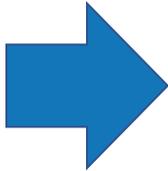


# Sharing Electrical Impedance Tomography and neuroimaging data from stroke patients

James Avery  
*University College London*  
*NIHR Imperial BRC*

# EIT of Acute stroke



EIT helmet  
EEG like electrodes

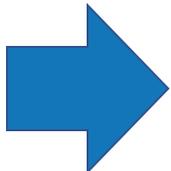
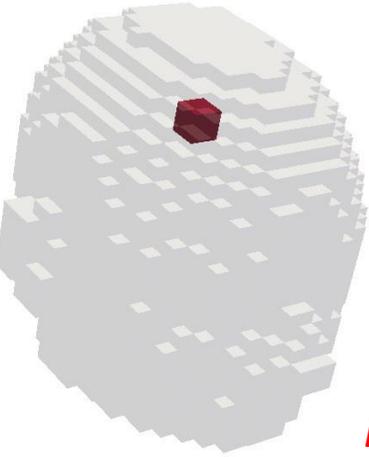
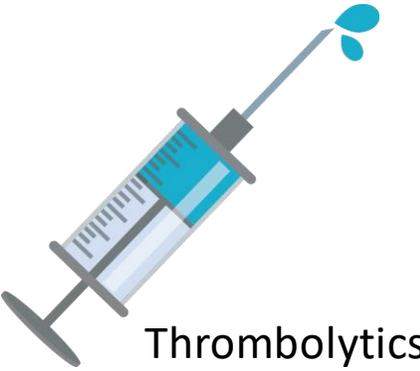


Image  
Classifier

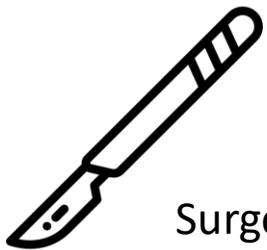


*Ischaemia*

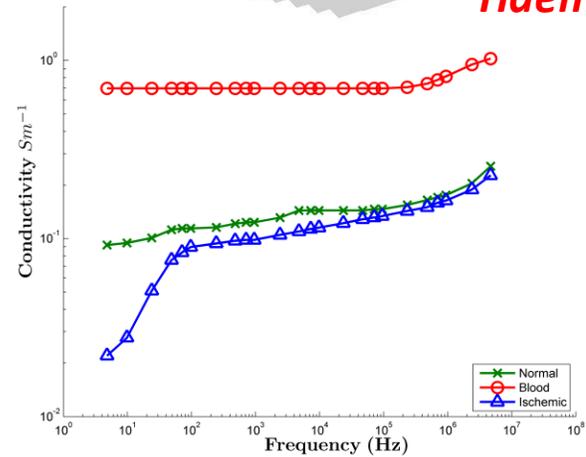


Thrombolytics

*Haemorrhage*

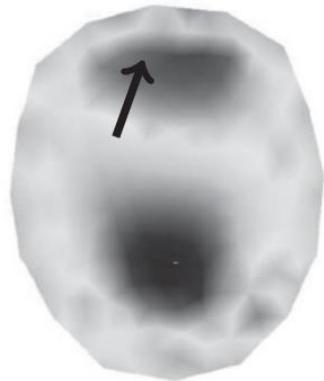
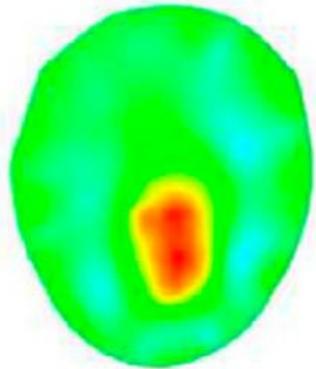
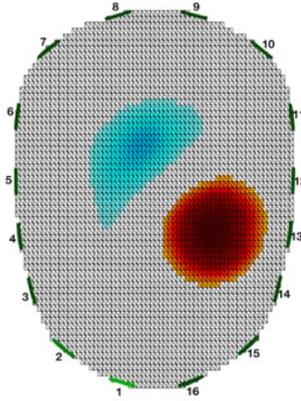
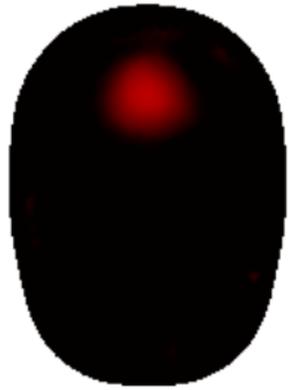
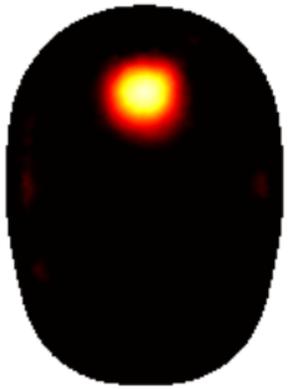


