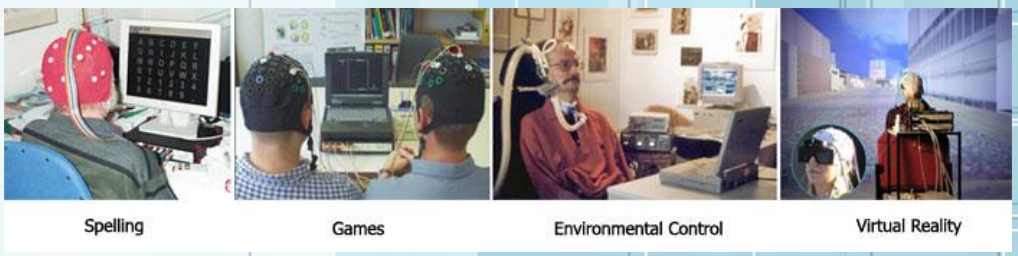
There are no rules here -- we're trying to accomplish something.

- Thomas A. Edison

Observe Features on ABO Blood Types From EEG data



Chung-Yeon Lee, Seongah Chin

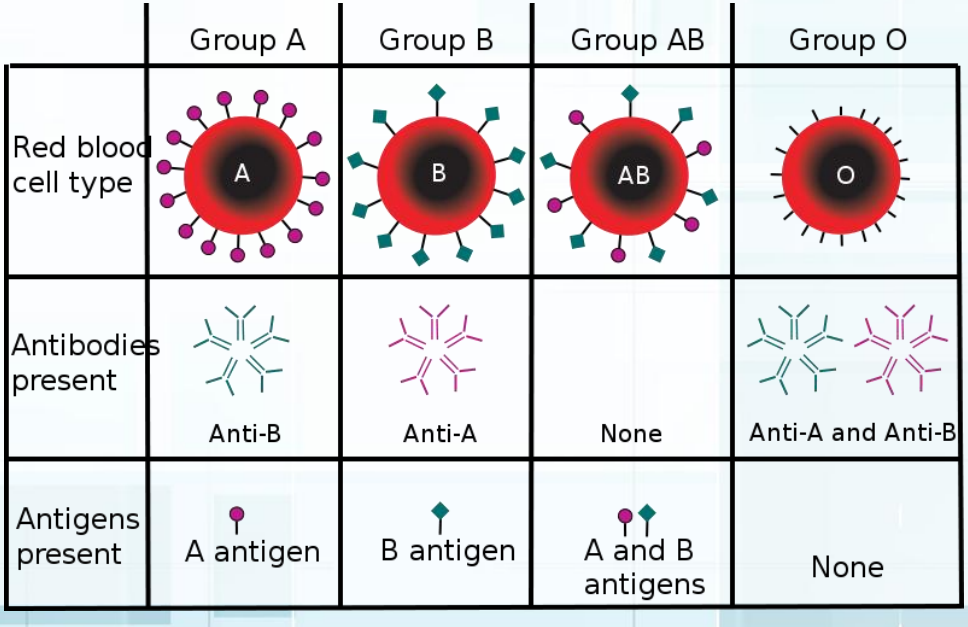
Multimedia Engineering Department, Sungkyul University

Outline

- **Introduction**
  - ABO Blood Type
  - Electroencephalogram
- **Methods**
  - EEG Acquisition Protocol
  - EEG Data Analyses
- **Results**
  - Powerspectral Density
  - ANOVA
  - SVM Classification
- **Conclusion**

Introduction

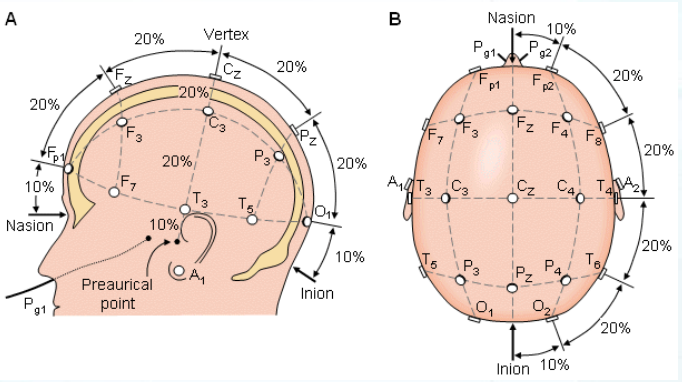
- **ABO Blood type**
  - A blood type is a classification of blood based on the presence of inherited antigenic substances on the surface of red blood cells.
  - The ABO system is the most important blood-group system in human-blood transfusion.



