

## ALZHEIMER'S DISEASE SEVERITY ASSESSMENT FROM EEG

K. D. Tzimourta\*, N. Giannakeas\*\*, A. T. Tzallas\*\*, T. Afrantou\*\*\*, P. Ioannidis\*\*\*,  
N. Grigoriadis\*\*\* D. G. Tsalikakis\*\*\*\* and M. G. Tsipouras\*\*\*\*

\* Department of Medical Physics, University of Ioannina, Ioannina, Greece.

\*\*Department of Informatics and Telecommunications, School of Informatics and Telecommunications,  
University of Ioannina, Arta, Greece;

\*\*\* 2nd Department of Neurology, AHEPA University Hospital, Thessaloniki, Greece;

\*\*\*\* Department of Informatics and Telecommunications Engineering, University of Western Macedonia, Kozani, Greece;  
ktzimourta@cc.uoi.gr, afrantou@gmail.com, ioannidispanosgr@yahoo.gr, grigoria@med.auth.gr,  
giannakeas@uoi.gr, tzallas@uoi.gr, dtsalikakis@uowm.gr, mtsipouras@uowm.gr

### Introduction

Alzheimer's disease (AD) is neurodegenerative disease characterized by loss of memory, cognitive decline and behavioral issues. The Mini-Mental State Examination (MMSE) is a 30-point cognitive questionnaire employed to assess the severity of AD, with lower score indicating more severe cognitive decline. Research studies [1,2] have extracted quantitative features from EEG signals showing that there is a decrease of high-frequency EEG band power and an increase of the power of lower bands mainly at the occipito-parietal and temporal regions [3]. In this work, a set of features are extracted from AD patients and healthy age-matched participants to investigate their correlation with MMSE score.

### Materials and Method

In this study, 14 AD patients and 10 healthy subjects from the 2nd Department of Neurology of AHEPA University Hospital participated. The MMSE score ranged from 14-23 and recordings of approximately 13 minutes were acquired during routine EEG examination. Statistical features namely Mean, Variance, Standard Deviation (STD), Skewness, Kurtosis and Interquartile Range (IQR) along with spectral features, i.e. Relative band power (of  $\delta, \theta, \alpha, \beta$ , and  $\gamma$  rhythm), Shannon entropy (ShanEn) and Multiscale Entropy (MSE) are calculated from 12-sec EEG segments. Then, Multiple Regression Analysis is conducted.

### Results

The best square value of Multiple Correlation Coefficient ( $R^2$ ), is obtained for O2(0.417), followed by T5(0.390), T6(0.356), T3(0.317), P3(0.313), O1(0.312), C4(0.301), Pz(0.269), C3(0.265), P4(0.272), F7(0.270), T4(0.267), Cz(0.266), F8(0.240), F4(0.213), Fz(0.191), F3(0.190), Fp1(0.147), Fp2 (0.103). Fig.1 shows the contribution of each electrode site in the prediction of MMSE score. According to the results, relative band power of all rhythms, MSE, ShanEn, Mean, and Kurtosis are the predictors that were participated in most of the regression models.

### Discussion

Channels from occipital, parietal and temporal regions showed the highest association with MMSE score variation and spectral features were the best predictors, which is consistent with literature review. Statistical features (i.e. Mean and Kurtosis) were also good predictors. A set of

simple linear and non-linear features is highly associated to MMSE score in occipital region (O2), which is highly affected in AD.

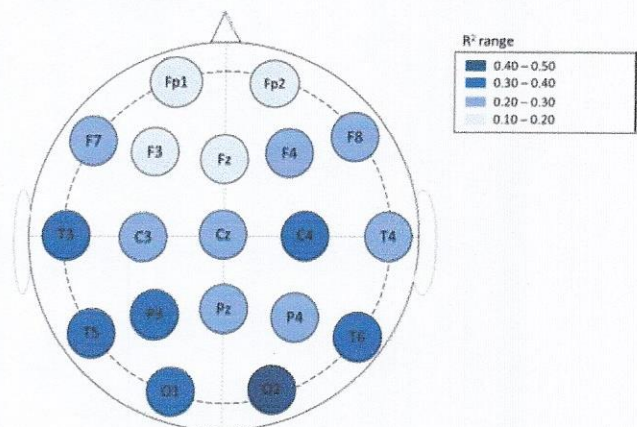


Figure 1. Depiction of MMSE correlation with each EEG electrode site according to  $R^2$ .

### References

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### Keywords:

Alzheimer's Disease, EEG, MMSE, regression

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