

[Last updated 2/10/2018]

BIOM/ECE 537 Biomedical Signal Processing

Spring 2018

Lectures: MWF, 10AM-10:50AM, Engineering B105

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Office Hours: TBD

Your feedback and input is always welcome! You have the opportunity to help shape this class for future students.

OVERVIEW: An in-depth course on modeling and classification of biosignals (e.g. EEG, ECG, EMG), covering adaptive filtering, wavelets, support vector machines, neural networks, and handling problems with overfitting of noisy data.

PREREQUISITES: MATH340 or ECE311 or STAT303

LEARNING OBJECTIVES: At the end of this course, successful students will be able to:

- Choose an appropriate model for biomedical signals
- Evaluate model fitting results and recognize overfitting
- Classify signals using fitted model parameters and extracted features
- Extract from biomedical signals features that are relevant to a research question or medical diagnosis

REQUIRED TEXTBOOK:

- *Biosignal and Medical Image Processing*, 3rd ed. by J. Semmlow & B. Griffel, CRC Press Taylor & Francis Group, 2014. (Available at CSU bookstore)

OTHER REQUIRED MATERIALS:

- *The Biomedical Engineering Handbook*, 2nd ed. Edited by J. D. Bronzino, CRC Press, 1999. Accessible online <http://www.crcnetbase.com/doi/book/10.1201/9781420049510> from any campus computer through CSU library subscription.
- *The Elements of Statistical Learning*, 2nd ed., by Hastie, Tibshirani, and Friedman. Accessible online through <https://web.stanford.edu/~hastie/ElemStatLearn/>.
- MATLAB software. Available on any ENS lab computer, or remotely through the [ENS Virtual Classroom](#).

Canvas: canvas.colostate.edu will have the syllabus, links, homework, course grades and other postings. It is your responsibility to check the calendar under the Index tab each week for new postings.

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COURSE TOPICS: The planned topics for this course are:

Weeks 1-2	Intro to signal modeling & classification, model complexity, and overfitting.
Weeks 3-4	Autoregressive modeling, spectral estimation, selecting model complexity, inverse problems and regularization
Weeks 5-6	Adaptive filtering, theory, multiple inputs and nonlinear models, applications to ECG filtering and interference suppression
Week 7	Review and Midterm Exam.
Weeks 8-10	Classifiers: linear regression, support vector machines, neural networks; overfitting and cross-validation
Week 11-13	Wavelets: continuous, discrete, applications for denoising and feature extraction.
Week 14-15	Independent component analysis: theory and application to EEG blind source separation
Week 16	Finals week: project presentations.

GRADING:

Quizzes (online and in-class): 20%

Homework assignments: 40%

Midterm Exam: 20%

Final Project: 20%

The final exam date and location is TBD. Check with your instructor and Canvas for updates.

Final grades will be determined by the following scale:

A+	100%	to 96.67%
A	< 96.67%	to 93.33%
A-	< 93.33%	to 90%
B+	< 90%	to 86.67%
B	< 86.67%	to 83.33%
B-	< 83.33%	to 80%
C+	< 80%	to 76.67%
C	< 76.67%	to 70%

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D	< 70%	to 60%
F	< 60%	to 0%

HOMEWORK:

Homework will be due at the start of class one week after it is assigned, typically each Thursday, but check the website for updates. Links to the homework can be found on Canvas. I request that you record the time spent on each question on your paper. **All late assignments will receive a zero.**

All submitted homework and code must be your own individual work. Since a large portion of the work will be writing MATLAB code, students are expected to adhere to the Academic Integrity Policies found on the Computer Science Department website: http://www.cs.colostate.edu/cstop/csacademics/student_info.php

ACADEMIC INTEGRITY: Students are expected to adhere to the Academic Integrity Policy of Colorado State University, outlined in the CSU General Catalog. Students are also expected to follow the Student Conduct Code which can be found at www.conflictresolution.colostate.edu. Academic dishonesty is not accepted in this course, and any form of cheating (including plagiarism) will be reported. Penalties may include a lowered course grade, loss of course credit, and expulsion from the university.