

# EE596 Wavelets and Graphs for Signal Processing and Machine Learning

## Course Syllabus

**Term:** Spring 2021 — Updated January 17, 2021<sup>1</sup>

**Goals:** In signal processing and machine learning, many problems of interest take as an input a signal defined on a regular domain (time, images, 3D point clouds) or a graph (sensor, communication or social network) and it is useful to represent the signal in a different domain before processing. The most familiar of these representations are the various types of Fourier Transforms. Alternative representations can help capture different signal characteristics (e.g., time frequency localization), to improve processing efficiency (e.g., dimensionality reduction) or for efficient compression (e.g., perceptual masking). In this class we will provide an overview of the state of the art of signal representations, focusing on applications in signal processing and machine learning. Specific topics include:

- basics of multi-rate signal processing, filter bank design, overcomplete signal representations and wavelets;
- sparsity based methods to find optimal signal representations;
- basic concepts of graph signal processing;
- application of these concepts to develop practical programming projects on applications of interest.

**Instructor:** Prof. Antonio Ortega, Dept. of Electrical and Computer Engineering, EEB 436 E-mail: aortega@usc.edu

**Lecture:** Monday and Wednesday, 10:00-10:50am Online

**Office Hours:** TBD

**Midterms:** There will be two take home midterm exams

**Grading:** Homework/Participation (10%), Midterm 1 (30%), Midterm 2 (30%), Project (30%).

### Textbooks and other materials:

- Martin Vetterli and Jelena Kovačević, *Wavelets and Subband Coding*, [https://infoscience.epfl.ch/record/33934/files/VetterliKovacevic95\\_Manuscript.pdf](https://infoscience.epfl.ch/record/33934/files/VetterliKovacevic95_Manuscript.pdf)
- Martin Vetterli, Jelena Kovačević and Vivek K. Goyal, *Foundations of Signal Processing* [http://fourierandwavelets.org/FSP\\_v1.1\\_2014.pdf](http://fourierandwavelets.org/FSP_v1.1_2014.pdf)
- Antonio Ortega, *Graph Signal Processing: An Introduction*, Cambridge University Press, 2021. <http://www.graph-signal-processing-book.org> A PDF version of this book will be distributed.
- We will also use research papers to cover specific topics

**Schedule:** [https://docs.google.com/spreadsheets/d/1\\_0kH7IduvnNUR0LMbvqJCW-7QWJS2CeDmai82tbIH08/edit?usp=sharing](https://docs.google.com/spreadsheets/d/1_0kH7IduvnNUR0LMbvqJCW-7QWJS2CeDmai82tbIH08/edit?usp=sharing)

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<sup>1</sup>This syllabus is subject to change and will be updated.

**Statement for Students with Disabilities:** Any student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m.–5:00 p.m., Monday through Friday. Website and contact information for DSP:

[http://sait.usc.edu/academicssupport/centerprograms/dsp/home\\_index.html](http://sait.usc.edu/academicssupport/centerprograms/dsp/home_index.html),  
(213) 740-0776 (Phone), (213) 740-6948 (TDD only), (213) 740-8216 (FAX) [ability@usc.edu](mailto:ability@usc.edu).

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