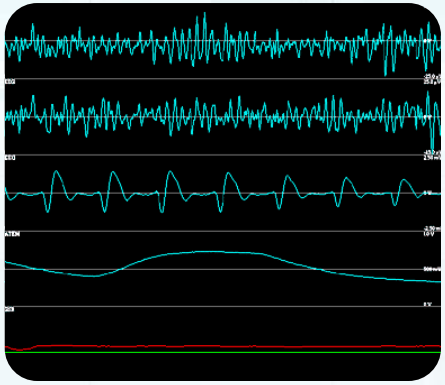
Introduction

- **Electroencephalogram (EEG)**
  - EEG is an electrophysiological brain signals as can be used as meaningful data to measure genuine human properties.
  - The electrical activity captured by some electrodes is used to carry out feature extraction and pattern classification.

Synapse illustration



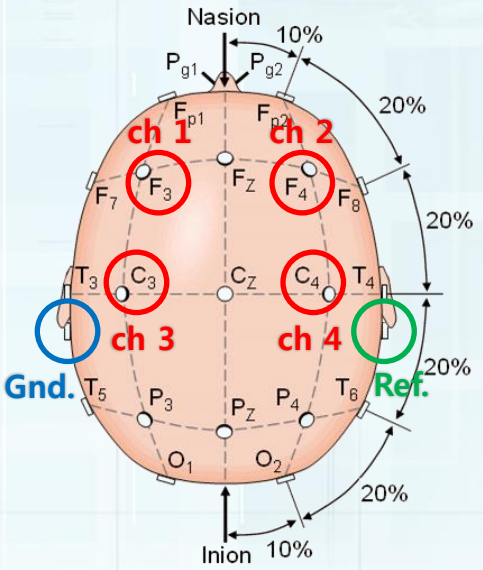
The international 10-20 system



Brain signals

Methods

- **EEG Acquisition Protocol**
  - EEG were sampled at 256Hz for 120sec using QEEG-4 (Neuromedi Inc.) while 25 Subjects were calmly watching a blank screen.
    - A type: 3 men and 3 women
    - B type: 2 men and 1 women
    - O type: 4 men and 5 women
    - AB type: 4 men and 3 women



  - Ag/AgCl electrodes were placed on F3, F4, C3 & C4 (according to the 10-20 system).
  - Ground and reference electrodes were placed on each mastoid process.

Methods

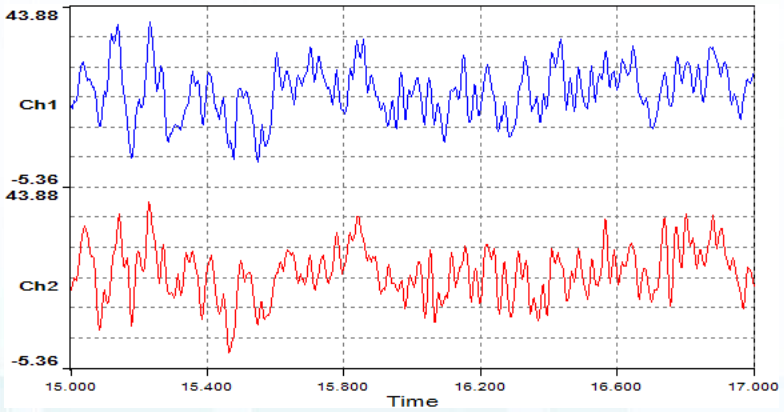
- **EEG Data Analysis - Preprocessing**
  - The EEG data were segmented into non-overlapping epochs (512 points).
  - Then, epochs contaminated by ocular or body movements were manually excluded while reviewing the recorded video data using MATLAB.
  - To reduce the computational complexity and deviation of individual differences due to their fundamental frequency rhythms, normalization was conducted so that the range became 0–1.

