Software to automate functional analysis of reconstructed EIT data

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Introduction

In order to make Electrical Impedance Tomography (EIT) analysis more accessible to clinical researchers, we have developed a tool to analyse and display functional EIT measures of reconstructed EIT data of the thorax. We set out to design a tool that enables the user to select from several different analysis techniques on their reconstructed data, and run an identical analysis across a large number of files simultaneously, decreasing the complexity of EIT analysis. Existing clinical software performs reconstruction and basic analysis, typically providing an overview of the data and some basic analysis such as: ventilation images, regions of interest, perfusion calculation and data selection. Several EIT analysis tools have been developed such as AUSPEX (University of Amsterdam) and IBEX [1]. Here, we seek to create an open-source and automated tool that offers the flexibility of a pluggable interface for new functional algorithms.

Implementation

The ventilation analysis algorithms were created with the purpose of analyzing the effect of medication on asthmatic horses. Several open source algorithms are available for selection which can then be run on all files contained within a directory to analyze both ventilation and heartbeat signals. Reconstructed EIT data is imported and options are set by user input in a config file. The results across all files are then displayed in an HTML table so they can be quickly compared across all files.
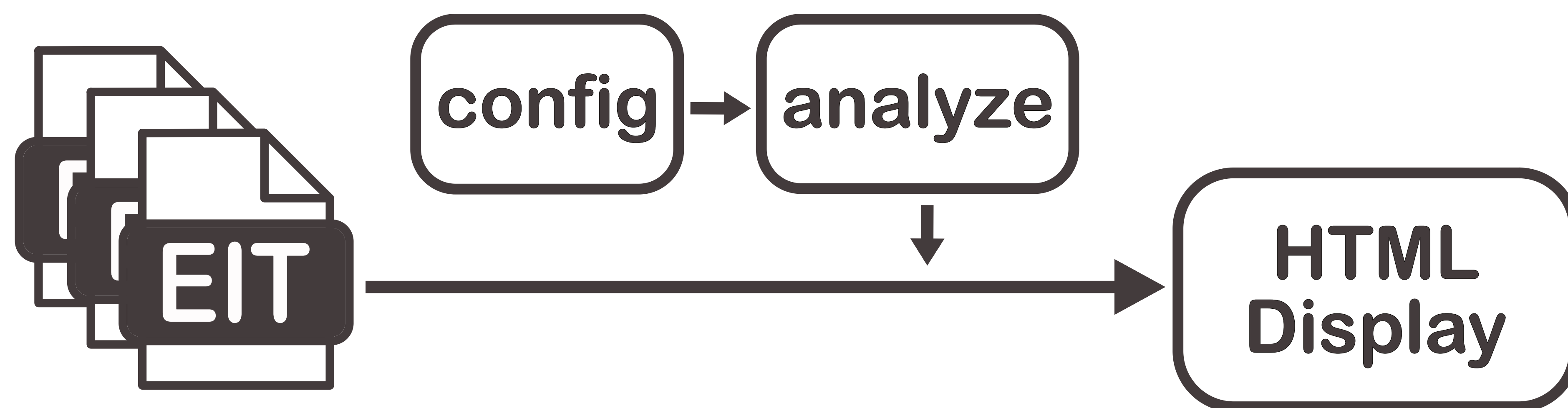

Ventilation Analysis

Focus has been placed on flow-volume analysis for its potential for detecting and analyzing a wide variety of respiratory diseases [2]. The flow signal is superimposed over the global ventilation signal, then a plot of flow vs. volume is used to calculate slopes. A flow-volume image is generated from the total flow-volume loop.
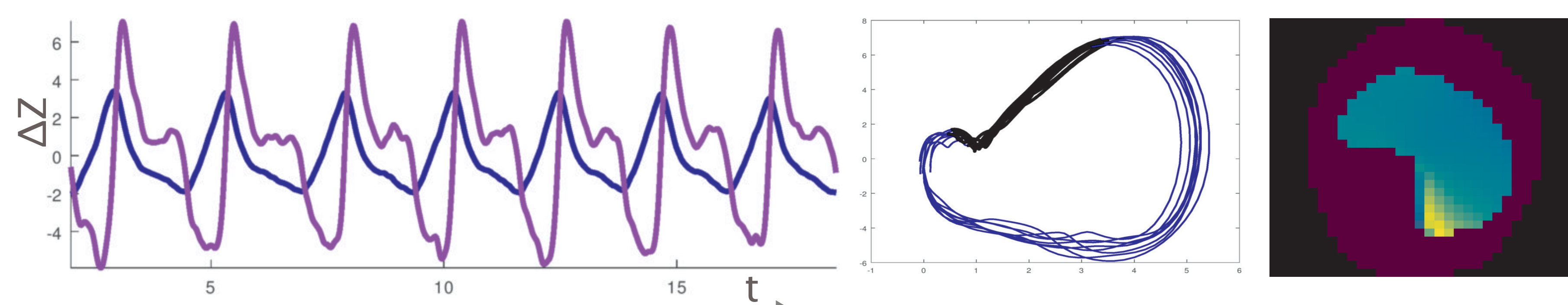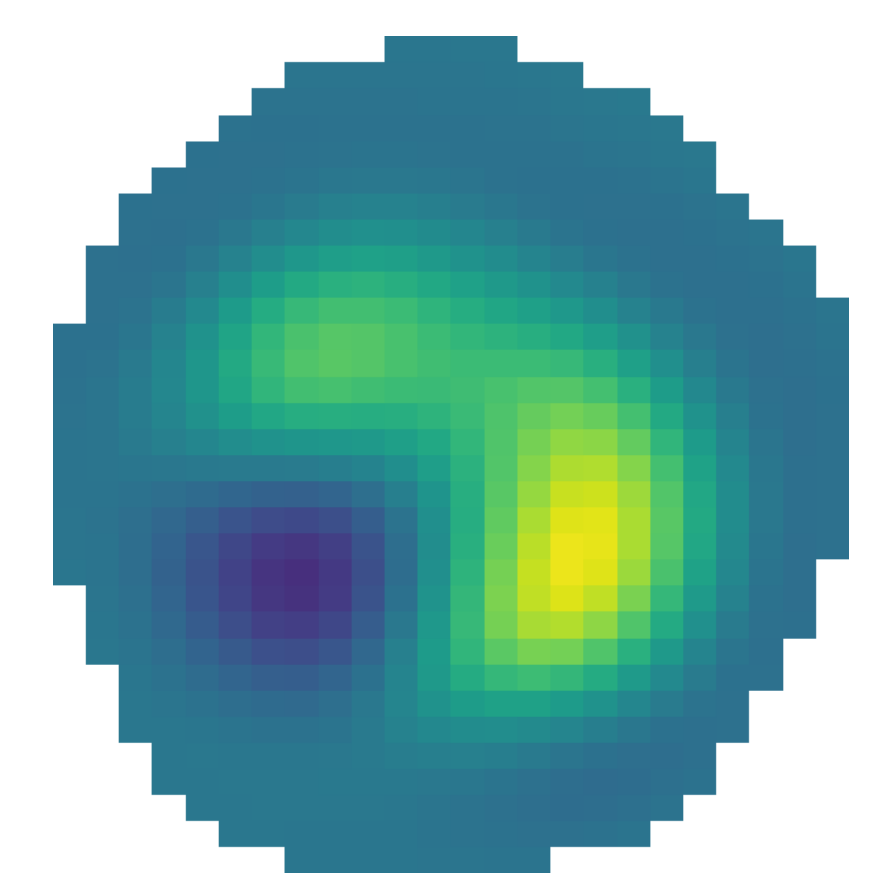

