BME 774 Principles of Neurorehabilitation
Spring 2013
Course Syllabus

INSTRUCTOR
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CLASS HOURS
Monday 2:30am - 5:25pm Fenster 636

OFFICE HOURS (FENSTER 616 OR 665)
Monday 1:00pm– 2:30pm and by appointment.

READING MATERIAL:
Printouts and Powerpoint presentations will be posted on http://moodle.njit.edu and will be distributed in the classroom and by email.

COURSE OUTLINE
Students are encouraged to take BME 674 Principles of Neuromuscular Engineering before taking this class. This will be a research-focused course that will provide in-depth review of current studies in neurorehabilitation with a focus on electroencephalography.

Outline of EEG Studies
Week1: Introduction to neurorehabilitation

- What is neurorehabilitation
- History
- Trends in neurorehabilitation research
- Survey of motor neurophysiology
- Populations of study
- Paper topics are assigned

Week 2: Introduction to EEG

- Origin of the EEG signal/Neurophysiology
- How is EEG used clinically
- How is it used in research
- Equipment/technology
- ERP design considerations

Week 3: EEG data collection (All)

*Students will be asked to have selected their papers and bring them to class by week 4 – students will now need to bring their papers to every class

Week 4: Basic EEG Preprocessing

- Filtering
- Artifact removal
- Signal conditioning

- Averaging
- Bring papers - focus will be on preprocessing methods

Week 5: Introduction to EEGlab
- No presentations/EEGlab focus in class

Week 6: ICA analysis and EEG
-Student presentations on ICA for EEG
Week 7: ERP analysis of EEG
-Student presentations of studies using ERP design
Week 8: Frequency analysis of EEG
-Student presentations of studies using ERP design
Week 9: EEG mapping data collection
-No student presentations
-Collection of SSEP and motor responses
Week 10: EEG/EEG coherenece and functional connectivity analysis
-Student presentations
Week 11: EEG for brain mapping
- Data collections
- Student presentations
    - Motor topography: EEG/EMG coherence
    - Sensory topography: Somatosensory evoked potentials

Week 12: Introduction to Brain computer interfaces
- Data collection

Week 13: Brain computer interfaces and rehabilitation

The following topics will be discussed in class:
* Pathophysiology of disability (movement disorders related to cerebral palsy, stroke and Parkinson's disease);
* Advanced therapeutic interventions (constraint-induced therapy, bilateral therapy, pharmacology, mirror therapy, functional electrical stimulation);
* Emerging neurorehabilitation technologies that are intended to encourage neural reorganization and relearning (rehabilitation robotics, virtual reality, transcranial magnetic stimulation, electrical brain stimulation);
* Novel interfaces through chronic implantation in the brain, spinal cord and muscles, including deep brain stimulation, brain-machine interfaces, neuroprosthetics and functional electrical stimulation;
* Methods of assessing outcomes (clinical measures, brain imaging, functional tests).

Students will participate in weekly discussions of assigned articles from scientific journals. Each student will present one paper during the semester. The presentation should include an overview of a paper published in a peer-reviewed journal and stimulating questions for the class to discuss. The course will also include a number of guest speakers. For the final project, students will present the results of the EEG study conducted in class and will write the report.

Grading:
Paper Presentations: 35%, Class Participation: 25%, EEG Project: 40%.

NJIT Honor Code
The NJIT Honor Code will be upheld in this and all courses, and any violation will be brought to the immediate attention of the Dean of Students. The Honor Code can be found at http://www.njit.edu/academics/honorcode.php.