Xi'An Jiaotong University Jointed Program
Physiologic Signal Processing for Human Computer Interface
2017 (Tentative)

General information Lecture Time	6 Weeks: July 1- Aug 12, 2017 **(3 Credits)**
Room	Classroom and Lab in Xian Jiaotong University, China
Instructor	Chaoyang Chen, MD, Associate Professor, Research
Office	Wayne State University, Bioengineering, #2119
Phone	313-577-1015
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Teaching Assistant	TBD
Tentative Office Hours:	Will be defined according to students and instructors schedule.

Course Title: **Physiology Signal Processing for Human Computer Interface**
Credit: 3
Teaching Hours: Lecture hours 32, Experimental Hours: 48

Introduction:
This course introduces the basic knowledge of human electrophysiology and joint kinesiology and bio-electrical signals processing including EMG and EEG signals recording, digital processing, and computer coding for machine control. There are several laboratory projects for students to select, including EEG controlled wheelchair movements, EMG controlled arm movement, image processing based - robot motion control, and EEG-based brain spelling projects. The aim is to let students understand ergonomics-related human physiology, physiological signal measurements and acquisition, and digital signal processing for robot/machine control via human computer interface. The laboratory skill training focuses on performing experiments using electromyography (EMG), electroencephalography (EEG), and computer programming for medical robot/machine control. Students will learn how to write academic reports eligible to be publish in science citation indexed (SCI) journals. The course will introduce methodologies on experimental designs, literature review, basic biomedical statistical analysis, reference citations, and skills on selecting journal for publications.

Course Objectives
1. To acquire a core scientific knowledge about human neurophysiology and joint kinesiology
2. To be aware of current clinical rehabilitation and challenges
3. To understand current research on intuitive medical robot controls.

Topics covered:
1. **Nerve system, neurophysiology, human joint kinesiology:**
   - Nerve signal generation and conduction
   - Brain wave (electroencephalography, EEG) and muscle bioelectricity (electromyography, EMG) recording, signal processing, and analysis
   - Human joint anatomy and kinesiology
2. **Clinical rehabilitation modalities**

- Clinical disorders and dysfunction: stroke, spinal cord injury, Parkinson's disease, etc.
- Conventional rehabilitation methodologies, robotic, current robotic rehabilitation & Engineering, EMG-controlled robotics, EEG-controlled robotics.

3. Artificial intelligent (AI) and machine learning

- EEG & EMG signal acquisition system
- Bio-electrical signal processing
- AI circuit board, microcontroller, coding algorithms.

Teaching modalities:

- Didactic lectures
- Laboratory experimental research
- Experiment reports

Evaluation:

Oral presentation and writing report will be used for evaluation. There is ***not*** an exam for this course.

Textbook: None.

Grading: Final grade will be based on lab work, group presentation, and writing report. The final grade is determined from total points.

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Policies:

Attendance: Attendance will generally be taken at the beginning of each class. A student's attendance record will be considered in the assessment of his/her commitment to learning the course material.

Homework and Lab Assignments: Homework will be reviewed on its due date and will therefore not be accepted late. Specific reporting details will be given at the time of lab assignments. Lab assignments turned in late will be docked 5% per day. No assignments will be accepted after 14 days.

Assigned Reading: It is always very helpful if you read the appropriate notes *before* the lecture. Just skimming the material will allow you to follow the lectures much more easily and will help your understanding.

Makeup Policy: If you must miss an exam, lab, or class due to exceptional circumstances, you must inform me in advance. An exceptional circumstance would include documented medical reasons or a legitimate emergency.

Academic Integrity: It is expected that all work submitted by students on homework, tests, programs, and projects is the product of the student's (or team's) own efforts. Cheating on assignments will result in a grade of zero on that assignment for all parties involved. Cheating on exams will carry the maximum penalty as prescribed by the student handbook. Students are expected to conform to the Wayne State University Honor Code. Consult the following web site and associated links for information on academic integrity: http://doso.wayne.edu/academic-integrity.html. Any violations of academic integrity will be recorded with the department and result in grade-related penalties up to an including course grade F. Serious violations, and anything involving an exam, will be reported to the Graduate Program Committee, Chair of the Biomedical Engineering Department, and Dean of Students Office for further action up to and including expulsion from the University and transcript notations.

