CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

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Project Number

S1525

Project Title

A Novel Approach to Seizure Prediction Using Deep Learning

Abstract

Objectives/Goals

Epilepsy is a neurological disorder affecting more than 65 million people world wide. A seizure prediction system can greatly help epileptic patients to avoid potentially dangerous activities or to timely administer medications.

In this project, we propose the use of deep learning methods such as Recurrent Convolutional Neural Networks (R-CNN) to differentiate between the preictal periods, which signal the imminent onset of a seizure, and the interictal periods of epileptic patients based on their intracranial electroencephalograms (iEEG) data.

Methods/Materials

Using the iEEG-recorded brain data on five canines and two human patients from the American Epilepsy Society Seizure Prediction Challenge 2014, we first created an image-based representation of the multi-channel iEEG signals. Then a recurrent convolutional neural network was trained to capture the spectral, temporal, and spatial patterns in iEEG recordings to predict whether or not the image belongs to the preictal class. In order to find the optimal network structure and parameters, we used the training data to experiment with different network configurations and parameters on Linux/MacOS machines with GPUs, using open source deep learning software packages such as Theano and Lasagne. Cross validation on prediction accuracy was used to evaluate our model's effectiveness.

Results

Our experiments showed that we can predict seizure with 88% accuracy on data from the dogs, and 72.5% accuracy on data from the human patients. This demonstrates that recurrent convolutional neural networks can be effective in seizure prediction.

Conclusions/Discussion

Recurrent convolutional neural networks can be utilized to predict seizure using iEEG data, thus helping epileptic patients live a better and safer life.

Seizure prediction is still an active area of research. Compared to most previous machine learning approaches, ours avoids manually crafting learning features. To our knowledge, there has been no published work that uses a recurrent convolutional neural network in seizure prediction (vs. detection).

Summary Statement

Using a deep recurrent convolutional neural network, we successfully predicted seizure with 88% accuracy on dogs and 72.5% on human patients.

Help Received

We thank Dr. Casso from The Harker School for being our faculty sponsor, and The Harker School for general support. We got our idea from two papers by the following two groups of researchers:1. Thodorof, Pineau, and Lim; 2. Bashivan, Rish, Yeasin, and Codella.