Surgery

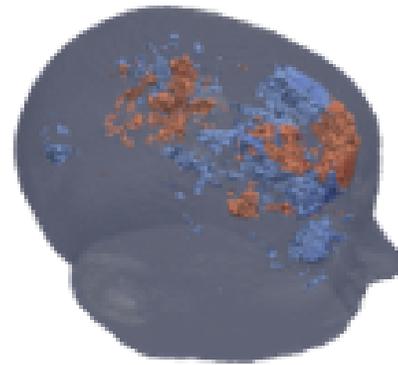
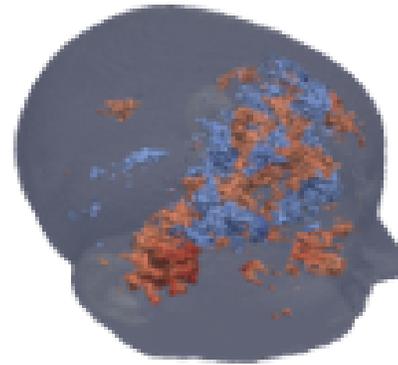


# Challenges

Works in simulations, maybe even phantoms



Not in real data...



Why?

- SNR
- Movement
- Electrode mislocation
- ...

What does real data look like?

What errors should these methods be robust to?

# The Dataset

# SCIENTIFIC DATA

OPEN

## Data Descriptor: Multi-frequency electrical impedance tomography and neuroimaging data in stroke patients

Received: 28 November 2017

Accepted: 16 April 2018

Published: 3 July 2018

Nir Goren<sup>1,\*</sup>, James Avery<sup>1,\*</sup>, Thomas Dowrick<sup>1</sup>, Eleanor Mackle<sup>1</sup>, Anna Witkowska-Wrobel<sup>1</sup>, David Werring<sup>2</sup> & David Holder<sup>1</sup>

Electrical Impedance Tomography (EIT) is a non-invasive imaging technique, which has the potential to expedite the differentiation of ischaemic or haemorrhagic stroke, decreasing the time to treatment. Whilst demonstrated in simulation, there are currently no suitable imaging or classification methods which can be successfully applied to human stroke data. Development of these complex methods is hindered by a lack of quality Multi-Frequency EIT (MFEIT) data. To address this, MFEIT data were collected from 23 stroke

