal Soft Tissue Surgery*. Wiley. pp.438–458.



**Fig. 3:** EIT waveforms and images at indicated times of a beagle with CPAP transition from 8 to 12 cmH<sub>2</sub>O