Accommodations and Education Accessibility Services: If you feel you may need special accommodations due to a disability or other life circumstances, please make an appointment to see me or visit me during my office hours. If you have a documented disability that requires accommodations, you will need to start with Student Disability Services for coordination of your academic accommodations. This office is located at 1600 David Adamany Undergraduate Library. SDS telephone number is 313-577-1851 or 313-577-3365 (TTY: telecommunication device for the deaf; phone for hearing impaired students only). Once you have your accommodations in place, I will be glad to meet with you privately during my office hours to discuss your special needs. The Student Disability Services' mission is to assist the university in creating an accessible community where students with disabilities have an equal opportunity to fully participate in their educational experience at Wayne State University. (http://studentdisability.wayne.edu/)

C Chen Feb-16-2017

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Physiologic Signal Processing for Human Computer Interface

DATE		**July 4**		**July 6**	
Week1	*Mon*	*Tuesday*	*Wednesday*	*Thursday*	*Friday*
9:00-10:00	Touring XJTU and labs	Orientation Introduction of research projects for student's selection	Lab Experiments	Muscle structure	Lab Experiments
10:00-11:00	Touring XJTU and labs	Introduction of physiology data acquisition system and AcqKnowledge 4.0 software	Lab Experiments	Muscle physiology function And EMG	Lab Experiments
11:00-12:00	Touring XJTU and labs	Getting familiar with laboratory and equipment Selection of lab project	Lab Experiments	EMG recording using Biopac MP-36	Lab Experiments
12-1pm Lunch					
1:00-2:00					
2:00-3:00					

DATE		**July 11**		**July 13**	
Week2	*Mon*	*Tuesday*	*Wedn*	*Thursday*	*Friday*
9:00-10:00	Lab Experiments	Electromyography: EMG signal processing and analysis, derive RMS analysis, integrated EMG, EMG frequency and power analysis.	Lab Experiments	EMG signal processing for exoskeleton/prosthesis control	Lab Experiments
10:00-11:00	Lab Experiments	EMG output from Biopac for Arduino	Lab Experiments	Introduction to Arduino	Lab Experiments
11:00-12:00	Lab Experiments	EMG and related biomechanical study	Lab Experiments	Using Arduino micro-controller for EMG-controlled stepper motor motions	Lab Experiments
12-1pm Lunch					

DATE		**July 18**		**July 20**	
Week3	*Mon*	*Tuesday*	*Wedn*	*Thursday*	*Friday*
9:00-10:00	Lab Experiments	Introduction basic brain structure and function	Lab Experiments	Event-related spectral perturbation (ERSP) bands analysis.	Lab Experiments
10:00-11:00	Lab Experiments	EEG signal processing and analysis: power spectral density (PSD) and fast Fourier transform (FFT) analysis, delta band power, alpha band root mean square (RMS), EEG frequency analysis, and derive EEG frequency	Lab Experiments	EEG signal processing for exoskeleton/prosthesis control.	Lab Experiments
11:00-12:00	Lab Experiments	Steady status visual evoked potential (SSVEP),	Lab Experiments	Peripheral nerve structure and function signal transmission	Lab Experiments
12-1pm Lunch					

DATE		**July 25**		**July 27**	
Week4	*Mon*	*Tuesday*	*Wedn*	*Thursday*	*Friday*
9:00-10:00	Lab Experiments	Event-related spectral perturbation (ERSP) bands analysis.	Lab Experiments	Neurophysiology of eye	Lab Experiments
10:00-11:00	Lab Experiments	EEG signal processing for exoskeleton/prosthesis control.	Lab Experiments	EOG measures and data analysis	Lab Experiments
11:00-12:00	Lab Experiments	Peripheral nerve structure and function signal transmission	Lab Experiments	EOG measurement by Biopac-MP6	Lab Experiments
12-1pm Lunch					

DATE		**Aug 1**		**Aug 3**	
Week5	*Mon*	*Tuesday*	*Wedne*	*Thursday*	*Friday*
9:00-10:30	Lab Experiments	Autonomic system	Lab Experiments	Waveform recognition and template matching technique	Lab Experiments
10:00-11:00	Lab Experiments	EDA measurement and analysis: Galvanic skin response and polygraph introduces derive phasic EDA and from tonic and event-related EDA analysis	Lab Experiments	Electrophysiology of the Heart	Lab Experiments
11:00-12:00	Lab Experiments	EDA measure using Biopac-Mp36	Lab Experiments	ECG measurement and HRV analysis	Lab Experiments
12-1pm Lunch					
1:00-2:00					

DATE		**Aug 8**		**Aug 10**	
Week6	*Mon*	*Tuesday*	*Wednes*	*Thursday*	*Friday*
9:00-10:00	Lab Experiments	Statistical Method I: T test, ANOVA, Univariate	Lab Experiments	Student report	Lab Experiments
10:00-11:00	Lab Experiments	Statistical Method II: Chi-square, Mann Whitney, Regression	Lab Experiments	Student report	Lab Experiments
11:00-12:00	Lab Experiments	Clinical rehabilitation	Lab Experiments	Class review	Lab Experiments
12-1pm Lunch					

Lecturer: Chaoyang Chen, Associate Professor, Research. Department of Biomedical Engineering, Department of Orthopedic Surgery, Wayne State University, Detroit, Michigan, 48201, USA. Phone: 313 577 1015, email: cchen@wayne.edu