- 23 Stroke Patients
- 10 Subjects
- Everything necessary to begin EIT research

# HASU Connection – Privileged Position

Collaboration opportunity unavailable to even other biomedical EIT researchers



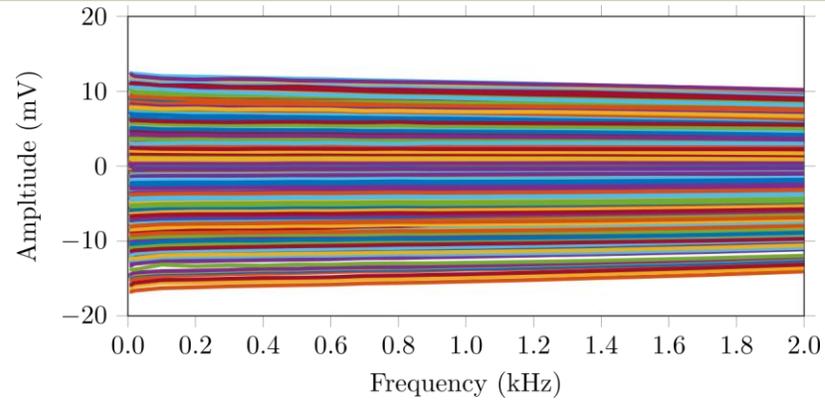
Testing



Data collection

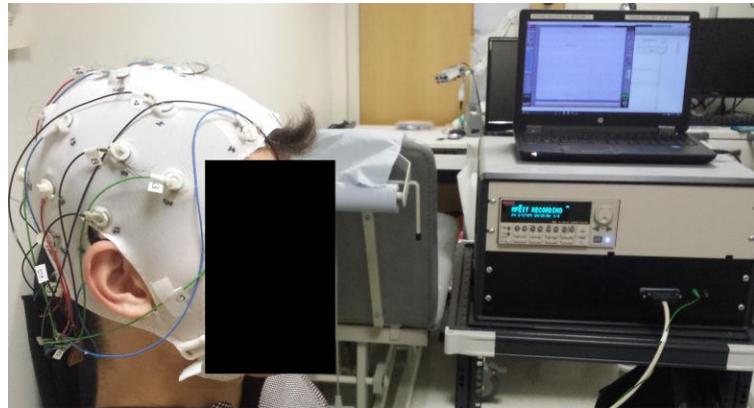
System design

# The Dataset

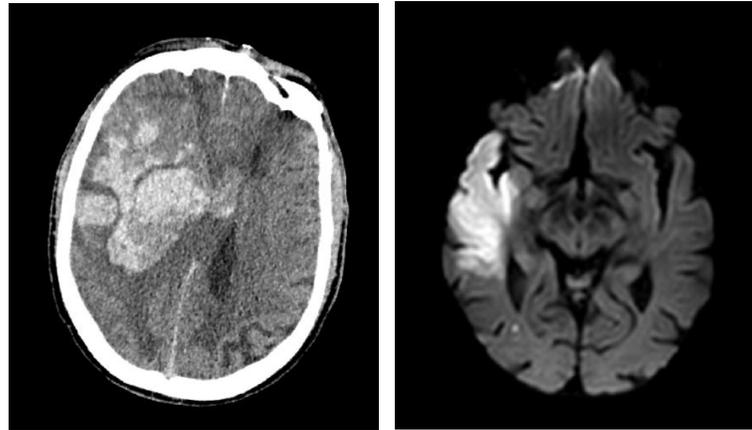


EIT: 22,320 measurements

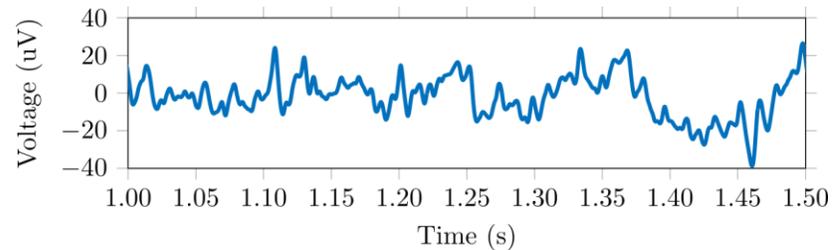
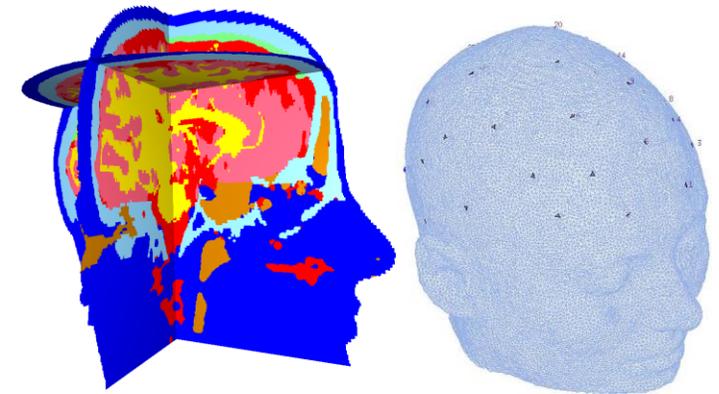
*Suitable for segmentation*



For each patient



CT/MRI: All relevant scans



EEG: 1 min (or 45 min)

Lowest barrier for entry as possible



# Why share?

Finding help  
online can be  
tricky!

