E9252 Mainly Aug until now, sometimes Jan 3:0

Mathematical methods and techniques in signal processing

Instructor

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Department: Electronic Systems Engg.

Course Time: Typically. 11:30 to 1 pm (Is variable sometimes)

Lecture venue: Auditorium, Old conference room, NPTEL during Fall 2017

tailed Course Page: http://pnsil.dese.iisc.ac.in/mathematical-methods-and-techniques-in-signal-processing-e9-252-30-fall-20

Announcements

Exam #2 is on 2nd November 2017 from 6 pm to 9 pm.

Final Exam is on 11th December from 2 pm to 5 pm

Brief description of the course

To introduce graduate level students with mathematical foundations into signal processing. This will be touching upon basics of signal theory, sampling and multirate signal processing, convergence aspects of Fourier series, wavelets and KL transforms, signal modeling and inverse problems depending on time.

Prerequisites

Digital signal processing at the undergrad level.

Syllabus

Review of basic signals, systems and signal space: Review of 1-D signals and systems, review of random signals, multi-dimensional signals, review of vector spaces, inner product spaces, orthogonal projections and related concepts.

Basics of multi-rate signal processing: sampling, decimation and interpolation, sampling rate conversion

(integer and rational sampling rates), oversampled processing (A/D and D/A conversion), and introduction to filter banks.

Signal representation: Transform theory and methods (FT and variations, KLT), other transform methods.

Wavelets: Characterization of wavelets, wavelet transform, multi-resolution analysis.

Statistical signal modeling: The least squares method, Padeâ€™s approximation, Pronyâ€™s method, Shanksâ€™ method, iterative pre-filtering, all-pole modeling and linear prediction, autocorrelation and covariance methods, FIR least squares inverse filter design, applications and examples.

Inverse problems (signal reconstruction): underdetermined least squares, pseudo-inverse (SVD), min-norm solutions, regularized methods, reconstruction from projections, iterative methods such as projection onto convex sets, expectation-maximization and simulated annealing.

Course outcomes

Students will get the foundations into signal theory necessary to pursue advanced research. Masters' level students can use these skills in the industry having a solid analytical background.

Grading policy

Homeworks : 25%

Mid Term Exams (2 of them): 25%

Project : 25%

Final Exam : 25%

Assignments

Please refer to the last five years under the course pages.

http://pnsil.dese.iisc.ac.in/teaching-activities/

Resources

Moon & Stirling, Mathematical Methods and Algorithms for Signal Processing, Prentice Hall, 2000. (required)

P. P. Vaidyanathan, Multirate systems and filter banks

Monson Hayes, Statistical Digital Signal Processing and Modeling, John Wiley and Sons, 1996. (optional)

Class notes