Decoding Cursor Position from ECoG data
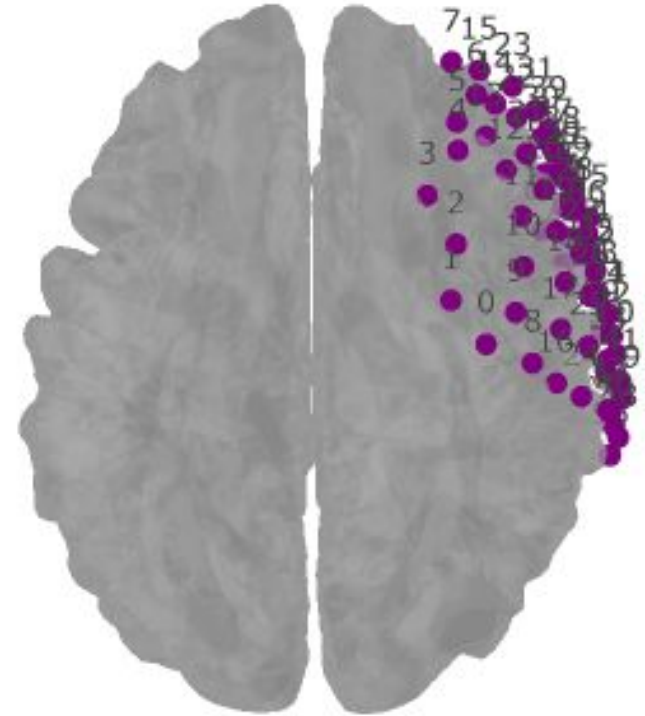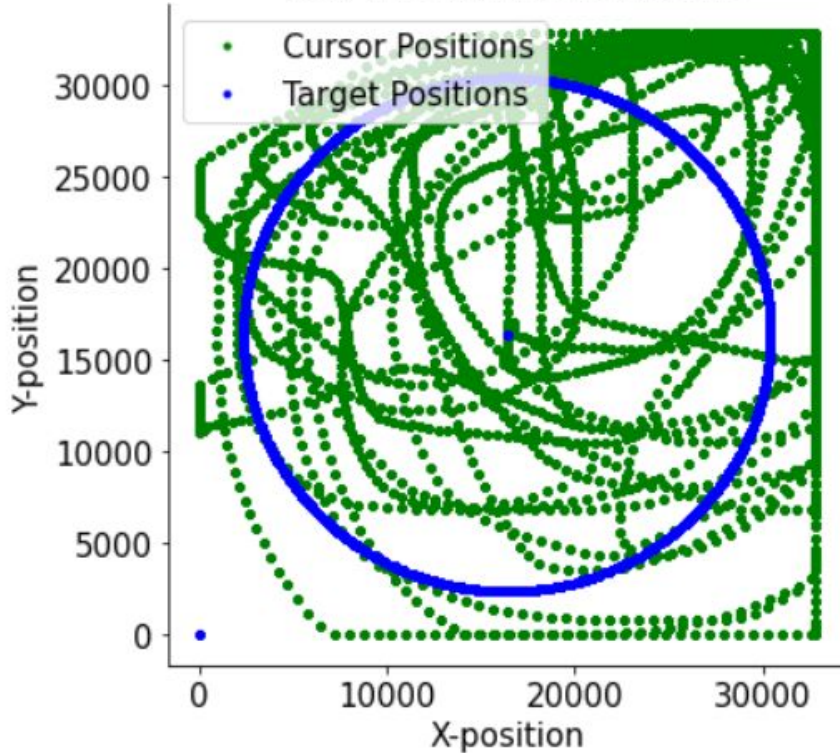
By: Omika Wadhwa, Dominik Schmid-Schickhardt
Pod Unknown Rats (G4M3R R4T5)