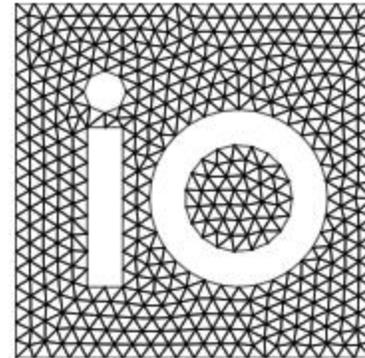


Sometimes it can be magic!

README.md

## The exact thing you need

build passing coverage 96% code style black pypi v2.3.3 Debian Testing 2.3.3-1 DOI 10.5281/zenodo.1173115 Stars 188



JUST DOWNLOAD AND USE IT

- [Abaqus](#)
- [ANSYS msh](#)

# Benefit from others sharing



## Programmable source - Threshold Unstructured Grid update when changing time step

```
import paraview.simple
s=paraview.simple.FindSource('recon_')
t=paraview.simple.Threshold(Input=s)
output=self.GetOutputDataObject(0)
cd=s.CellData[0]
DataRange=cd.GetRange(0)
minthres=-10
maxval = -500
#maxval = DataRange[0]
```

```
Fstop1 = 150;
Fpass1 = 200;
Fpass2 = 300;
Fstop2 = 350;
Astop1 = 65;
Apass = 0.5;
Astop2 = 65;
Fs=16384;
```

Go Down | Pages: [1] 2 3 ... 4221

| Subject  | Started by    | Replies    | Views         | Last post                            |
|--|---------------|------------|---------------|--------------------------------------|
| Using millis() for timing. A beginners guide                       | UKHelioBob    | 3 replies  | 70,808 views  | Oct 02, 2017, 08:17 am by UKHelioBob |
| Useful links - check here for reference posts / tutorials          | nickgammon    | 0 replies  | 46,932 views  | Mar 05, 2016, 11:33 pm by nickgammon |
| How to use this forum - please read.                               | nickgammon    | 0 replies  | 52,944 views  | Feb 14, 2013, 10:31 pm by nickgammon |
| Read this before posting a programming question ...                | nickgammon    | 29 replies | 198,504 views | Aug 06, 2012, 05:20 am by nickgammon |
| TEA5767 Spirit box (Ghost Box)                                     | BrettRogersUK | 6 replies  | 119 views     | Today at 11:47 am by PaulS           |
| Arduino Mega 2560 led turns on and the light gradually gets weaker | ribkar        | 6 replies  | 115 views     | Today at 11:47 am by ribkar          |
| Reading an array with PROCMEM after I mapped it                    | vhrdr         | 1 replies  | 55 views      | Today at 11:41 am by PaulS           |
| jendefs.h not found  | softtoytre    | 7 replies  | 107 views     | Today at 11:36 am by darrob          |
| MPR121 Switching outputs   | Jumpdyke      | 1 replies  | 27 views      | Today at 11:35 am by PaulS           |
| error code expected initializer                                    | bmachining    | 56 replies | 1,013 views   | Today at 11:32 am by UKHelioBob      |



## How To Uninstall Internet Explorer

HowToBasic 9.3M views • 3 years ago

Today I show you how to easily remove Internet I for running incredibly ...