$$E_k = \frac{X_k - min(X_k)}{max(X_k) - min(X_k)},$$

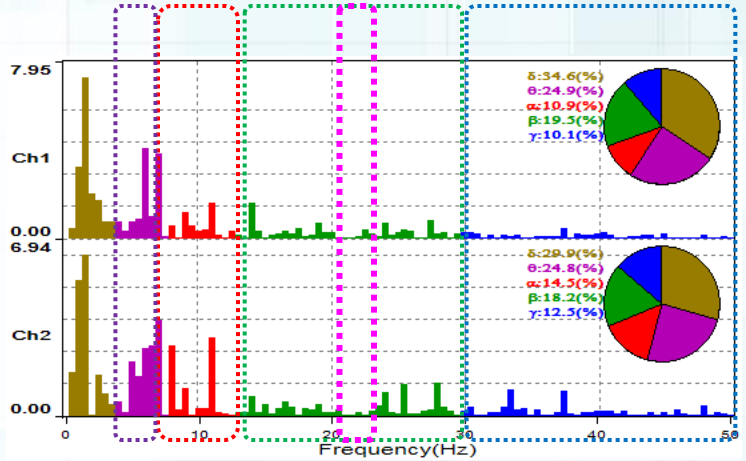
Methods

- **EEG Data Analysis - Powerspectral Density**
  - The absolute values of θ (4-7.9Hz), α (8-12.9Hz), β (13-29.9Hz), γ (30-50.0Hz) and β_m (21-23Hz) were derived from power-spectral density (PSD) of each EEG signal.