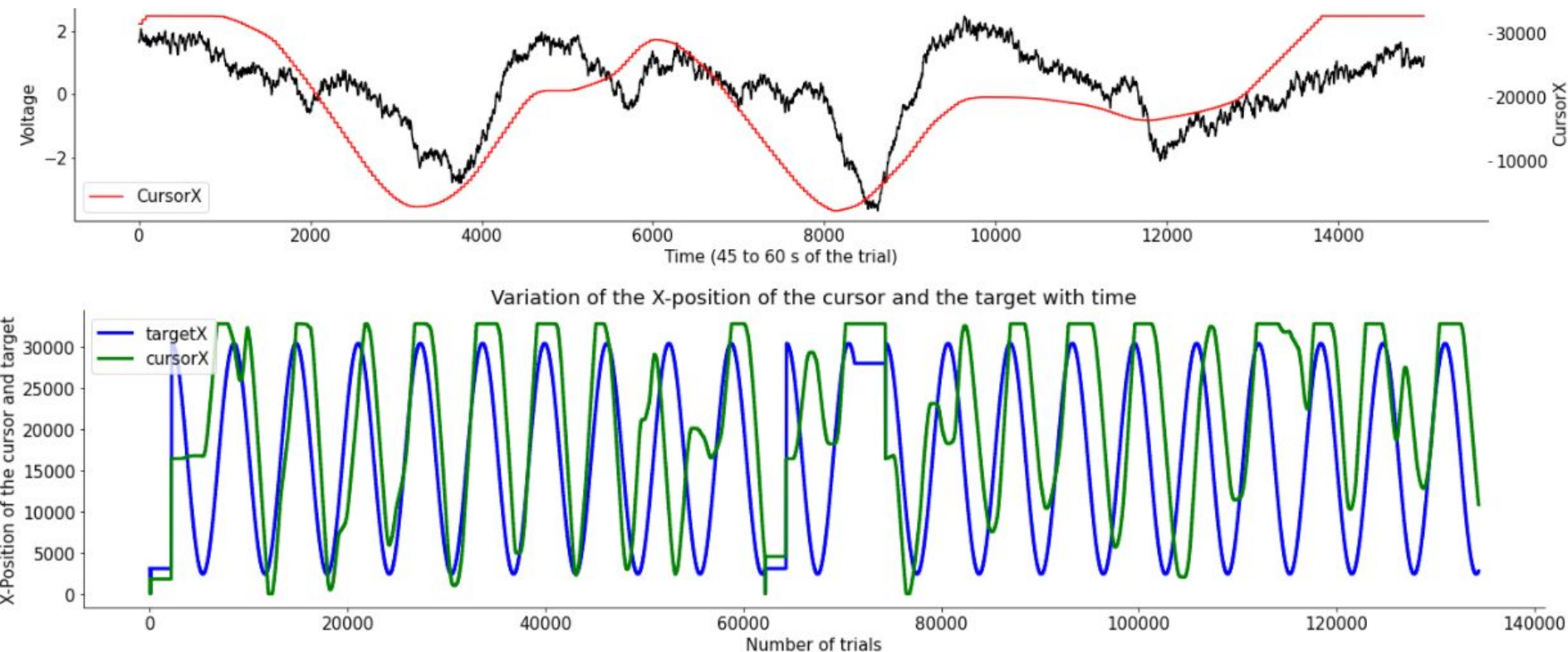neuromatch
academy

ECoG Joystick data

Target positions presented to the subject and the Cursor Positions

Electrode placement example: Right Frontal Lobe

The Question

Can ECoG data be used to decode cursor position controlled by a participant?