## How To Replace a Door Knob With a Hot Dog

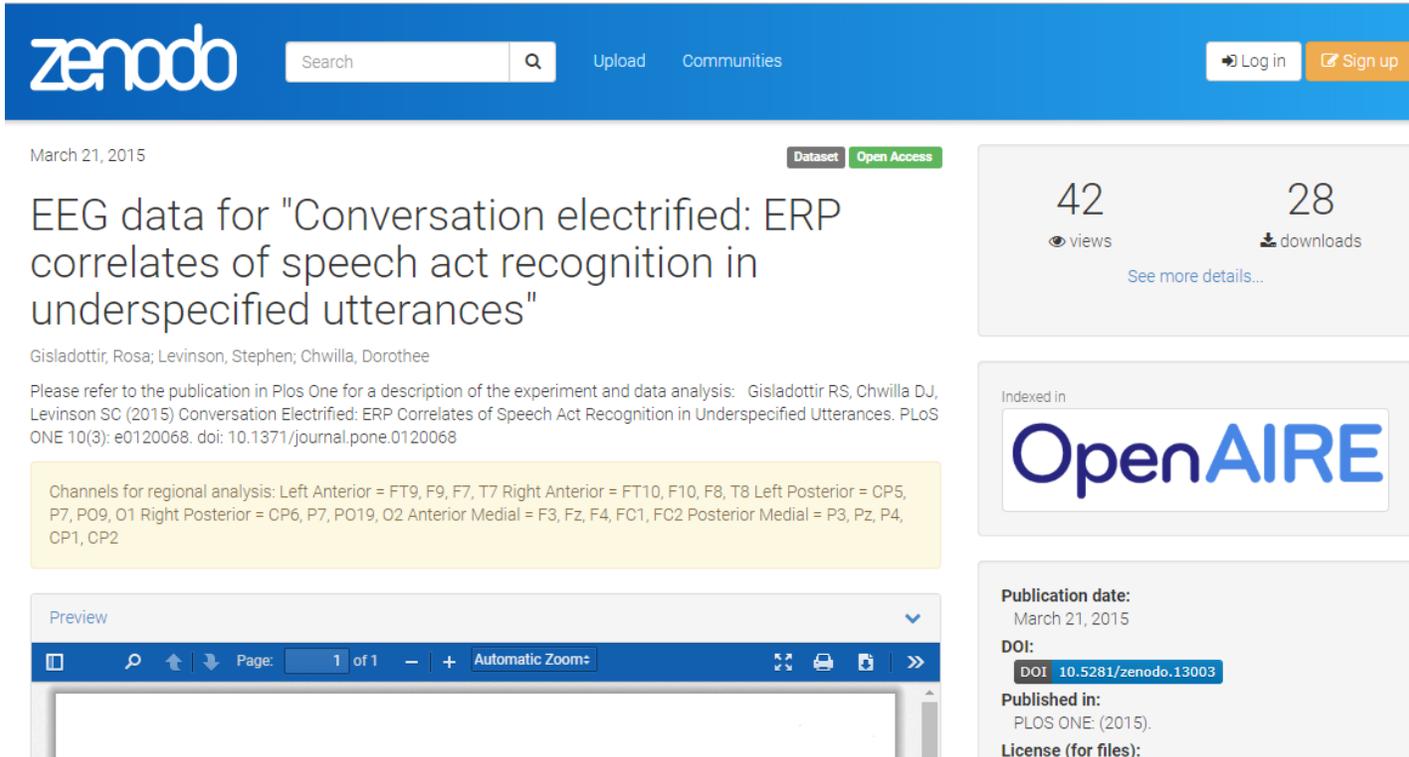
HowToBasic 1.6M views • 1 week ago

Today I show you how to replace a door knob with a hot dog. Has you learn how to fix it? This video ...

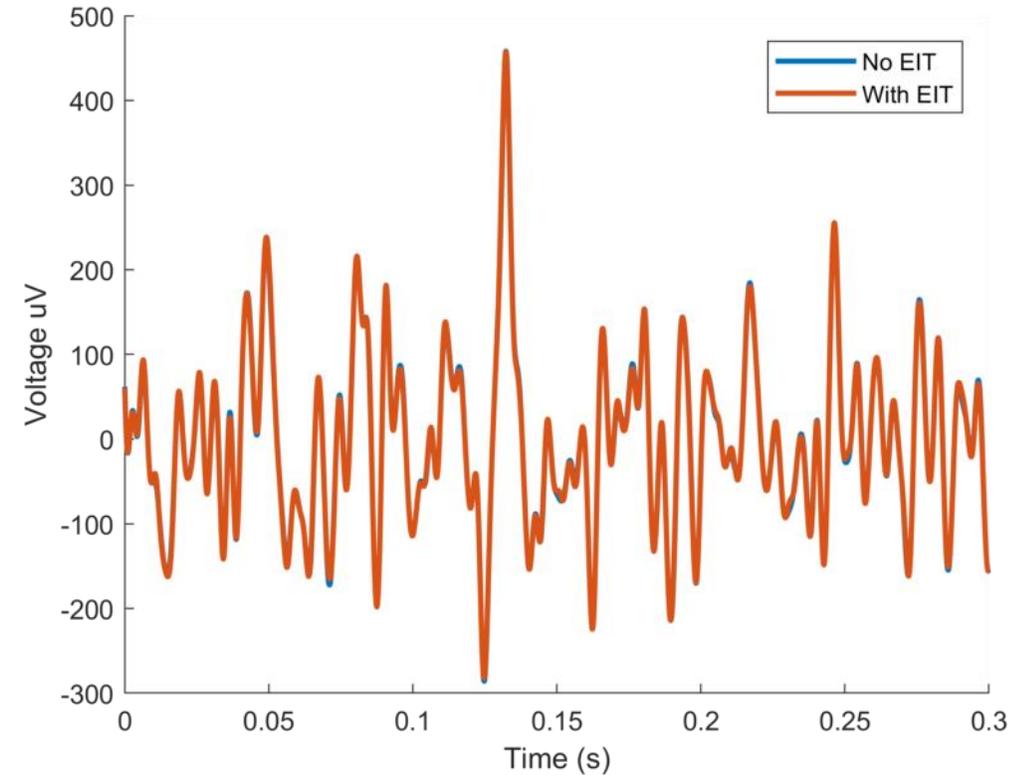
I constantly benefit from people taking the time to help, or to share tutorials online