$$Y_k = \sum_{n=0}^{N-1} X_n \, exp(-i \cdot 2\pi \cdot N^{-1} \cdot nk),$$



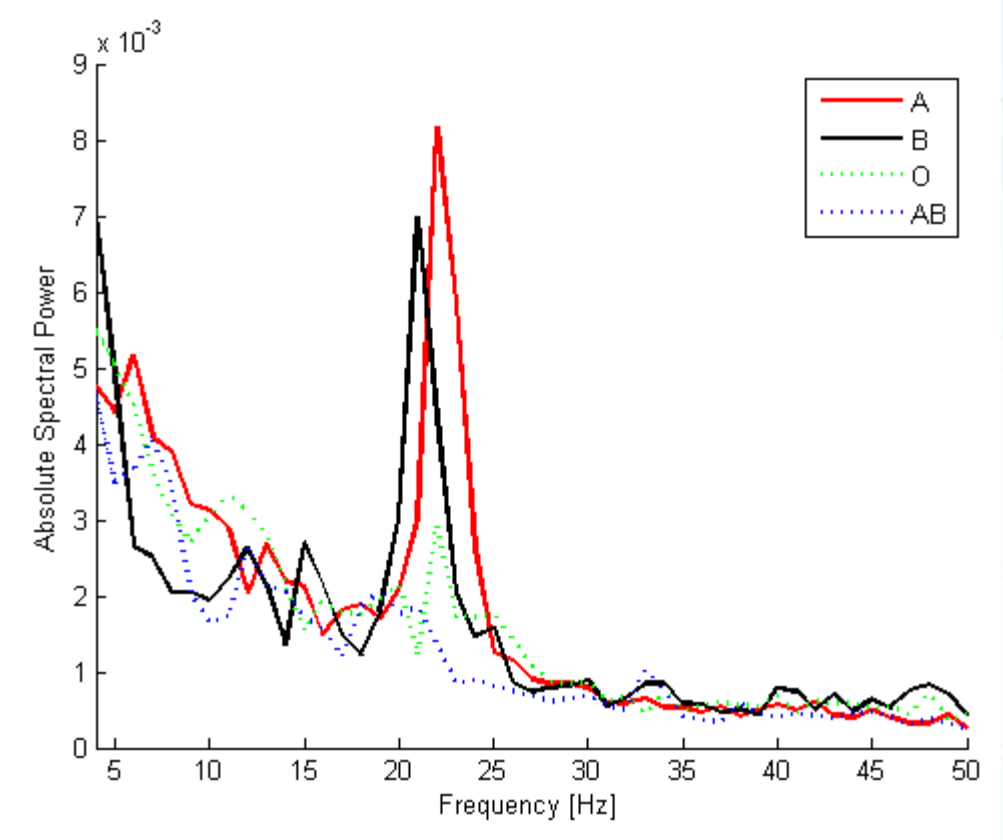
Raw EEG signals



PSDs (red: α, green: β)

Results

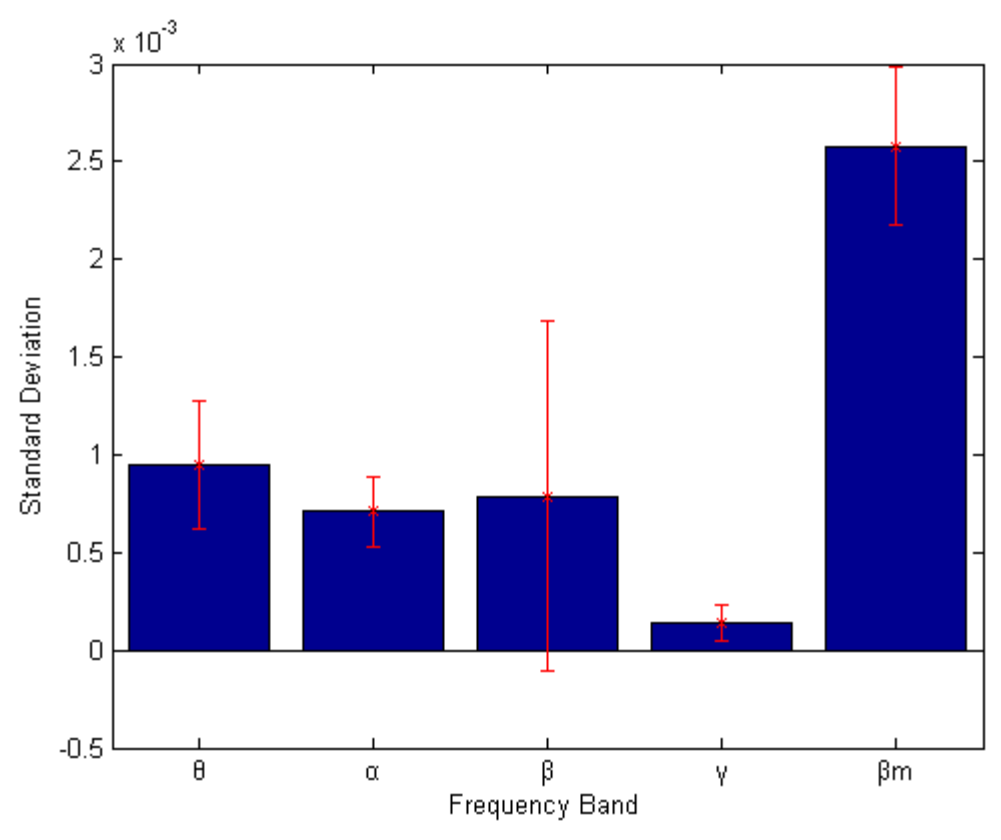
- **Power-spectral Densities**



- EEG activation in subjects with blood type B was lower than others in the theta band.
- A & O types exhibited higher EEG activation than B & AB in the alpha band.
- A & B types showed distinguishably higher EEG activation than O & AB in the $beta_m$ band.

Results

- **Power-spectral Densities**



- EEG activation in subjects with blood type B was lower than others in the theta band.
- A & O types exhibited higher EEG activation than B & AB in the alpha band.
- A & B types showed distinguishably higher EEG activation than O & AB in the $beta_m$ band.

