Carleton University

Department of Systems and Computer Engineering

SYSC 5370F: Multiresolution Signal Decomposition: Analysis and Applications
Fall 2011
Course Syllabus

Instructor: Prof. Richard M. Dansereau
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Office Hours: TBA

Calendar Description: Multirate signal processing: sampling rate conversion, polyphase representation. Bases, filter banks: series expansion of discrete-time signals, series expansion of continuous-time signals, multiresolution concept and analysis, construction of wavelet, wavelet series. Complexity of multirate discrete-time processing, filter banks, and wavelet series computation.

Prerequisites: A basic course in Digital Signal Processing such as SYSC 4405 or SYSC 5602 is a necessary prerequisite.

Textbook:

- Martin Vetterli and Jelena Kovačević, *Wavelets and Subband Coding*, Prentice Hall, 1995. ISBN: 978-0130970800, URL: http://www.waveletsandsubbandcoding.org/ (now under a Creative Commons license)
- Martin Vetterli, Jelena Kovačević, and Vivek K. Goyal, *Fourier and Wavelet Signal Processing*, 2011. URL: http://fourierandwavelets.org/ (under a Creative Commons license)
- Ali N. Akansu and Richard A. Haddad, *Multiresolution Signal Decomposition: Transforms, Subbands, and Wavelets*, $2/e$, Academic Press, 2001. ISBN: 978-0120471416

Other References:

- P. P. Vaidyanathan, *Multirate Systems and Filter Banks*, Prentice-Hall, 1993. ISBN: 978-0136057185
- S. Mallat, *A Wavelet Tour of Signal Processing: The Sparse Way*, $3/e$, Academic Press, 2008. ISBN: 978-0123743701 (or earlier editions)
- G. Strang and T. Nguyen, *Wavelets and Filter Banks*, $2/e$, Wellesley College, 1996. ISBN: 978-0961408879

Grading:

Assignments:	30%
Project:	30%
Final Examination:	40%

WWW: Announcements, assignments, and additional material will be posted on the website:
http://www.sce.carleton.ca/courses/sysc-5370/
Login: TBA
Password: TBA

Final Exam Policy: The final exam is for evaluation purposes only and will not be returned to the student.

Plagiarism: Plagiarism (copying and handing in for credit someone else's work) is a serious instructional offense that will not be tolerated. Please refer to the section on academic integrity in the Graduate Calendar for additional information.

Health and Safety Information: Here is the link to the health and safety manual:
`http://www.sce.carleton.ca/courses/health-and-safety.pdf`

Academic accommodation: You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

Pregnancy obligation: write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website `http://www.carleton.ca/equity/accommodation/`

Religious obligation: write to me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details visit the Equity Services website `http://www.carleton.ca/equity/accommodation/`

Students with disabilities requiring academic accommodations in this course must register with the Paul Menton Centre for Students with Disabilities (PMC) for a formal evaluation of disability-related needs. Documented disabilities could include but are not limited to mobility/physical impairments, specific Learning Disabilities (LD), psychiatric/psychological disabilities, sensory disabilities, Attention Deficit Hyperactivity Disorder (ADHD), and chronic medical conditions. Registered PMC students are required to contact the PMC, 613-520-6608, every term to ensure that I receive your Letter of Accommodation, no later than two weeks before the first assignment is due or the first in-class test/midterm requiring accommodations. If you only require accommodations for your formally scheduled exam(s) in this course, please submit your request for accommodations to PMC by the deadlines published on the PMC website:
`http://www.carleton.ca/pmc/new-and-current-students/dates-and-deadlines/`

Course Content (preliminary):

- Time-frequency distributions, Riesz bases, frames, multiresolution approximations, windowed Fourier transform, orthogonal and bio-orthogonal bases
- Multirate signal processing; downsampling and upsampling; general sampling rate conversion; polyphase representation
- Perfect reconstruction; two-channel filter banks, mirror filter banks, M-band filters, power complementary filters; tree-structured filter banks; pyramid and overcomplete expansions
- Series expansions using wavelets and modulated bases; construction of wavelets, wavelet series and properties
- Algorithms and complexity; complexity of multirate discrete-time processing, filter banks, and wavelet series computation