# Why not in academia too?

I needed some EEG data in a hurry...



The screenshot shows the Zenodo interface for a dataset. At the top, there is a search bar and navigation links for 'Upload' and 'Communities'. The dataset is dated 'March 21, 2015' and is labeled as 'Dataset' and 'Open Access'. The title is 'EEG data for "Conversation electrified: ERP correlates of speech act recognition in underspecified utterances"'. The authors listed are Gisladdottir, Rosa; Levinson, Stephen; Chwilla, Dorothee. A summary of the publication is provided, including the journal name 'PLOS ONE' and the DOI '10.1371/journal.pone.0120068'. A yellow box contains technical details about EEG channels for regional analysis. On the right, statistics show 42 views and 28 downloads. Below that, it is indexed in 'OpenAIRE'. Publication details include the date 'March 21, 2015', the DOI '10.5281/zenodo.13003', and the publisher 'PLOS ONE (2015)'. A preview window is visible at the bottom left.



~~“Contact the authors via email if you are interested in the data”~~



# Someone might actually read it



GitHub navigation bar for repository `EIT-team / Stroke_EIT_Dataset`. It includes a search bar, navigation links for Pull requests, Issues, Marketplace, and Explore, and interaction buttons for Unwatch (12), Star (4), and Fork (0).

Repository overview for `Stroke_EIT_Dataset`. It shows 56 commits, 1 branch, 3 releases, and 2 contributors. A file list includes folders like `Anonymised_Radiology`, `Patients`, `Subjects`, `example_figures`, `resources`, `src`, and files like `.gitignore`, `EITDATA.json`, `EITSETTINGS.json`, `LICENSE`, and `UCL Stroke EIT Dataset.mat`.

README content for the repository:

## UCLH Stroke EIT Dataset

This Multifrequency Electrical Impedance Tomography (EIT) data was collected as part of clinical trial in collaboration with the Hyper Acute Stroke unit (HASU) at University College London Hospital (UCLH).

An overview of EIT along with a more detailed description of the data collection methodology and clinical context is given in the accompanying [publication](#).

This repository contains the already processed data ready for analysis or use in imaging or classification studies, as well as the code to process all of the raw voltages.

## Using Processed dataset

The processed data has been saved in JSON and MATLAB `.mat` formats. The steps to generate this data from the raw files is covered in the **Processing Raw Data** section.

### MATLAB

Load the dataset using `load('UCL_Stroke_EIT_Dataset.mat')`. The data is stored in the structure `EITDATA`, with relevant settings saved in `EITSETTINGS`.