Variation of the X-position of the cursor and the target with time

Methodology

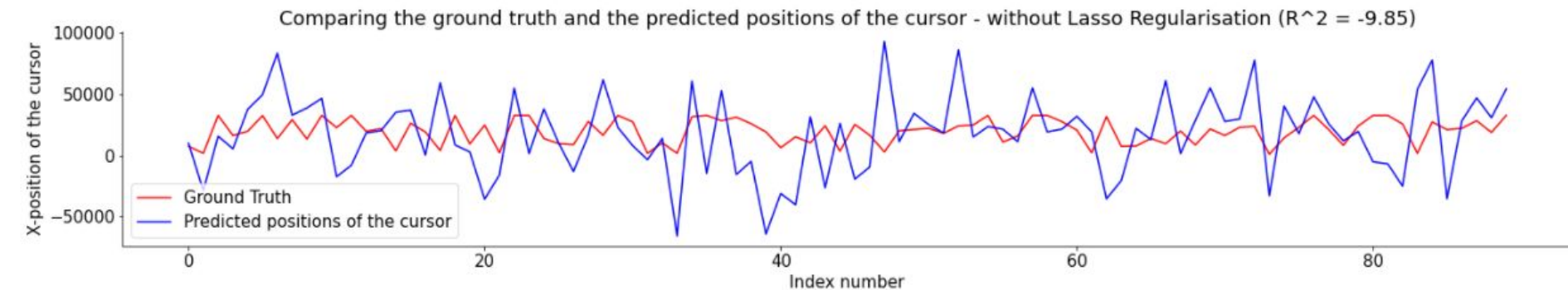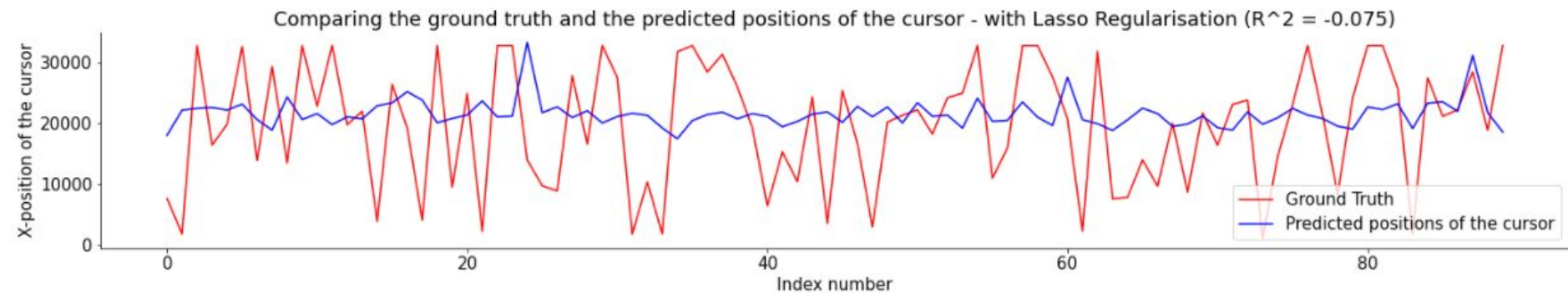| Feature Extraction from ECoG data	Feature Extraction from the cursor data	Linear Regression Model
Spectral analysis of the voltage signal from all the channels in time windows of 300 ms was done. The average power of the frequency components were then calculated.	Extract the X-position of the cursor at each of the time points	Fit a Linear regression model with Lasso Regularisation to extract speed data from the neural data. Also tried fitting a Linear regression model without Lasso regularisation.

Result

Comparing the ground truth and the predicted positions of the cursor - with Lasso Regularisation (R^2 = -0.075)

Comparing the ground truth and the predicted positions of the cursor - without Lasso Regularisation (R^2 = -9.85)

Conclusion & Future Work

- Linear Models are not great models to predict X-position of the cursor.
- One might need to use Autoregressive methods over a spectral analysis to extract better features from the ECoG data.
- One could use raw signals as features to predict the X-position of the cursor.
- One needs to try fitting models of higher complexity to the data.
- Negative results of high correlation between features and predictions in the Spearman and Kendall's test show that the space of nonlinear models that can be fit to the data is lesser than before.
- One could also perform a control study between seizure and non seizure patients to see if this affects the results in any way.
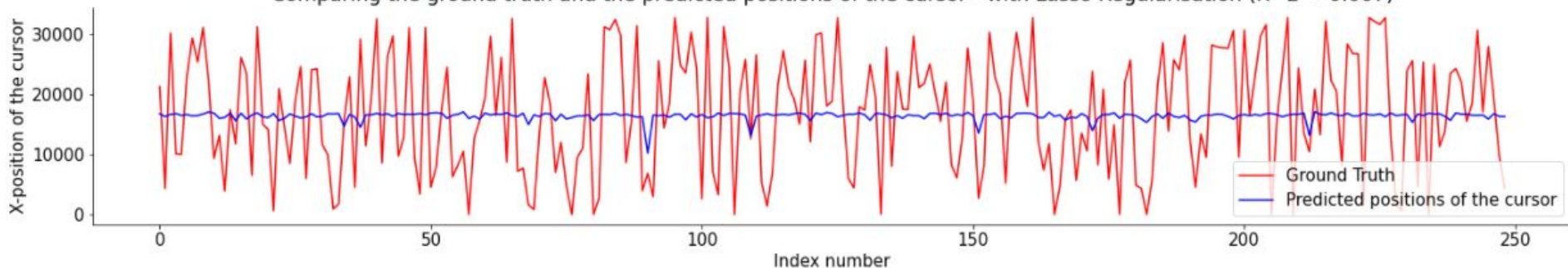- Experimental paradigms with humans need to made simpler.

Acknowledgement

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- Our Project TA Daniel Finol for helping us in the implementation of the project.
- Neuromatch Academy for giving us this opportunity to work with the ECoG dataset.
- You, the audience for attending this presentation.

Results from other Subjects

Comparing the ground truth and the predicted positions of the cursor - with Lasso Regularisation ($R^2 = 0.007$)

Comparing the ground truth and the predicted positions of the cursor - with Lasso Regularisation ($R^2 = -0.249$)