

Applied Signal Processing (ENGN 395) Spring 2020

[Last updated: 19 May 2020]

Major Topics We Will Cover:

1. Event Detection;
2. Digital Filters;
3. Time-Frequency Transforms;
4. Blind Source Separation

Date	Topic	Application	Readings
<i>Week 1</i>			
W 29 Apr	Intro to signal processing Event detection intro	Smartrock: Is the river rising?	Harbor et al, rock plucking events
R 30 Apr	Event Detection: * Sampling Discrete Signals; * Gaussian Stats Statistical Thresholding; * Teager-Kaiser energy operator for event detection	Straight from the Heart: Detecting the QRS complex	Pan 1985 Kaiser 1990 Mukhopadyhay 1998
F 01 May	Digital filters Part I: Discrete Convolution		
<i>Week 2</i>			
M 04 May	Discrete Fourier Transforms: *Frequency Spectra *Mirroring and Aliasing	ECG revisited: noisy (real world) recordings	
T 05 May	Project time – share, compare, revise algorithm	Step right up! Accelerometers counting steps	Feehan 2018 Vajdi et al (database)
W 06 May	Digital Filters: Part II * Z-transform *Convolution Theorem * Transfer function	Deep in the Math Weeds	See notes on course website
R 07 May	Digital Filters: Part III *Frequency response of FIR filters *Input-output relationships	How to build digital filters: the math under the hood	See course website for pptx
F 08 May	Student mini-presentations: share and compare methods and results for step counter project		

Week 3			
M 11 May	Wavelets: Part I Continuous Wavelet Transform Time-Frequency representation	Gravity Waves @ LIGO	Torrence and Compo 1998 (sections 1-3) Abbott et al 2016
T 12 May	Spectral whitening as filter	Still hunting for gravity waves	
W 13 May	Wavelets Workshop day	Choose your own mini-adventure	
R 14 May	Wavelets: part II Discrete Wavelet Transform Approximation and Detail Coefficients: Multi-resolution analysis	Data compression & denoising	Polikar tutorial
F 11 May	Wavelets: part III Data compression and denoising		
Week 4			
M 18 May	Second Order Blind Identification	Non-invasive sensing of the GI system activity: Part I	Belouchrani 1997 ; Erickson 2009
T 19 May	Project Workshop day		
W 20 May	Work on final project		
R 21 May	Work on final project		
F 22 May	Final presentations	Written/video reports due by noon	
<i>Additional topics we might pursue (time permitting)...or maybe check them out on your own!</i>			
	Dynamic Mode Decomposition	Brain injury: mechanical considerations	Laskari 2018

Independent Component Analysis	Speech synthesis; Brain Dynamics (EEG)	<u>Hyvarinen 2000;</u> Makeig 1996
Empirical Mode Decomposition	Non-invasive of GI activity: Part II	<u>Huang 1998</u>