So for example, to plot the full spectrum data for patient 7

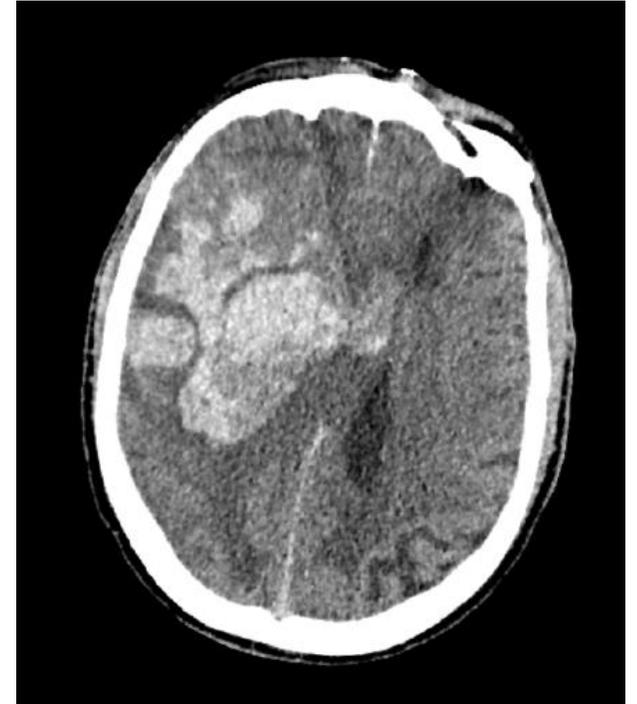
```
plot(EITSETTINGS.Freq,EITDATA(7).VoltagesCleaned)
xlabel('Frequency (Hz)');ylabel('Amplitude (mv)');title('EIT Data in Patient 7');
```

Better code, better documentation.  
Even if just for myself!

This stuff is hard!

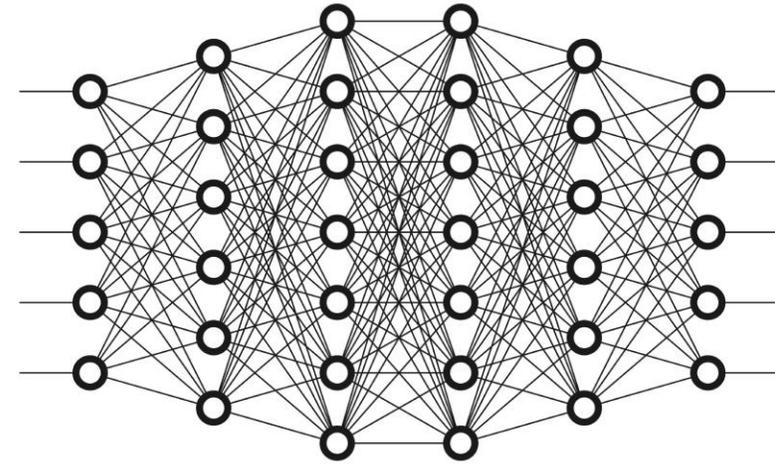
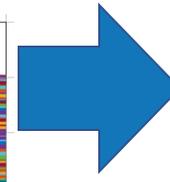
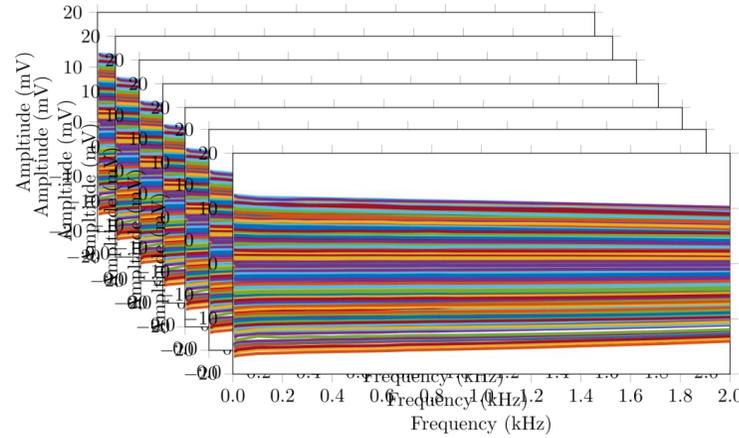
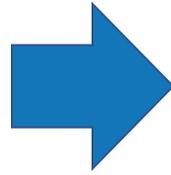
Success requires collaboration

**We want this to work!**



# What's next?

## Generate training datasets for deep learning



- New collaborations
- New analysis
- New opportunities

Thanks for listening

**[eit-team.github.io](https://eit-team.github.io)**

Data, code, hardware

## Acknowledgments

UCLH Stroke  
research team



Prof. Holder and the UCL  
EIT Group