Results

- **ANOVA**
  - A 1-factorial analysis of variance (ANOVA) was performed with all samples of the absolute power spectra.
  - significant effects of blood type were observed in all channels of the alpha and beta bands and in some channels in the theta and gamma bands.

Freq.	F3		F4		C3		C4	
	F	Sig.	F	Sig.	F	Sig.	F	Sig.
θ	1.668	0.179	4.039	**0.009**	0.642	0.590	3.660	**0.015**
α	4.441	**0.006**	5.257	**0.002**	5.110	**0.003**	3.848	**0.012**
β	4.596	**0.005**	5.110	**0.003**	3.335	**0.023**	3.792	**0.013**
γ	5.114	**0.003**	1.921	0.131	5.026	**0.003**	0.209	0.890
β_m	1.414	0.233	1.582	0.199	1.582	0.199	1.023	0.386

[a] Only comparisons significant after Bonferroni-correction (Sig<0.05) are indicated in bold.

Results

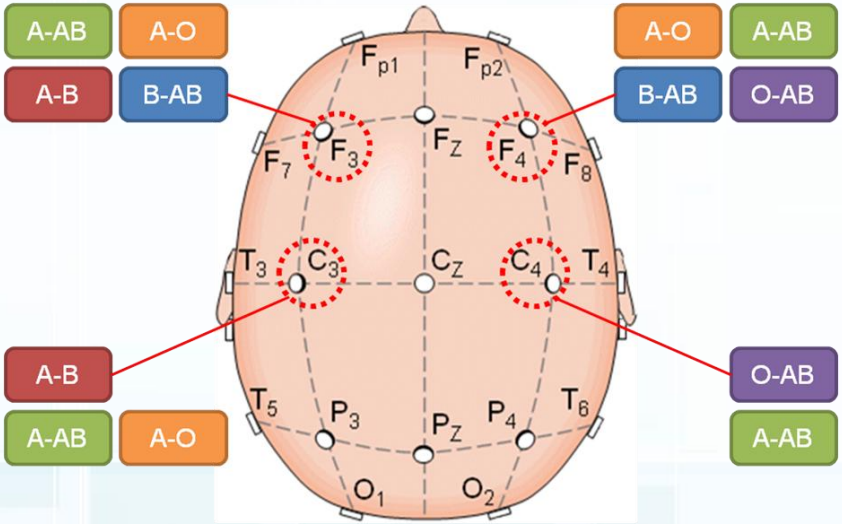
- **ANOVA**
  - According to these results, we chose the F3 (Sig: 0.003) and C3 (Sig: 0.003) channels of the gamma band, the F4 (Sig: 0.009) and C4 (Sig: 0.015) channels of the theta band, and all channels F3, F4, C3 and C4 of the alpha and beta band as the features to be used for distinguishing blood types.

Freq.	F3		F4		C3		C4	
	F	Sig.	F	Sig.	F	Sig.	F	Sig.
θ	1.668	0.179	4.039	**0.009**	0.642	0.590	3.660	**0.015**
α	4.441	**0.006**	5.257	**0.002**	5.110	**0.003**	3.848	**0.012**
β	4.596	**0.005**	5.110	**0.003**	3.335	**0.023**	3.792	**0.013**
γ	5.114	**0.003**	1.921	0.131	5.026	**0.003**	0.209	0.890
β_m	1.414	0.233	1.582	0.199	1.582	0.199	1.023	0.386

[a] Only comparisons significant after Bonferroni-correction (Sig<0.05) are indicated in bold.