Heartbeat Analysis

Heartbeat detection and identification can be performed on both apnoea and regular segments. The typical heart rate range can be adjusted in the config file to better identify the cardiac signal.
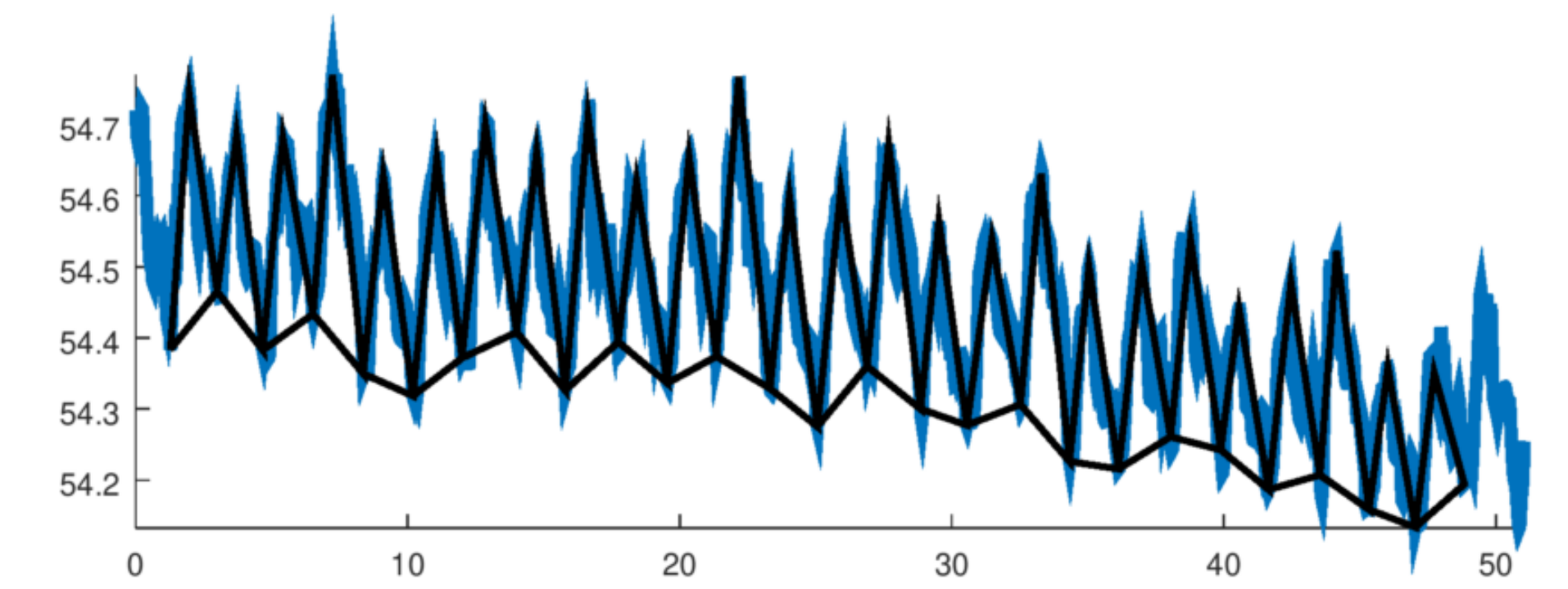
Through ensemble averaging the change in impedance over a heartbeat can be imaged.

Features

The following analysis techniques are available:
- breath detection and display
- heartbeat detection and display
- tidal volume image
- display global flow-volume signal
- display the flow-volume image
- calculate and display the slope of flow-volume loops
- display in a table peak flow rates

References

[1] P Róka et al *Conf 16th EIT*, p.59, Neuchâtel Switzerland, Jun 2015
[2] A Troyer, S Borenstein, R Cordier *Thorax*, 35:603–610, 1980

HTML Display