1. General Information

Alpha-numeric codification: BING 8995

Course Title: **Brain Machine (Computer) Interfaces**

Number of credits: 3

Contact Period: 3 hours of lecture per week

Required in BING

Course coordinator's name

2. Course Description

This course introduces a technology: the interfacing of the human brain to electronic circuitry. Applying engineering to neuroscience including neural tissue engineering, models of neural function, and neural interface technology. The course will emphasize brain-machine interfaces and deep-brain stimulation (such as for treatment of Parkinson`s disease). Discuss the components of a brain-machine interface system, including invasive and non-invasive neural interfaces and prosthetics, the clinical and practical applications for a variety of users, currently in development or produced commercially.

3. Pre-Requisites

Consent of BING Chair

4. Course Objectives

Students will investigate the benefits and limitations of commonly used signal processing and machine learning methods (which include independent component analysis, Bayesian inference, dimensionality reduction, and information theoretic approaches), and then apply these methods on real neural data. The aim is to equip students with the foundational knowledge and skills to pursue opportunities in the emerging field of brain-machine interfacing.

By the end of the course, students should be able to
- Identify and analyze various brain signals for brain-machine interfaces and build a simple BMI.

5. Instructional Strategies

Conference, Discussion

6. Minimum Required Resources Available:

Computer facilities with access to MATLAB, BCI lab equipment, Brainwave server datasets.

7. Course time frame and thematic outline

Outline	Contact Hours
Basics of BMI systems	4
Methods for brain signal acquisition	5
Signal Acquisition for BMI Design	2

Spike BMI controllers	2
Preprocessing methods in BMI Design (Filtering)	4
Source localization for BCI	2
Dimensionality reduction, feature extraction, feature selection	5
Machine learning for BMI design	3
Deep brain stimulation	2
Brain plasticity and neural rehabilitation	2
BMI applications: movement, neurological and psychiatric disorders	3
Visual Evoked potentials of EEG (SSVEP BCI)	2
P300 BCI	2
ERS/ERD BCI	2
Motor Imagery BCI	2
Functional Near Infrared Spectroscopy (fNIRS) BMI	2
Ethics of BMIs	1

8. Grading system

Quantifiable

9. Evaluation Strategies

Partial Exam (2)	15%	September 25, 2018, 12:00 to 1:30 pm in CID 221
Midterm project (1)	15%	
Final Project	30%	
Paper Discussions	15%	
Final project presentation	10%	

10. Bibliography

References

1. Brain machine interface engineering, J. C. Sanchez, J. C. Principe, Synthesis lectures on biomedical engineering, Morgan and Claypool publishers, 2007.
2. Brain computer interfacing: an introduction, R. P. N. Rao, Cambridge, 2013.
3. Brain-computer interfaces, current trends and applications, A. E. Hassanien, A. T. Azar, Springer 2015.
4. Brain computer interface research: a state-of-the-art summary 5 & 6, Springer, 2017.