Results

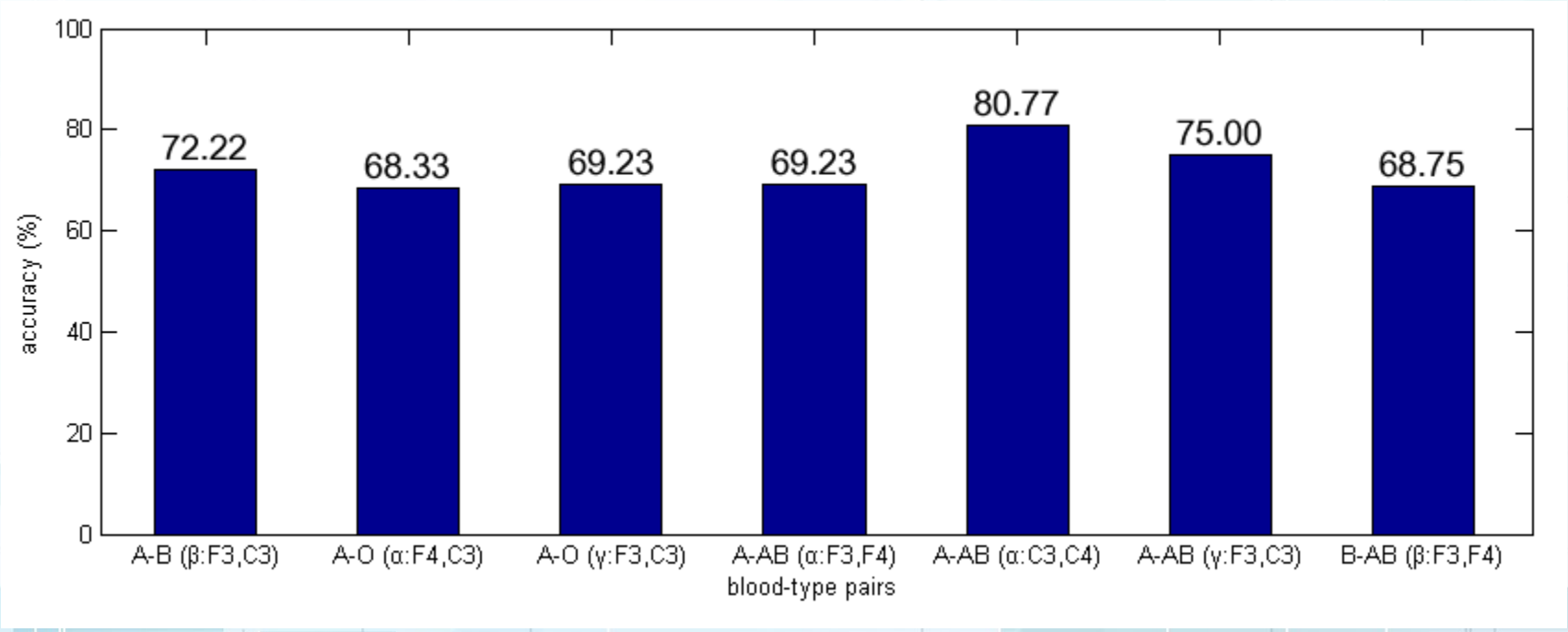
- **ANOVA**
  - Post hoc analysis using Bonferroni correction were carried to figure out the blood type which makes dominant influence of the differences.
  - For instance, the pairs that show significant distinctions on F3 are A-AB, A-O, A-B, B-AB.



pair	freq.	mean diff.	std. err.	Sig.
A-B	β	-0.006282	0.002181	0.029934
A-O	α, γ	0.004248	0.002715	0.023036
A-AB	α, γ, θ	0.009475	0.003343	0.005881
B-O	-	-	-	-
B-AB	β	0.006963	0.002122	0.008657
O-AB	β, θ	0.005008	0.001613	0.017316

Results

- **SVM Classification**
  - SVM classification method was employed in order to demonstrate the results of the statistical analysis.
  - As we had only a small number of samples available for each blood type, 10-fold cross-validation was used to test the classification effectively.



Conclusion

- ABO Blood type–related differences were examined using EEG signals measured from four scalp electrodes.
- The results of power spectrum analysis, ANOVA, and SVM classification showed significant distinguishable features in EEG signals among ABO blood types.
- In future work, more EEG signals using multiple electrodes to identify the relationships between EEG and blood type will be considered.

Q & A

"No brain, No gain"

Acknowledgement

This research was partially supported by the Korean Science and Engineering Foundation Grant funded by Korean Government (KOSEF-2009-0072325)