Decoding Brain Waves: Machine Learning for Epilepsy Detection via EEG Scans

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Introduction

Electroencephalogram (EEG) scans are utilized as a primary diagnostic tool for epilepsy, a neurological condition defined by recurring and severe seizures. Recent research has explored machine learning's ability to analyze EEG, improving epilepsy detection and misdiagnosis rates, where traditional radiologic findings are reported as half potentially inaccurate.
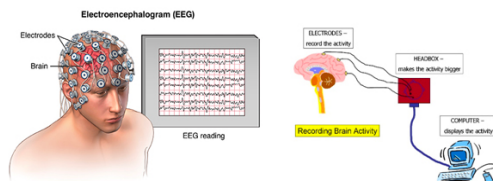

Objectives

- Analyze publication trends regarding machine learning, epilepsy detection, and EEG scans.
- Assess the effectiveness/accuracy of machine learning to analyze EEG scans for epilepsy diagnosis.
- Provide insight into how traditional radiologic interpretation can be improved through machine learning, decreasing misdiagnosis rates.

Methods

Using a bibliometric analysis method, the Web of Science database was searched using the keywords "machine learning," "epilepsy detection," and "EEG scans," which yielded 604 publications. The top 100 most-cited articles were selected for analysis. 504 publications were found to be non-eligible studies. Analysis was done using the R programming language and Bibliometrics software.
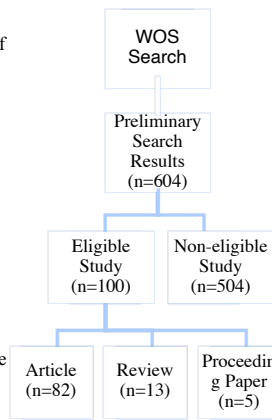

Results/Discussion

The top 100 most-cited publications were classified into 82 articles, 13 reviews, and 5 proceeding papers. From 2012-2022, 90 of these articles were relevant to EEG scans, with first-world countries producing the most scientific research. Hojjat Adeli (Adeli, H) was the most frequently cited senior author.

Figure 2: Senior Authors With Two or More Papers of the 100-Most Cited Articles on Epilepsy Detection, EEG Scans, and Machine Learning
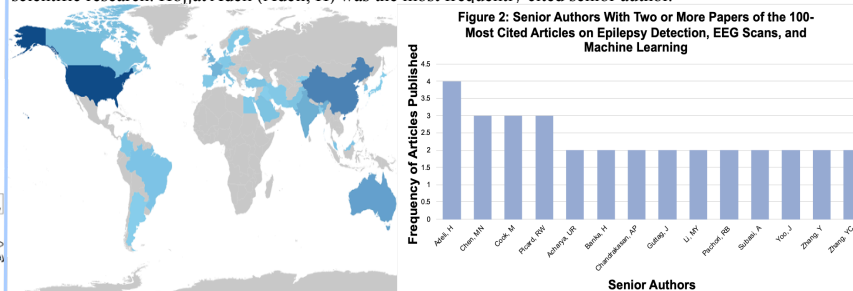
"EEG" was the most popular keyword used by the top 100 most-cited publications, emphasizing EEG's capability to detect epilepsy effectively. Furthermore, the most common words in these publications included "classification," "system," "epilepsy," and "approximate entropy," demonstrating researchers' utilization of machine learning with extracted entropies to detect epilepsy.

Figure 5: Topics in Top-100 Cited Articles
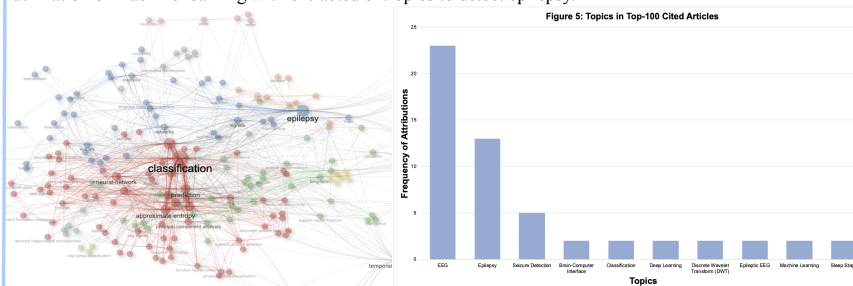
The USA is the top leader in this research with a staggering 1801 primary citations, followed by China at 1101 primary citations. Enormous research is occurring in the USA in the field of epilepsy detection and automation diagnosis with EEG scans.


Most Cited Countries
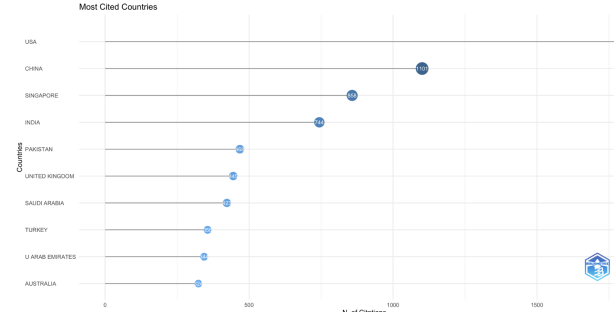
Conclusion

Machine learning shows promise in interpreting EEG scans for epilepsy detection and classification.

1. The majority of articles were from first-world countries. Investment is needed in second/third-world countries/underserved populations to represent the population better.
2. EEGs are an effective diagnosis tool for epilepsy. 32% of publications showed that machine learning significantly decreased the rate of epilepsy misdiagnosis.
3. The USA is a leader in this scholarly field and is a resource for most publications.
4. EEG scan analysis using machine learning shows promise in classifying different kinds of epilepsy. However, further research is required to understand this relationship better.

Overall, this study contributes to the utilization of machine learning in analyzing EEG scans to detect epilepsy.
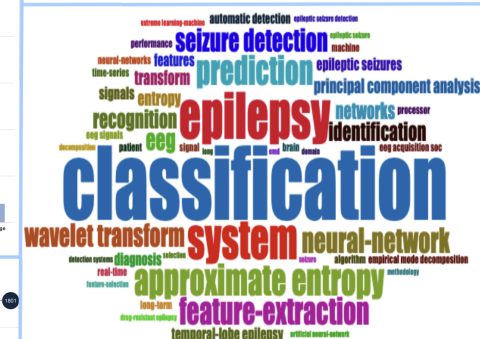
References

- Web of Science Database
- R-Studio Application
- Biblioshiny
- National Institutes of Health